The Humber environment in focus 2011

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Foreword

I am pleased to introduce **The Humber environment in focus 2011.** This is the first of our planned two-yearly reviews of the Humber Estuary and the land around it. In the past there have been Humber water quality reports. This document not only looks at water quality, but also at other aspects of the Humber environment as well as providing some economic and social context. The aim is to provide a state of the environment "snapshot".

The ports, industries, agriculture and communities around the Humber Estuary make a vital contribution to the UK economy. Our flood risk management strategy for the Humber Estuary, *Planning for the rising tides,* considers how to limit the impact of flooding from the estuary on people, property and industry in ways that won't damage the area's landscape or wildlife. The data we have collected and collated will support the strategy and its ongoing management as well as the day to day management of reducing the risk of flooding and the implementation of the Water Framework Directive. In addition to providing information directly, the report acts as a signpost to further data and more detail.

The 2011 findings will provide a baseline against which we can measure progress. We aim to produce follow-up reports every two years and, for that purpose, we have identified a limited number of key datasets which will appear in each report as the main indicators to monitor change. Some of the indicators measure factors that will be influenced directly by flood risk management actions, some will monitor other changes that may affect the way in which the strategy is implemented or developed in future.

We hope that you find the report useful.

David Dangerfield
Director
Yorkshire and North East

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1 Introduction to the report

1.1 The Humber Flood Risk Management Strategy

The Environment Agency's Humber Flood Risk Management Strategy, *Planning for the rising tides* [1.1] aims to manage the risk and limit the impact of flooding from the estuary on people, property, agriculture and industry as the climate changes and sea levels rise. The strategy has an essential part to play in safeguarding the growth and prosperity of the Humber's economy and communities, continuing to meet its legislative obligations, and protecting food security while also enabling the area to make a contribution to a low carbon future.

This report presents the baseline status and past trends of a broad range of, mainly environmental but also economic and social, datasets and other information for the Humber area against which to track changes as the strategy is delivered. Some of the indicators presented measure factors that will be influenced directly by flood risk management actions. Others are included in order to monitor changes that may be relevant to the way in which the strategy is implemented or developed in future.

It is anticipated that follow-up reviews will be produced every two years to keep track of changes from the baseline. Although the content and format of these reviews may change, those datasets that are expected to appear repeatedly, as monitoring indicators, have been listed at the end of each section of the current report.

1.2 Our role

It is our job [1.2] to look after the environment and make it a better place now and for the future.

We play a central role in managing the risk of flooding, holding the strategic overview role for flood risk management from all sources, including rivers, the sea, groundwater, reservoirs and surface water in England – and from rivers and the sea in Wales. We support and work closely in partnership with local authorities, who are responsible for managing the risk of flooding from surface water and smaller local watercourses. We engage with local communities to improve understanding of the risks from flooding and coastal erosion, provide flood warnings and to help develop and promote solutions that make them more resilient to flood events. Working alongside internal drainage boards and local authorities, we commission the design and construction of flood defences in England and Wales, and maintain and operate them. This work involves creating and improving habitats for fish and other water-based wildlife, helping species at risk like salmon and eels, and provision of angling and boating facilities which enable people to enjoy outdoor recreation.

While the Humber Flood Risk Management Strategy sets out our vision for managing the risk of flooding from the Humber Estuary overall, both Catchment Flood Management Plans (CFMPs) and Shoreline Management Plans (SMPs) also form part of our high-level strategic plan for sustainable flood risk management in the area, over the next 100 years. CFMPs assess the risk of flooding (location, size and causes) within a catchment in the face of possible future changes in land use, urban development, climate change and rising sea levels. SMPs assess and help reduce the risks associated with coastal processes such as tidal patterns, wave height, wave direction and the movement of beach and seabed materials. See *Flooding and Flood Risk* (Section 3) for more details.

Much of the environmental legislation that applies in England and Wales comes from European Directives. Government departments convert these requirements into regulations and we have specific powers and duties to implement them, using permits, authorisations and consents to set the conditions that operators must comply with so that their activities do not have a negative impact on the environment. The European Water Framework Directive (WFD) became part of UK law in December 2003. This framework gives an opportunity to protect and improve the overall quality of surface freshwater, estuaries, coastal waters out to one mile from low-water, and groundwaters. We are the 'competent authority' for carrying out the WFD and - in consultation with a wide range of organisations and individuals - producing River Basin Management Plans for England and Wales. The Humber River Basin Management Plan [1.3] sets out the pressures facing the water environment throughout the entire catchment area draining to the Humber Estuary, and the actions that will address them.

1.3 Structure and scope of the report

This report is divided into the following sections:

- Land use and development pressures
- Flooding and flood risk management
- Habitats and wildlife
- Water status in the estuary
- Recreation and leisure relating to the natural environment

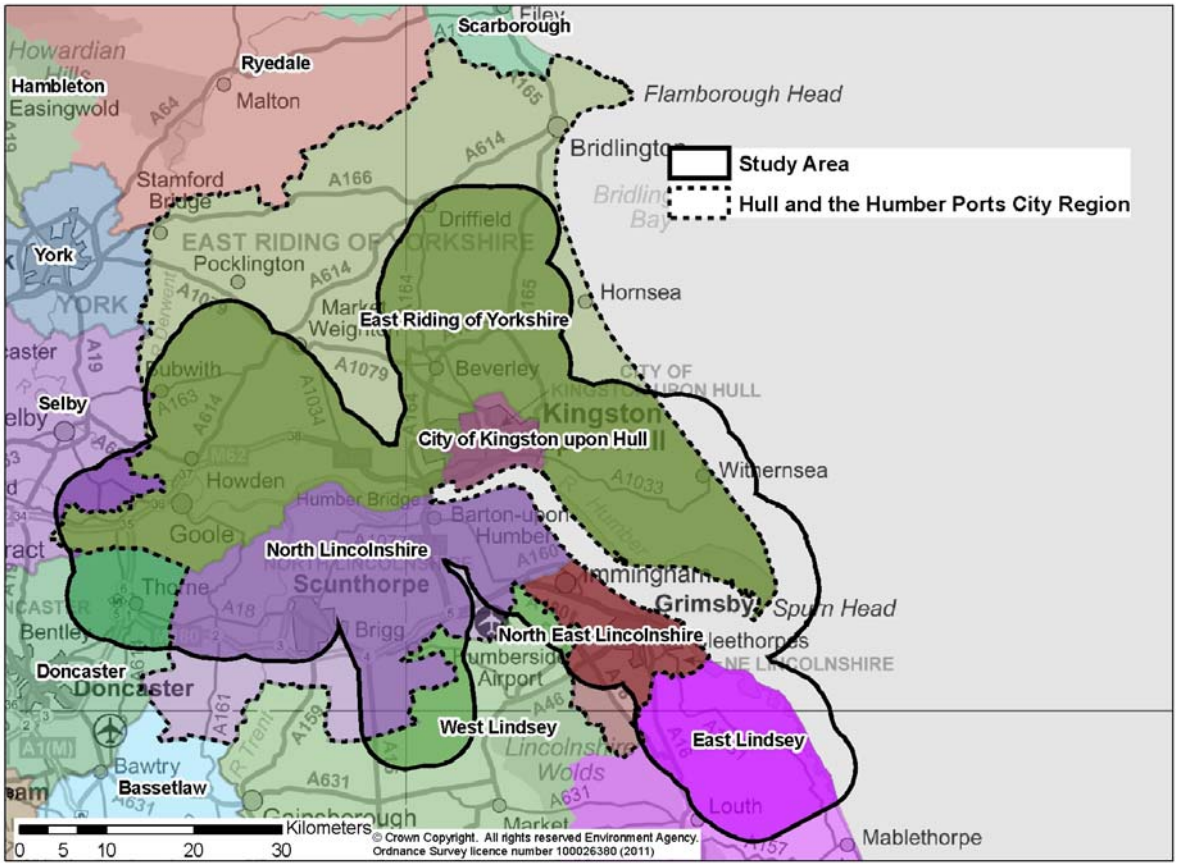
The Humber Flood Risk Management Strategy defines a flood area boundary for the estuary which is split into separate flood areas. Where possible, data presented in the report and any supporting information is drawn from and limited to the flood area boundary but with an added “buffer zone” of five kilometres extent around it. This area will be referred to in the report as the Study Area – see Figure 1.1.

Some datasets, particularly those used to measure economic and social factors, are available only down to local authority area or a grouping of these into city regions. Wherever possible, data for the five main authorities overlapping the study area will be presented:

- East Riding of Yorkshire
- Kingston-upon-Hull
- North Lincolnshire
- North East Lincolnshire
- East Lindsey

When data is drawn from studies carried out for Yorkshire and Humber, East Lindsey will not be available. If data is available only for the Hull and the Humber Ports City Region, then this will also exclude East Lindsey.

Figure 1.1 Humber boundaries used in the report



1.4 The European Marine Site and Humber Management Scheme

The Humber Estuary is the second-largest coastal plain estuary in the UK after the Severn, and the largest coastal plain estuary on the east coast of Britain. The Humber Estuary drains a catchment area of some 24,472 square kilometres (km^2), around 20 per cent of the total land surface of England. Water collected from this catchment flows to the estuary through many rivers and tributaries, the largest of which are the Aire, Derwent, Don, Ouse, Trent and Wharfe. The unique opportunities for economic prosperity and quality of life that the Humber Estuary provides are based upon the combined benefits of its strategic location, productive land and water, built infrastructure and biodiversity. The area is of great economic importance to the wider region and the rest of the UK. At the same time, the area contains a variety of natural environments and habitats that are protected and preserved by national, European and international designation. Achieving economic development while adapting to climate change and rising sea levels and also meeting environmental legislative requirements, presents both a major challenge and an outstanding opportunity for the Humber over the coming years.

The marine area (land covered continuously or intermittently by tidal waters) of the Humber Estuary has been recognised as one of the most important estuaries in Europe for wildlife and has been designated as a **European Marine Site**. The European Union's (EU) Habitats and Birds directives set out a number of actions to be taken for nature conservation within the marine site:

- Under the Habitats Directive - promotion of the maintenance of biodiversity, taking account of economic, social, cultural and regional requirements
- Under the Birds Directive - protection of all wild birds and their habitats, with special measures for migratory birds and those that are considered rare or vulnerable.

The Humber Estuary Relevant Authorities Group, a partnership of over 30 relevant authorities that have jurisdiction on or around the Humber Estuary, have developed a Humber Management Scheme [1.4] (HMS) to ensure these actions are carried out. The group are now tasked with implementing the HMS with the ongoing advice and support of a Humber Advisory Group.

2 Land use and development pressures

2.1 Introduction

The productive capacity of land underpins the whole economy through its provision of food, timber and other goods, and through its use for housing, business, transport, energy generation, water management and recreation. Land (its extent, form, soils, vegetation and minerals) also plays a critical role in providing services that are vital for the physical and mental wellbeing that comes from a complex combination of things like good health, financial security, rewarding employment, an attractive environment, and supportive communities.

However, many land uses can conflict with each other and more land for one can mean less for another. Greater pressure on land in future will require management that not only balances competing uses, but also guards against actions that would reduce its capacity to provide the multiple services needed to support society. An ecosystem services approach to land use planning recognises the value of natural assets to our long-term social and economic wellbeing, and provides a basis upon which to develop strategies for sustainable growth and increased quality of life without pressurising the natural environments which underpin that growth. A Yorkshire Futures report [2.1] published in November 2010 represents an early attempt to apply the approach at sub-regional scale in Yorkshire and the Humber, including the Hull and Humber Ports City Region. Priorities for further work identified in the report include a better basis on which to evaluate the ecosystem service benefits from urban and industrial areas, and the inclusion of marine ecosystems, where relevant.

2.2 Land use for agriculture

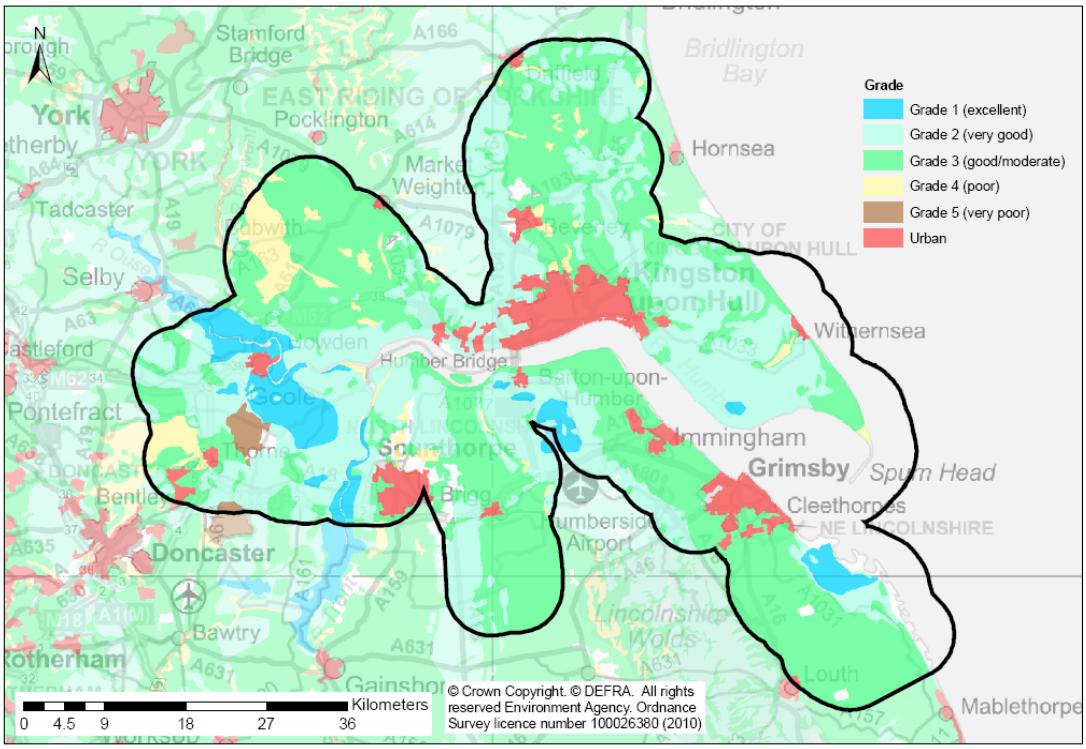
Agricultural land classification

Most of the land surrounding the Humber Estuary is in agricultural use. The agricultural land classification (ALC) categorises land into five grades. It is based upon an assessment of limiting factors including soils, climate and other physical limitations and the way in which these interact. Grades 1 (excellent), 2 (very good) and 3 (good/moderate) are defined as being the best and most versatile land. This land is the best to deliver future crops for food and non food uses such as biomass, fibres and pharmaceuticals. The ALC is used to advise on land use and planning issues.

For more information on the agricultural land classification system, see the report [2.2] published in 1988.

Figure 2.1 shows the agricultural land classification around the Humber Estuary, as well as urban areas. 83% of agricultural land around the Humber Estuary is classified as Grades 1 to 3, compared to 65% for England as a whole.

Figure 2.1 Agricultural land classification in and around the Humber



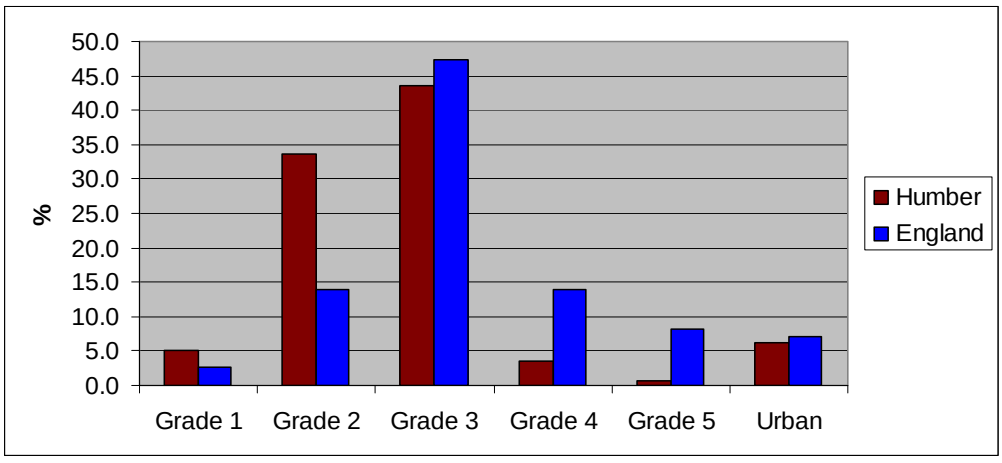
Data source: DEFRA

Table 2.1 Agricultural land classification grades in the Study Area and England

ALC Grade	Humber (hectares)	Humber %*	England (hectares)	England %
Grade 1	15,558	5.1	354,645	2.7
Grade 2	10,3503	33.6	1,849,266	14.0
Grade 3	134,466	43.7	6,291,715	47.4
Grade 4	10,861	3.5	1,840,320	14.1
Grade 5	1,888	0.6	1,100,785	8.3
Urban	19,257	6.3	9,523,021	7.2
TOTAL	285,533	92.8	20,959,752	93.7

* total Humber area is the total land area in the Study Area minus estuary and sea
Data source: DEFRA with Environment Agency analysis

Figure 2.2 ALC grades in the Study Area and England as % of total



Data source: DEFRA with Environment Agency analysis

June agricultural survey

The June agricultural survey [2.3] is an annual survey which collects detailed information on arable and horticultural cropping activities, land usage, livestock populations and labour force figures. It is a compulsory survey conducted under EU legislation and helps provide hard evidence on the condition of the agricultural industry. The survey is published every year and provides information at county / unitary authority level, the most recent dataset available being 2009. Although here is some data suppression to avoid disclosure of individual holdings, information on main crop types can be derived for the Hull and Humber Ports City Region (East Riding of Yorkshire, Hull, North Lincolnshire and North East Lincolnshire).

The 2009 figures reveal that the Hull and Humber Ports City Region contains 3% of the farmed area of England. As would be expected in a lowland area, it has a higher than average proportion of land used for arable farming and lower for cattle and sheep. There is a particular concentration of pig rearing with 13.5% of England's total livestock in the area. Other concentrations of note are those for peas and beans, with 7.1% of the England total and crops grown under glass/plastic with 7.7% of the England total.

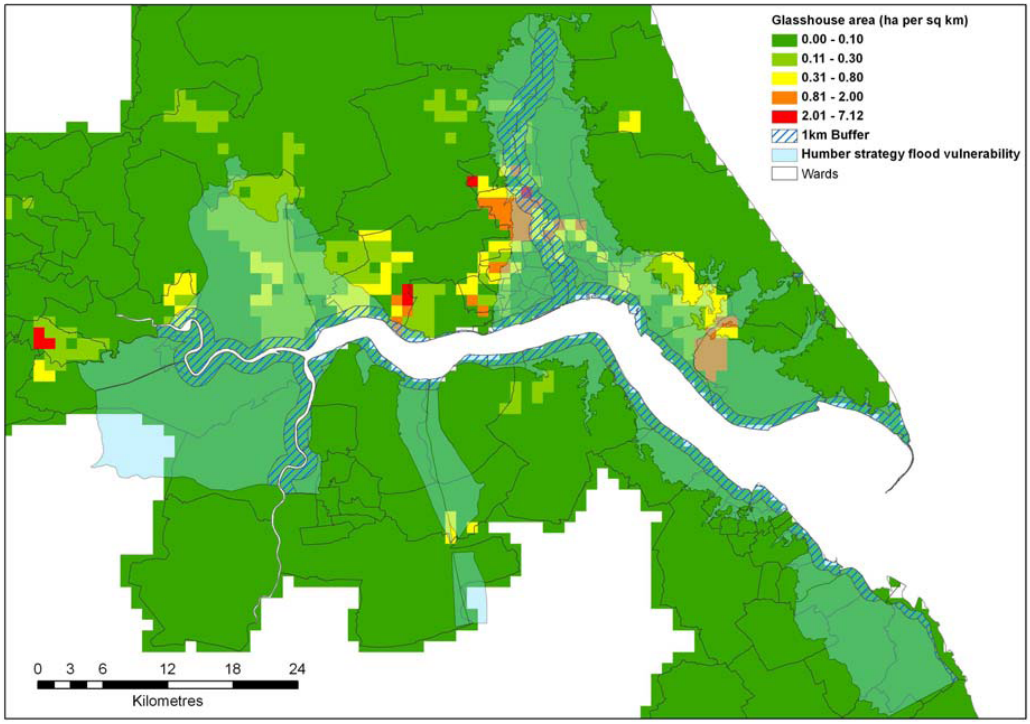
Table 2.2 June Agricultural Survey 2009 - Areas by crop/livestock type

Crop	**England (hectares)**	**Hull and Humber Ports (hectares)**	**%**
Cereals	2595752	149968	5.8
Oilseed rape /linseed	547797	34038	6.2
Peas and beans	261260	18538	7.1
Sugar beet	116470	4192	3.6
Potato	105095	6619	6.1
Fodder crops	37860	1008	2.7
Fruit	30122	65	0.2
Hardy Nursery Stock / Flowers	10518	152	1.5
Glasshouse crops	1752	125	7.7
Livestock	**England total**	**Hull and Humber Ports total**	**%**
Pigs	3872413	521868	13.5
Poultry	121855376	74486670	6.1
Cattle	5484083	57748	1.1
Sheep	14983839	97215	0.7
Total Farmed Area	897590	273261	3.0

Data source: Defra with Environment Agency analysis
Note: data is not available for East Lindsey

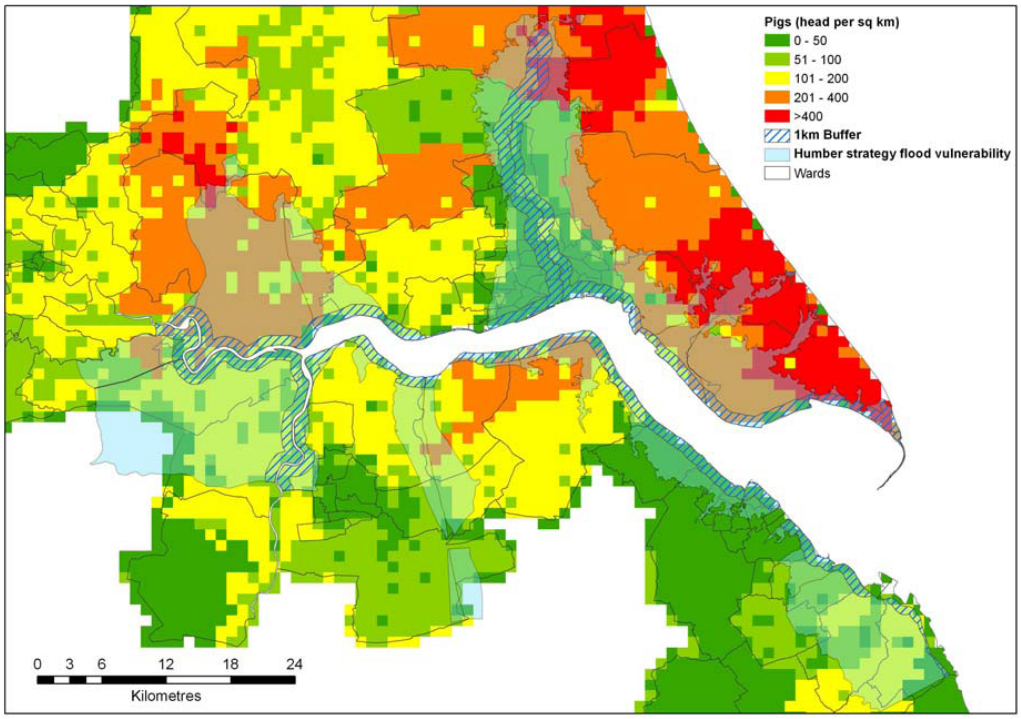
It is difficult to make definitive statements regarding trends in the June agricultural survey data, partly because of the disclosure restriction mentioned above. However, while pig-rearing has been an important feature of the area for several decades, actual pig numbers have reduced slightly since 1990. The area of land used for cereals has changed little since 1990 but, within it, the proportion devoted specifically to oilseed rape has increased since 1990 while the proportion devoted to sugar beet and potatoes has reduced. ADAS [2.4] carried out some spatial analysis of land use in the vicinity of the Humber using June agricultural survey data in order to assess the possible impacts on flooding / climate change. This work showed that that there was considerable spatial variation of land use within the study area – maps of glasshouse area per square kilometre (km^2) and pigs per km^2 are shown below.

Figure 2.3 Glasshouse area per km^2 around the Humber



Data Source : ADAS

Figure 2.4 Pigs head per km^2 around the Humber



Data Source : ADAS

This dataset is a statistical representation of the agricultural practice in the region. It is based on agricultural survey data published by Defra and has been manipulated onto a one kilometre square grid using algorithms. The data is therefore a representation of practice and values presented should not be considered absolute.

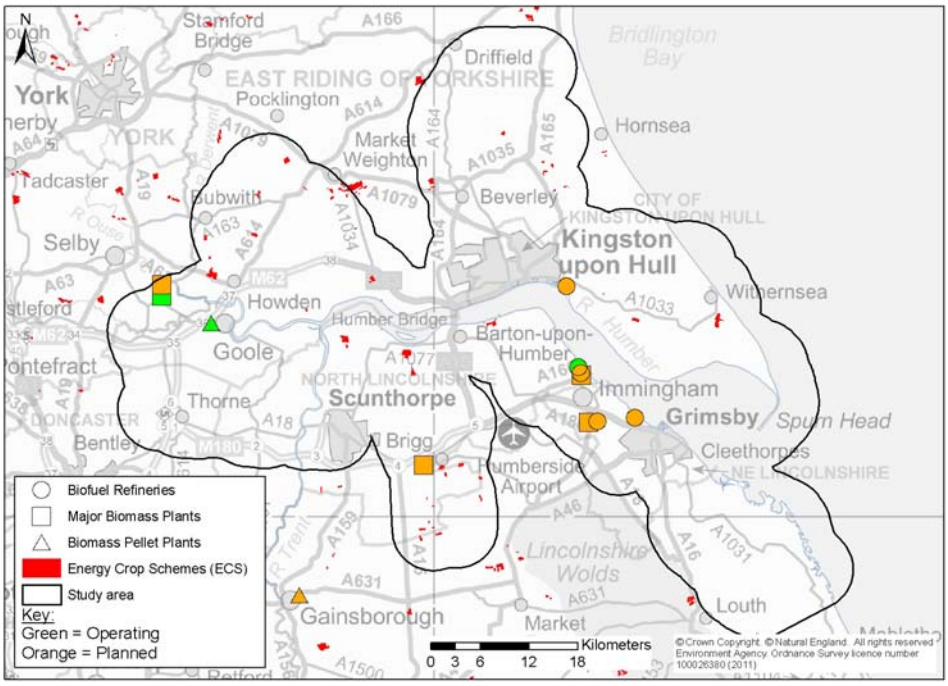
2.3 Land use for energy crops

Crops and crop materials, produced by agriculture as a substitute for fossil fuels, will play a part in the UK's move to a more sustainable low carbon future and its EU commitment to obtain 15% of all energy from renewables by 2020. The 2007 UK Biomass Strategy [2.5] concludes that 350,000 hectares (ha) of perennial energy crops will be needed by 2020, in addition to an estimated 740,000 ha for transport fuel from biofuel.

Biomass is a term for any organic material derived from recently living organisms, such as wood, crops and other plants, and animal wastes. Biofuels are fuels, liquid and gas, derived from biomass – see the Glossary of terms for more detail on first and second generation biofuels. A 2008 report on the Status of Biofuels in Yorkshire and Humber [2.6] identified the Humber as having major advantages for future development as a centre both for first and second generation biofuels and biorefineries. A major factor leading to this conclusion was the local availability of agricultural land suitable to grow biofuel "feedstock" such as wheat and oilseed rape. Additional factors were the existing oil refineries and chemical plants in the area, as well as excellent port facilities providing the capacity to expand through the import of biomass, grains and oils.

Second generation biofuel capacity in the Humber will require large quantities of woody biomass, perennial energy crops and agricultural by-products such as straw. These same feedstock supplies are already being developed in the area for biomass co-firing at the large coal-fired power stations in the Lower Aire Valley. Drax [2.7] currently has the most ambitious plans nationally for biomass co-firing that include 500 megawatts (MW) of co-firing at Drax itself, three 290 MW standalone biomass plants (in partnership with Siemens) and pelleting facilities for straw and miscanthus (elephant grass) at Goole and Gainsborough in West Lindsey. This would bring Drax's biomass-burning capacity to 1,400 MW, enough to power two million homes, and would require between 1.5 million and two million tonnes of biomass a year. The majority will come from imports but the Drax Green Shoots programme offers contracts to local farmers and land owners for the long term supply of biomass.

Figure 2.3 Biomass plants (operating and planned) and Energy Crop Scheme Agreements (2009)



Data sources: Natural England; DECC Restats Planning database; Yorkshire and Humber Assembly

As part of the Rural Development Programme for England and to increase the quantity of energy crops grown in England in appropriate locations, the government's Energy Crop Scheme [2.8] (ECS) offers grants to farmers in England for establishing miscanthus and short rotation coppice for their own energy use, or to supply power stations. The total area of land under an ECS in the Humber Study Area is 1080 Ha. which represents 16.2% of all ECS in England.

The Humber is low lying, so agricultural land that is currently used for arable could become wetter in the future, possibly as a result of climate change. Under these conditions, one potential alternative to the growing of arable crops is to use the land for biomass production, which could also benefit wildlife and habitat. Short rotation coppice biomass crops such as willow can tolerate occasional flooding although not permanent water-logging. RSPB has recently carried out an assessment [2.9], based on a study in the Humberhead Levels, of the commercial viability of reed growing for biomass, thatch and other uses, and the kinds of stimulus that would be required to improve viability.

2.4 Land use for conservation

Many of the distinct semi-natural habitats and cultural landscapes in the Humber are valued in terms of their importance to the area's identity and heritage, protecting wildlife, and for the contribution they make to people's wellbeing and prosperity. In future, the effects of climate change and human-led changes in land use will present substantial challenges to the UK's semi-natural environments.

Addressing these challenges will require an integrated approach of continued protection and enhancement of the quality of land and habitat within specially designated conservation areas, such as National Nature Reserves (NNR), as well as careful land management beyond the designated areas.

Designated and protected areas

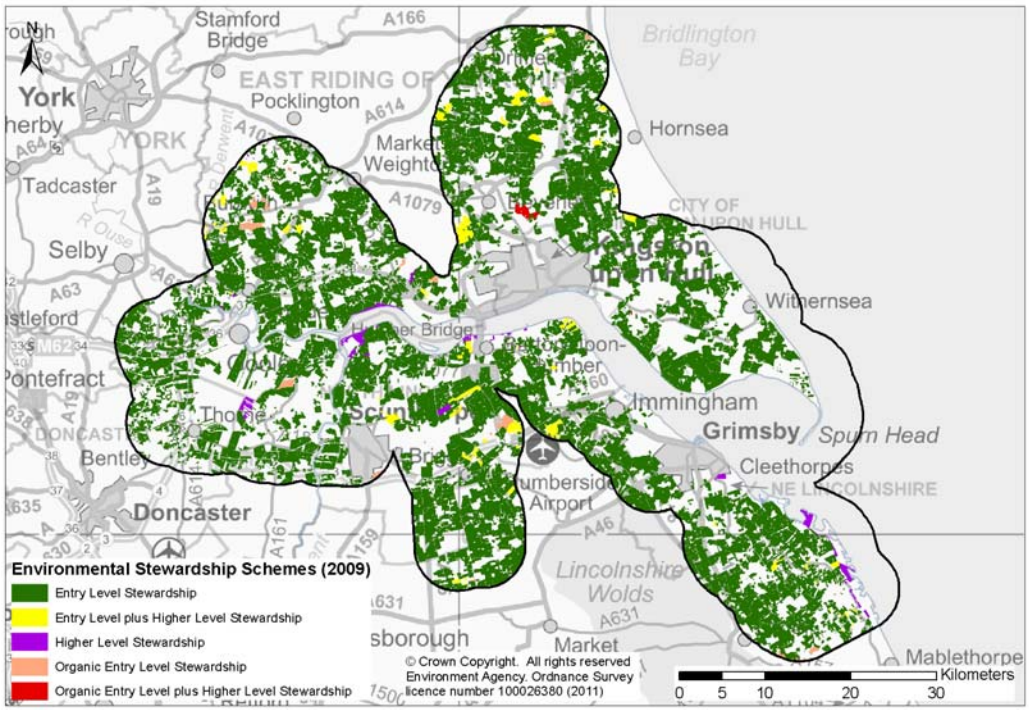
These are described within the Habitats and Wildlife section.

Environmental Stewardship

Natural England's Environmental Stewardship schemes [2.19] (ESS) represent a successful approach to the continued protection of the natural environment outside designated and protected areas. Under an ESS, farmers and other land managers in England are offered financial incentives to deliver effective environmental management of their land.

Figure 2.4 shows the spatial distribution of different types of Environmental Stewardship. There are three basic types: Entry Level Stewardship (ELS), Organic Entry Level Stewardship (OELS) and Higher Level Stewardship (HLS). The aim of ELS is to encourage a large number of farmers across England who manage all or part of their land to deliver simple and effective environmental management while OELS is available to those who manage part or all of their land organically. HLS aims to deliver significant environmental benefits in high priority situations and locations, and therefore requires more complex environmental management.

Figure 2.4 Environmental Stewardship Schemes around the Humber



Data Source : Natural England

Spatial analysis of all stewardship schemes within the Study Area reveals a significantly greater proportion of agricultural land covered by ELS (43%) than for England as a whole (31%), while HLS take up is broadly similar to that nationally – 0.5% and 0.6% respectively. The proportion of land covered by organic schemes around the Humber is much less than the national average – 0.4% and 2.1% respectively.

Table 2.3 ESS take up for Study Area and England, 2009

Scheme type	Humber (ha)*	%	England (ha)	%
Entry Level plus Higher Level Stewardship	3600	1.2	602075	4.5
Entry Level Stewardship	131601	42.7	4125696	31.0
Higher Level Stewardship	1414	0.5	81074	0.6
Organic Entry Level plus Higher Level Stewardship	242	0.01	60388	0.5
Organic Entry Level Stewardship	1144	0.4	272492	2.1

* total Humber area is the total land area in the Study Area minus estuary and sea
Data source: Natural England with Environment Agency analysis

2.5 Land use for urban and industrial development

Introduction

Approximately 900,000 people live in and around the estuary, with the Hull area providing the principal urban focus with a population of over 400,000, and other urban centres at Grimsby/Cleethorpes (140,000) and Scunthorpe (70,000). The most recent National Statistics estimates are that the population will increase over the next ten years – in North East Lincolnshire by only 2.3% but in all other authority districts by between 8.0 and 9.6% (Data source: National Statistics [2.11], 2008).

By virtue of a central location on the east coast of Great Britain, 40 million people and over 60% of the UK's manufacturing capacity lie within a four hour drive of the Humber, while a potential Europe-wide marketplace of 170 million people is within easy reach. The four main ports in the estuary (Grimsby, Hull, Immingham and Goole) constitute the country's largest port complex. The Humber also contains the second largest chemicals cluster in the UK, it accounts for about 25% of the UK's oil refining capacity, and is the landing point of the longest sub-sea gas pipeline in the world, capable of delivering 20% of the UK's natural gas requirements (Data source: Humber Economic Partnership [2.12], 2008).

The risk of, and standard of, protection against flooding are factors that are taken into account when deciding the type and location of residential, commercial and industrial development. The flood risk issues around the Humber are described in greater detail in Section 3 of this report. Water supply, particularly if dependent on groundwater sources, can also be a constraint on development. Some water resource issues on both the north and south banks of the estuary are described in the water resources section (Section 5.6).

Housing and employment

Note: Information on future housing growth is taken from emerging Local Authority Core Strategies, which set out the vision and framework for growth and development in an area. The strategies have not yet been adopted, and are subject to change. With the government's new localism agenda also being incorporated, housing delivery is likely to be difficult to predict.

Broadly, planned development across the Humber is focussed within existing urban areas. With the Humber Ports already the UK's largest port complex, there is an aspiration for the Hull and Humber Ports City Region to be the "Global Gateway [2.13] to the North and the rest of the UK". The current main centres of employment within the Study Area are Hull, Scunthorpe and Grimsby, although Beverley, Goole and Barton-upon-Humber are also important.

Within Hull, large scale regeneration of parts of the city is in progress or planned, with the city centre, Newington and St Andrews, Holderness Road corridor, and the new community at Kingswood, identified as priorities. Employment land is proposed within a wide corridor through the centre of Hull, and in corridors running along the estuary to the east and west of the city centre. The eastern corridor is deemed the most appropriate for port-related uses.

In North East Lincolnshire, Grimsby and Cleethorpes provide the focus for planned development – most of which is residential. Most employment opportunities will be on the South Humber Bank in the 'estuary employment zone' which includes Immingham.

The focus of development in North Lincolnshire is planned in and around Scunthorpe - for example, there is a proposed urban extension to the west-Lincolnshire lakes, and plans to develop Scunthorpe's urban centre. This will be supported by growth and "renaissance" in market towns, such as Barton-upon-Humber and Brigg.

In the East Riding of Yorkshire growth will be focused on the villages immediately west of Hull, e.g. Cottingham, Anlaby, Willerby, Kirkella and Hessle (known as the 'Major Haltemprice Settlements'). Growth will also take place within the existing larger settlements of Beverley and Goole (and Driffield, which lies on the northernmost boundary of the Study Area).

The area of East Lindsey covered by the Study Area is largely rural with some smaller villages. Most of it falls outside the areas identified as a focus for development within the draft core strategy. However, North Somercotes has been identified as a focus to meet more local needs.

Table 2.4 shows the percentage change in developed land around the Humber Estuary between 1991 and 2001 [2.14].

Table 2.4 Percentage change in developed land around the Humber Estuary

Local Authority	Area of Developed Land – 1991 (Ha)	Area of Developed Land – 2001 (Ha)	Change %
East Riding of Yorkshire	6599	7512	13.8
City of Kingston upon Hull	6030	6229	3.3
North East Lincolnshire	4504	4374	-3.0
North Lincolnshire	4585	5680	23.9
East Lindsey	3151	3763	19.4

Data source: Communities and Local Government – Urban areas 1991 and Urban Settlements 2001

Port-related development

The four main ports in the estuary (Grimsby, Hull, Immingham and Goole) constitute the country's largest port complex with approximately 40,000 commercial shipping movements every year, representing 14% of all UK seaborne trade. As the UK economy has moved away from a large manufacturing base, there has been an increase in imports of finished and semi-finished goods. Between 2008 and 2009, the economic recession resulted in a marked reduction in Humber Ports traffic, in line with other UK ports, but significant recent investments in ports infrastructure and rapid access to the UK distribution network leave the area well placed for further growth especially as a logistics hub, manufacturing/distribution centre and in chemical/energy-related industries.

Table 2.5 Humber Ports traffic (million tonnes) 1999-2009

	1999	2001	2003	2005	2007	2009
Grimsby and Immingham	49.76	54.83	55.93	60.69	66.28	54.71
Hull	2.65	2.63	1.91	2.62	2.28	1.64
Goole	10.12	10.59	10.53	13.36	12.50	9.77
Humber Ports (incl. Trent & Ouse tributaries	73.80	78.49	80.95	88.66	92.92	76.87

Data source: Associated British Ports

The Humber ports all possess areas of development land available within their own boundaries but it is anticipated that all suitable development areas within the ports will ultimately be utilised and the ports are therefore already looking to expand into neighbouring areas. The scope of this option for the ports of Grimsby and Goole is relatively limited, as these ports are constrained by their adjacent urban areas. It does however remain a very real option for Immingham and Hull. Much of the information on port development presented below is taken from Overview of the Humber Ports [2.15].

Twelve hour sailing times to three of the largest designated offshore wind farm sites and the widest estuary mouth in the UK, make the Humber a prime location for wind turbine manufacture, construction and servicing. This has become a focus for recent port investment planning.

Immingham

Associated British Ports (ABP) published a consultation draft Masterplan for Immingham [2.16] in March 2010, outlining the development options potentially open to the port over the next 30 years. ABP's forecasted demand analysis indicates that the biggest growth area will be in initiatives to support the UK's transition to a low carbon economy, including handling biomass for power stations, and manufacture and handling facilities for planned offshore wind farms in the North Sea, with some growth also expected in vehicles, container and agricultural bulk goods. Specific individual developments anticipated over the next 20 years include a rail extension, a further riverside berth at the Humber International Terminal, an Outer Harbour project with a fourth Roll-on-Roll-off (RoRo) berth and container terminal, and a western deepwater jetty.

At the time of writing, Able UK were progressing plans to develop some 250 hectares of land near Killingholme, north-west of Immingham, reclaim 50 hectares of the estuary, and build 1600 metres of new quays specifically tailored to the needs of the wind turbine offshore companies. As the first part of a superport strategy, these plans could see the area become a Marine Energy Park [2.17]. A 300 MW biomass plant, warehousing and external storage areas, transport depots, and road and rail links to nearby ports and the Humber Sea Terminal form part of the plans, with delivery set for around 2020.

Hull

'Green Port Hull' [2.18] is ABP's proposal to construct and service offshore wind turbines. The proposal would use existing planning approval for the development of a 600 metres riverside berth at Alexandra Dock and approximately 400 hectares of development land available close by, for expansion or to locate supply chain businesses. ABP states that commencement of turbine manufacture at the facility would be possible as early as 2014.

Also in the planning process is ABP's Hull Riverside Bulk Terminal project, a deep-water jetty designed to handle solid fuels which will also import biomass for burning in a biomass power station at the south-east corner of the port.

Grimsby

ABP has one marine project in the planning domain, a riverside RoRo facility to the north of the Royal Dock, designed to accommodate larger car-carrying vessels than can currently navigate the enclosed dock system. Grimsby's Fish Dock has recently seen a renaissance as a facility for operations and maintenance bases for servicing offshore wind farms and further expansion is expected.

Goole

Scope for expansion at Goole is limited because of the proximity of the urban area of the town. Rationalisation and reorganisation of facilities and infrastructure within the existing port boundary will inevitably be required for the port to continue to meet the needs of changing world trade.

Key data sources

- June Agricultural Survey: Defra; county level updated annually
- Energy Crop Scheme Agreements: Natural England; GIS files updated annually
- Environment Stewardship Schemes: Natural England; updated on an ongoing basis
- Humber Ports traffic: Associated British Ports; updated annually

3 Flooding and flood risk

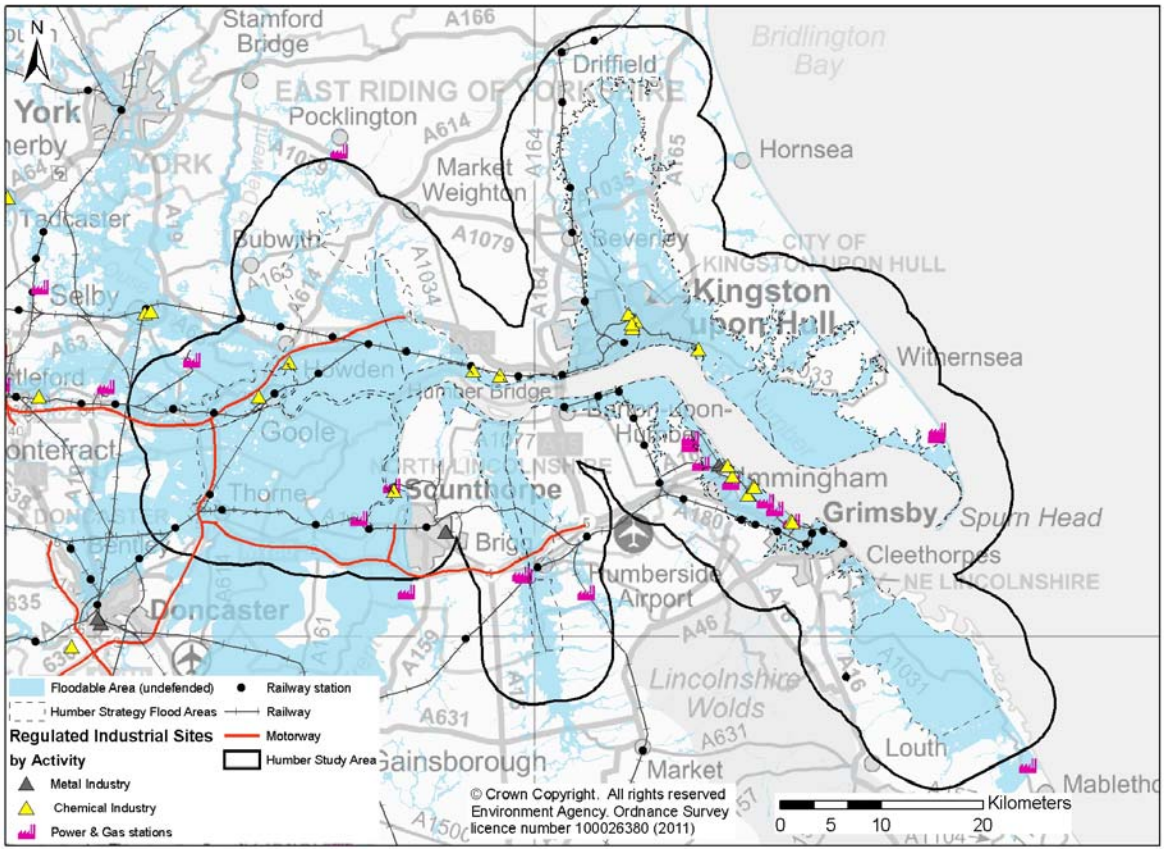
3.1 Floodable areas and current defences

The greatest risk from flooding around the Humber occurs when high tides and a storm surge from the North Sea combine. The most damaging storm surge on record in the North Sea was in January 1953 when 300 lives were lost, 24,000 homes damaged and almost 100,000 hectares of low-lying land flooded along the coast from Yorkshire to the Thames Estuary.

Currently about 114,000 hectares of land around the Humber are at risk of flooding from a storm surge in the North Sea. They contain the homes of about 400,000 people, mostly living in cities such as Hull and Grimsby or smaller towns, as well as some major industries such as power stations, refineries and the country's largest port complex. Most of the remaining land, over 85% of the total, is farmed with relatively few people living on it.

We are currently using new terrain data and modelling techniques to produce improved tidal flood zones and overtopping extents. In addition, predicted flood extents, depths, velocities and hazard ratings are being produced for flooding from various breach scenarios. The floodable areas identified in Figure 3.1 are defined as those areas with a 0.1% chance of flooding each year, also known as a 1 in 1000 annual probability flood. The flood zone outline shown south of the estuary has been revised to take the recent modelling work into account. North of the estuary, the modelling has yet to be completed and revised flood zone maps will be available in 2011.

Figure 3.1 Floodable areas, industry and transport infrastructure



Data source: Environment Agency

We manage the majority of flood defences around the Humber. The others are managed by organisations such as Associated British Ports, various local councils and riparian owners. We are responsible for the condition of defences and other assets, this is monitored and held on the National Flood and Coastal Defence database (NFCDD). Table 3.1 gives the lengths of condition categories for all types of flood defence asset within the Study Area while Figure 3.3 shows the locations.

Table 3.1 Condition of flood defences within the Study Area, Oct 2010 (in km)

Type	Good/very good	Fair	Poor	Very poor	Total
Raised defence (man-made)	376	229	34	0.8	639
Raised defence (natural)	0.7	0.4			1.1
Sea defence (man-made)	105	45	5.0	3.4	159
Sea defence (natural)	14	1.4			16
Culverted channel	3.5	5.8	0.9	0.04	10.2
Maintained channel	650	249	18	11	928
Natural channel	32	35			67
Flood defence structure	0.9	1.0			1.9

Data source: Environment Agency, National Flood and Coastal Defence Database (GIS analysis for numbers within Study Area)

We have investigated where there might be difficulty funding the improvements needed to maintain Humber flood defences because there are only a small number of houses at risk and few other assets. A map from the Humber Flood Risk Management Strategy, *Planning for the rising tides* [1.1], is reproduced as Figure 3.2. It distinguishes the flood defence sections where maintenance withdrawal is possible along with habitat creation sites and locations where inundation of flood storage areas could help to reduce flooding in populated areas.

Figure 3.2 Potential withdrawal of flood defence maintenance

Data source: Environment Agency, 2008 (reproduced from *Planning for the rising tides* [1.1])

3.2 The National Flood Risk Assessment

The floodable areas shown in Figure 3.1, and the associated number of people at risk, are determined on the assumption that the areas are undefended from flooding or that defences are not effective. The National Flood Risk Assessment [3.1] (NaFRA) takes an alternative approach in estimating the likelihood of flooding from main rivers and the sea while taking account of the type, height and condition of flood defences. NaFRA looks at both residential and non-residential properties to identify three risk categories as used by the insurance industry - low (0.5%, or 1 in 200, chance of flooding each year or less), moderate (1.3%, or 1 in 75, chance or less but greater than 0.5%, or 1 in 200, chance in any year) and high (greater than 1.3%, or 1 in 75, chance in any year).

According to the NaFRA 2009 assessment, Hull City Council is the local authority area with the greatest number of properties (residential and non-residential) at risk of flooding (low, medium or high) in England and Wales. East Riding of Yorkshire has the fourth highest total number of properties at risk of flooding nationally, East Lindsey the fifth, North East Lincolnshire the seventh and North Lincolnshire the 22nd. If only properties at significant risk are considered then East Lindsey becomes the third highest nationally, Hull City the 7th, East Riding the 9th, North Lincolnshire the 17th and North East Lincolnshire the 126th.

Table 3.2 Number of properties at risk from flooding by local authority (NaFRA09)

Local Authority	Residential Significant	Residential Moderate	Residential Low	Non-residential Significant	Non-residential Moderate	Non-residential Low
City of Kingston upon Hull	7,685	70,097	31,671	2,321	8,348	5,238
North East Lincolnshire	1,048	21,620	12,495	369	6,060	2,715
North Lincolnshire	3,488	2,967	7,318	2,483	3,031	3,580
East Riding of Yorkshire*	4,892	11,741	21,806	2,803	5,048	8,163
East Lindsey District*	6,236	3,590	20,054	6,732	3,221	9,980
TOTAL*	23,349	110,015	93,344	14,708	25,708	29,676

Data source: Environment Agency, National Flood Risk Assessment 2009, Appendix H
* Note that totals for East Ridings and East Lindsey include substantial numbers of properties outside the report Study Area

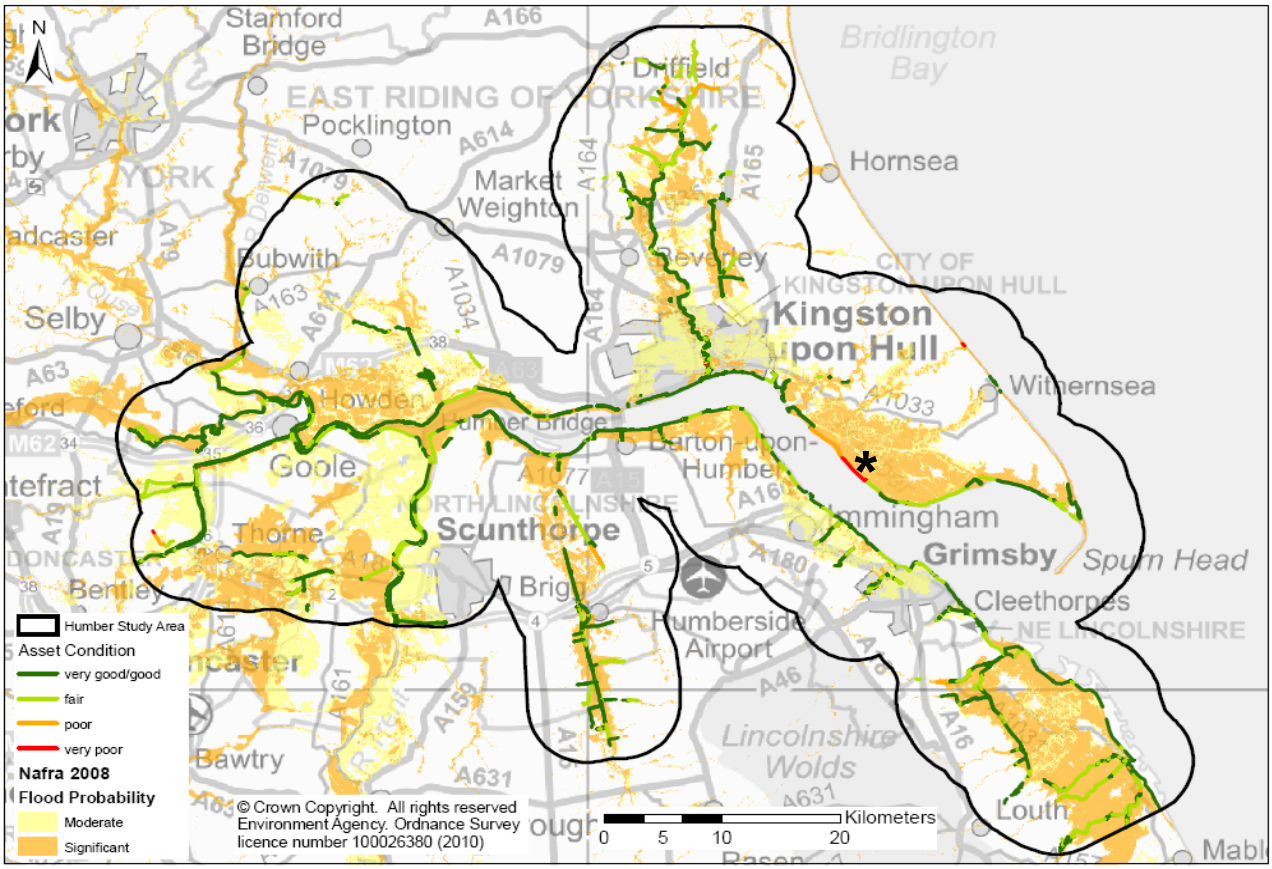
Deprivation levels of those people most susceptible to flooding were also analysed as part of the NaFRA 2009 assessment. According to this analysis, Hull City Council is the local authority with the most residential properties at **significant** risk of flooding which are also in the country's most deprived areas – 9.4% of the total. If residential properties at significant and moderate risk of flooding are combined then, not only does Hull have the greatest number of properties within the country's most deprived areas (21% of the total) but North East Lincolnshire is the second highest with a further 8%. For the analysis, "most deprived" is defined as the top 20% most deprived Super Output Areas in England, based on the ranked Index of Multiple Deprivation 2007 for England.

Table 3.3 Number of residential properties at risk from flooding within the 20% most deprived areas in England

Local Authority	Properties Significant	Properties Moderate	Properties Low
City of Kingston upon Hull	4,651	33,405	21,223
North East Lincolnshire	277	14,054	6,145
North Lincolnshire	0	219	328
East Riding of Yorkshire*	161	304	912
East Lindsey District*	630	1,237	11,604
TOTAL*	5,719	49,219	40,212

Data source: Environment Agency, National Flood Risk Assessment 2009, Appendix R
* Note that totals for East Riding and East Lindsey include substantial numbers of properties outside the report Study Area

Figure 3.3 National Flood Risk Assessment - flood risk areas and condition of flood defences



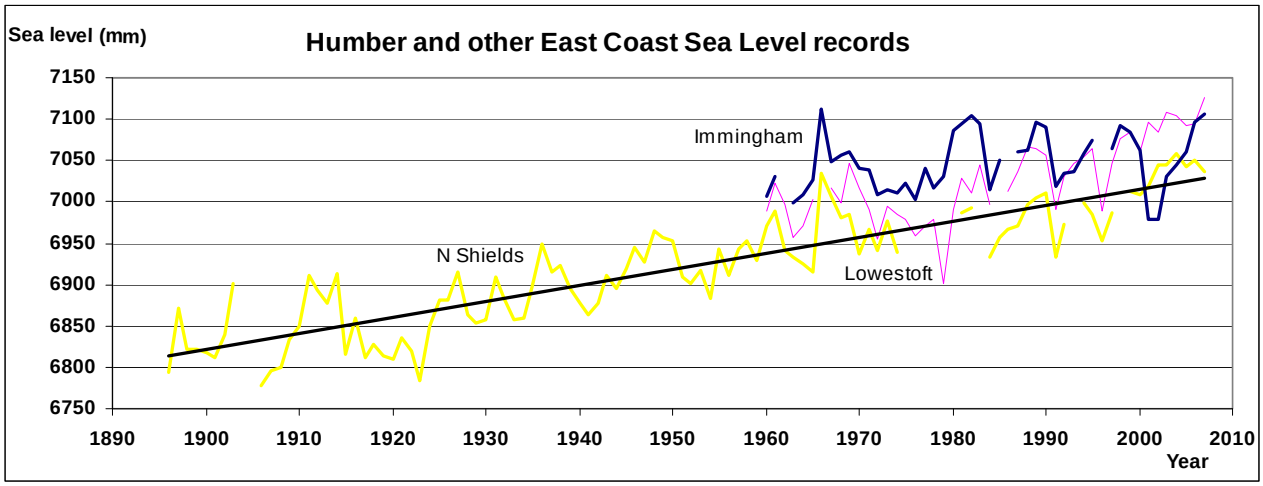
Data source: Environment Agency, National Flood Risk Assessment 2008

*This section of “very poor” asset condition is subject to change after the **South Holderness Study**

3.3 Future risk from rising sea levels

Change in sea levels is controlled by two factors. **Isostatic adjustment** relates to the vertical movement of land and, in the UK, it relates to “rebound” experienced since the last Ice Age following removal of the ice cap that covered the north and west of the country. The Humber Estuary is located between an upward land movement in the north of the country and a downward movement in the south and therefore isostatic adjustment is relatively small. **Eustatic change** relates to the increased volume of ocean water as temperature rises, either because of expansion of the existing water or addition of water from melting ice sheets and glaciers in the Antarctic, Greenland and on mountain ranges worldwide. As a result of the global warming associated with climate change, this component is dominant in predicted future sea level change and particularly in the Humber Estuary where isostatic adjustment is small.

Figure 3.4 Humber and other East Coast sea level records



Data source: Proudman Oceanographic Laboratory (POL,NERC), Permanent Service for mean sea level
Note: Immingham levels are currently being checked by POL for possible measurement errors resulting from variable fresh and saline water effects. They may be revised in future Data values are given in Appendix 1.

Figure 3.4 shows annual mean sea levels for sites along the East Coast, including Immingham on the Humber, that have been measured and are held by the government research laboratory, Proudman Oceanographic Laboratory, Permanent Service for mean sea level [3.2] (PSMSL). PSMSL determines the annual means for principal sites around the UK, by averaging levels recorded every 15 minutes throughout the year. However, there is considerable variation in mean sea levels from one year to the next (as shown in Figure 3.4) because of differences in storminess and other factors. In truth, at any individual tide gauge, the variability from year to year is much greater than the gradually rising trend in levels that is trying to be detected.

The Intergovernmental Panel on Climate Change (IPCC) scientists have applied the latest scientific knowledge to make assumptions about the warming effect of future green house gas emissions and how much the ocean is likely to expand because of the warmer climate. These estimates have then been used to predict how much sea levels might rise in the future. Using IPCC projections, the UK government has issued guidance on how much allowance we and others should make for rising sea levels in UK flood defence design. The allowances are considered to achieve the most appropriate balance between the risks to people and property if sea levels rise faster than expected, set against the unnecessary expenditure that might arise if sea levels do not rise as fast as expected. The guidance, contained in Planning Policy Statement 25 [3.3] is changed from time to time, most recently in 2010. In the Humber Strategy, we have adopted the currently recommended allowances to help assess when and where future investment in flood defences should be made.

Table 3.4 Recommended sea level rate allowances for the Humber (relative to 1990)

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Net sea level rate of rise	4.0 mm/yr	8.5 mm/yr	12.0 mm/yr	15.0 mm/yr
Total rise over the period	140 mm	255 mm	360 mm	450 mm

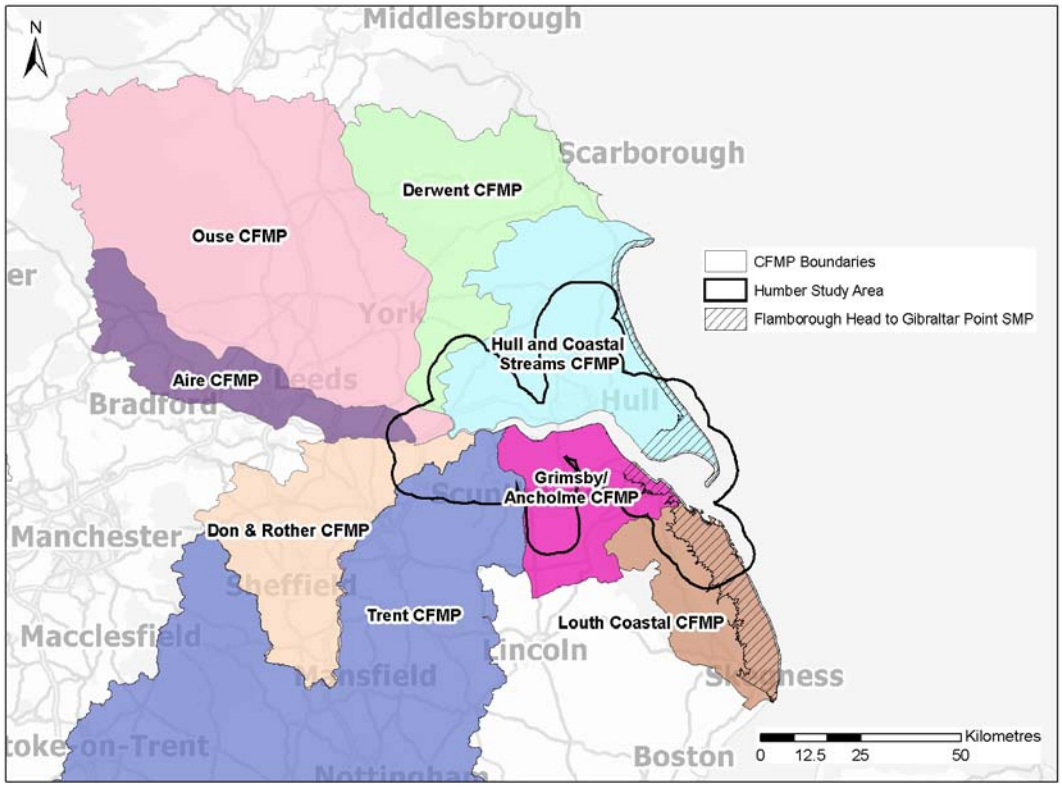
Data source: Dept of Communities and Local Government, Planning Policy Statement 25 Development and Flood Risk, Annex B

UKCP09 is a government programme of research and analysis that aims to provide climate projections for both land and marine regions around the UK as a basis for climate change planning and adaptation. UKCP09 projections [3.4] for sea level rise against various greenhouse gas emission scenarios have been released. They use IPCC, Proudman Oceanographic Laboratory and many other sources of data and may be used in future to refine current guidance.

3.4 Catchment Flood Management Plans

While the Humber Flood Risk Management Strategy sets out our vision for managing the risk of flooding from the Humber Estuary overall, both Catchment Flood Management Plans (CFMPs) and Shoreline Management Plans (SMPs) also form part of the high-level strategic plan for sustainable flood risk management in the area over the next 100 years.

Figure 3.5 Catchment Flood Management Plan and Shoreline Management Plan outlines in relation to the Study Area



Data source: Environment Agency

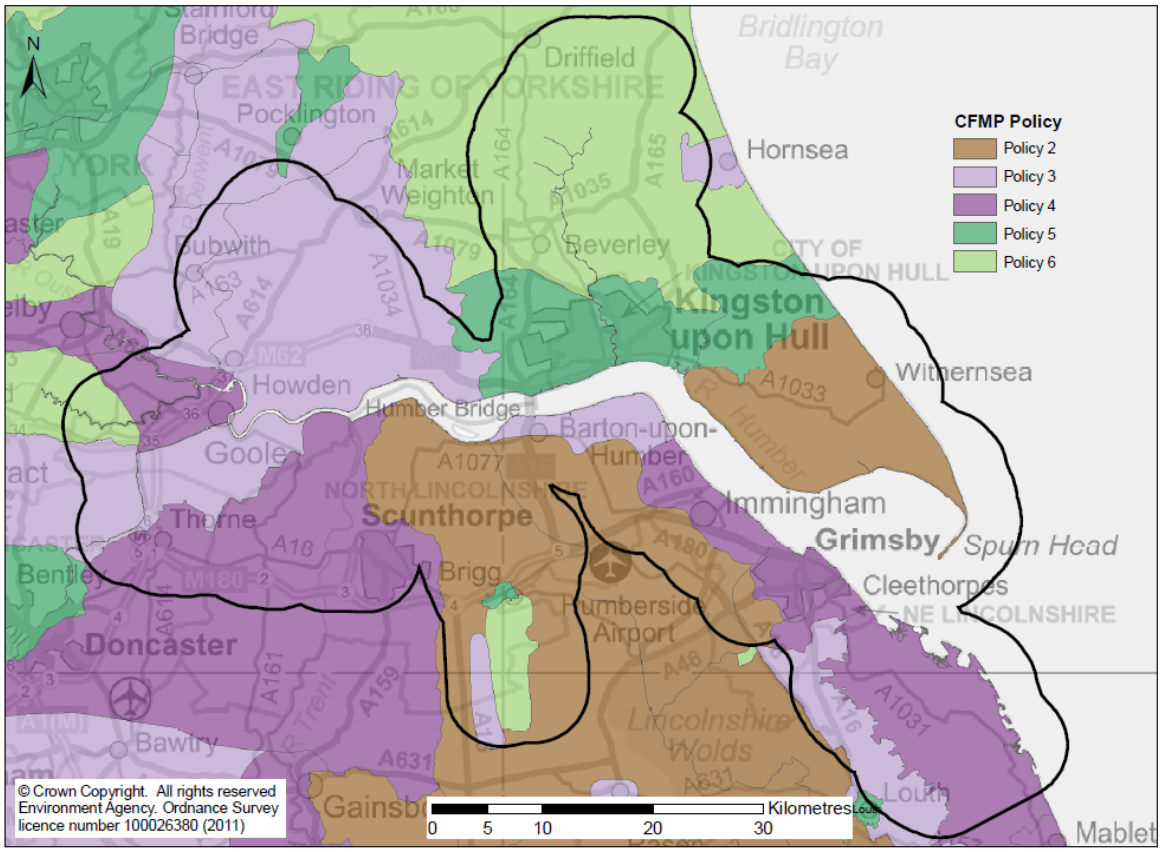
CFMPs assess flood risk (location, size and causes) within a catchment in the face of possible future changes in land use, urban development, climate change and sea level rise. Two CFMPs, for Hull and Coastal streams [3.5] and for Grimsby and Ancholme [3.6] cover the major portion of the Study Area for this report while those for the Trent, Don, Aire, Ouse and Derwent also feed into the upper estuary. Each plan identifies the most appropriate approach to managing flood risk and allocates one of six generic flood risk management policy options to defined sub-areas taking account of social, economic and environmental factors, and key issues specific to the sub-area. The allocation of policies to sub-areas across the Study Area is shown in Figure 3.6.

We use six policy options, these are:

- Policy 1: Areas of little or no flood risk where we will continue to monitor and advise
- Policy 2: Areas of low to moderate flood risk where we can generally reduce existing flood risk management actions
- Policy 3: Areas of low to moderate flood risk where we are generally managing existing flood risk effectively
- Policy 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change

- Policy 5: Areas of moderate to high flood risk where we can generally take further action to reduce flood risk
- Policy 6: Areas of low to moderate flood risk where we will take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits

Figure 3.6 CFMP policies in the Study Area



Data source: Environment Agency

The Flamborough Head to Gibraltar Point [3.7] SMP describes the assessment of coastal processes, status of coastal defences, projection of coastline position and provision of flood protection in the outer estuary - from Kilnsea to Stone Creek on the north bank of the Humber and from Immingham (eastern jetty) to Donna Nook on the south bank.

3.5 Surface water flooding

The most widespread flooding in recent years within the Study Area occurred in summer 2007. This flooding resulted from very heavy rainfall in the area that exceeded the carrying capacity of local watercourses, drains and culverts, as well as, in some cases, causing direct flooding from impervious urban surfaces. Urban areas, such as Hull where 8,600 residential and 1,300 business properties were damaged, were worst hit but rural areas were also affected where large areas of farmland were flooded with the loss of crops and livestock.

Surface water flooding is outside the remit of the Humber Flood Risk Management Strategy and the Flood and Water Management Act 2010 [3.8] gives powers to the lead local flood authority with regard to surface water flooding. However, following recommendations from the Pitt Review [3.9] of the 2007 floods, we are working with the Met Office and local authorities to develop techniques and models that identify areas at particular risk from surface water flooding.

Key data sources

- Condition of flood defences: Environment Agency; updated on an ongoing basis
- Number of properties at risk of flooding: Environment Agency; updated annually
- Mean sea levels for selected sites: Proudman Oceanographic Laboratory, Permanent Service for mean sea level [3.2] (PSMSL); updated on an ongoing basis

4 Habitats and wildlife

4.1 Introduction

The Humber Estuary is an internationally important area for wildlife. It is one of the top ten sites in Europe for wintering wildfowl and waders supporting internationally important populations of several species. Wildfowl and wader numbers can rise as high as 200,000 during the winter months. A wide range of habitats including mudflats, saltmarsh, reedbeds and sand dunes occur in and around the Humber. These habitats support a large range of mammals, fish, invertebrates and plants, some of which are rare or threatened [4.1].

4.2 Physical features and processes in the estuary

The average width of the Humber Estuary is 4.3 kilometres, the average depth is 6.5 metres, it is 14 kilometres at its widest point and totals over 30,550 hectares. By virtue of its position within the North Sea basin, the Humber has a large tidal range. A mean spring tidal range of 5.7 metres at Spurn is amplified to 6.9 metres around Hull. Because of these large tidal ranges, the Humber is classified as a macro-tidal estuary. The Humber's muddy appearance is caused by suspended sediment derived mainly from the eroding boulder clay cliffs along the Holderness coast but also from river inputs. Deposition of these sediments provides essential material to maintain the estuary's important habitats such as, mudflats, sandflats and saltmarsh.

Its macro-tidal range, high sediment load and fast flows all cause the bed of the estuary to be highly mobile. Port access requires the maintenance of access channels to remove recently deposited sediment. Most of the dredging occurs in the lower and middle estuary (below the Humber Bridge) to maintain access to port facilities and to provide a main access channel for larger vessels. Dredging and disposal sites for the sediment are subject, under Habitats Regulations, to an “appropriate assessment” of their impact on the European Marine Site. Sediment loads, current dredging operations, legislative and commercial background are described in an Associated British Ports (ABP) report [2.15].

4.3 Designations and protected habitats

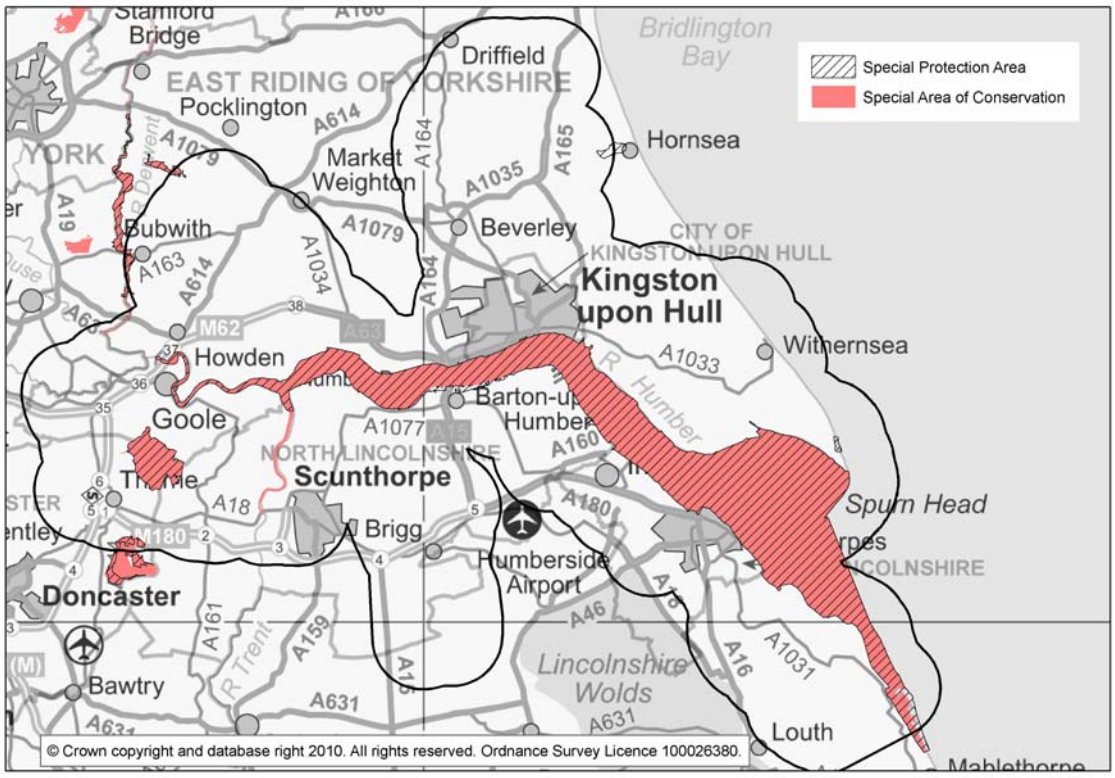
The whole of the estuary is a European Marine Site covered by several international wildlife designations:

Natura 2000 Special Area of Conservation (SAC), under the EU Habitats directive
Natura 2000 Special Protection Area (SPA) – under the EU Birds directive
Ramsar – the international convention on wetlands

There are also five National Nature Reserves – Humberhead Peatlands, Far Ings, Spurn Head, Donna Nook and Saltfleetby -Theddlethorpe Dunes. In total there are nearly 50,000 hectares of Sites of Special Scientific Interest (SSSI).

The extent of the SPA and SAC designations are shown below (the Humber RAMSAR designation covers the combined area of the Humber SAC and SPA designations).

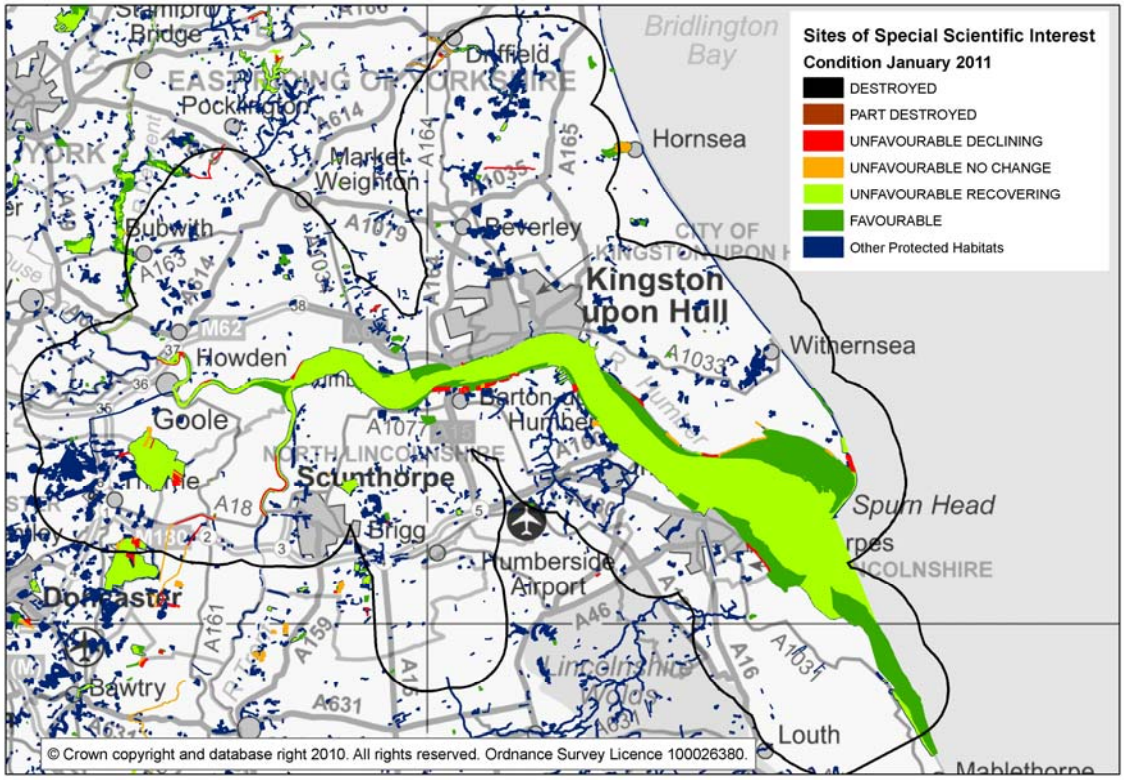
Figure 4.1 Special Protection Area and Special Area of Conservation Designations



Data Source : Natural England 2010

All these designations are composed of SSSI units which are assessed by Natural England to establish their condition. Figure 4.2 shows the current condition (2010).

Figure 4.2 Condition of Sites of Special Scientific Interest



Data Source : Natural England 2011

For the Humber itself, SSSI units cover 37000 hectares and 99% of this area is in favourable condition or unfavourable recovering condition (26% is favourable).

A number of the clay pit SSSI units around Barton-Upon-Humber are in unfavourable declining condition as a result of fish stocking and water pollution from agriculture/run off.

On the Humber foreshore itself the following units are in unfavourable declining condition [4.2]:

Unit 21 (near Flaxfleet) 19.98 ha. Unit needs grazing and reedbed management.
Unit 68 (near Hessle) 2.31 ha. Tipped material.
Unit 76 (near Cherry Cobb) 47.47 ha. Undergrazing.
Unit 83 (near Sunk Island) 22.17 ha. Undergrazing.
Unit 98 (near East Halton Beck) 19.58 ha. Tipping, erosion, vehicle access.
Unit 99 (near East Halton Beck) 9.98 ha. Tipping, erosion, vehicle access.
Unit 112 (near New Holland) 6.7 ha. Dumped Spoil and Coastal Squeeze.

On the Humber foreshore itself the following units are in unfavourable No Change condition:

Unit 81 (near Sunk Island) 24.74 ha. Undergrazing.
Unit 150 (near Patrington Haven) 36.61 ha. Undergrazing.
Unit 151 (Patrington Haven) 5.87 ha. Game management – other, inappropriate scrub control.
Unit 153 (Patrington Haven) 1.43 ha. Inappropriate scrub control.
Unit 158 (near Kilnsea) 9.52 ha. Overgrazing.

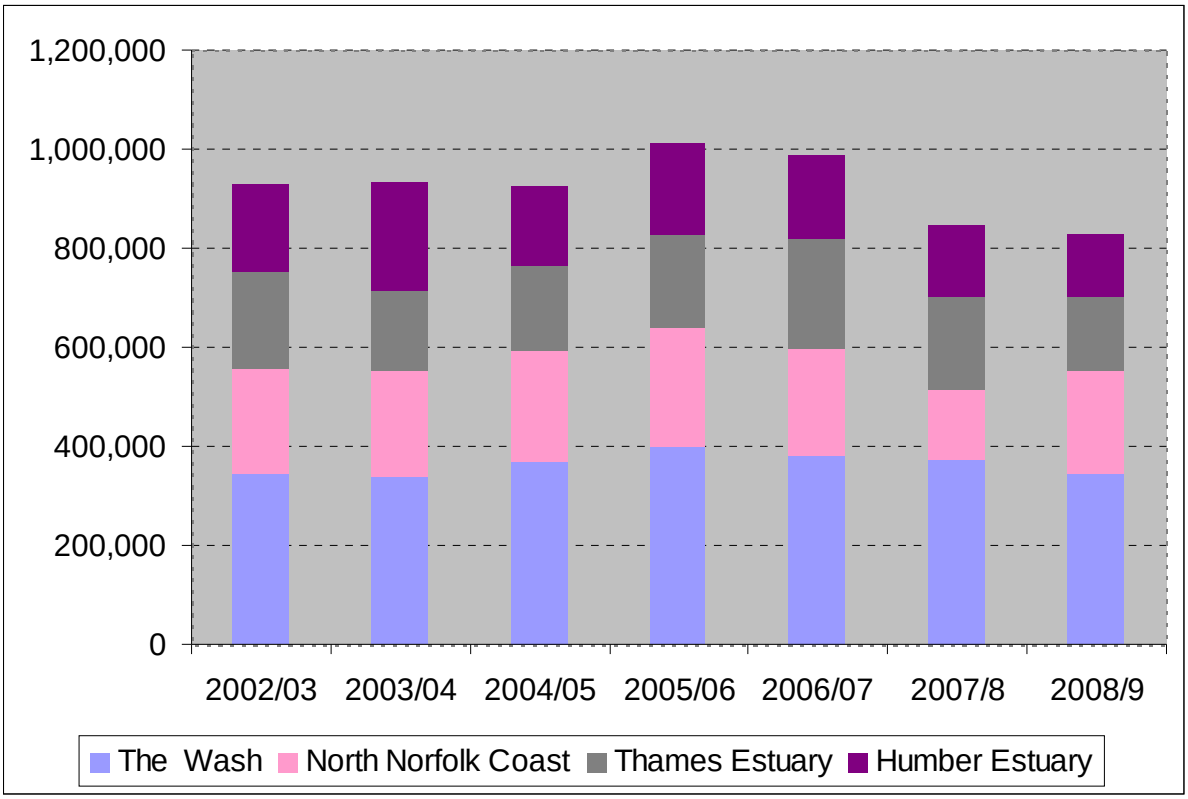
4.4 Birds

The Humber is internationally Important for Pink-footed Goose (*Anser brachyrhynchus*), Shelduck (*Tadorna tadorna*), Golden Plover (*Pluvialis apricaria*), Lapwing (*Vanellus vanellus*), Knot (*Calidris canutus*), Dunlin (*Calidris alpina*), Black-tailed Godwit (*Limosa limosa*), Bar-tailed Godwit (Limosa lapponica) and Redshank (*Tringa totanus*). It is nationally important for Dark-bellied Brent Goose (*Brenta bernicla*), Teal (*Anas crecca*), Shoveler (*Anas clypeata*), Goldeneye (*Bucephala clangula*), Oystercatcher (*Haematopus ostralegus*), Avocet (*Recurvirostra av*osetta), Ringed Plover *Charadrius hiaticula*), Grey Plover (*Pluvialis squatarola*), Sanderling (*Calidris alba*), Ruff (*Philomachus pugnax*), Turnstone (*Arenaria interpres*) and Curlew *(Numenius arquata*).

The Wetlands Bird Survey (WeBS) provides long term information on wintering waterbirds for the Humber SPA. The Core Counts Scheme is based on counts carried out each winter around high water and data assessed to provide information on total numbers and population changes.

Total numbers of wintering waterbirds on principal east coast sites are shown in Figure 4.3 [4.3]. The average for the Humber is 169,000 over the seven years considered, but numbers do vary from year to year at individual sites and certain sites are favoured in particular years. The main reason for variation is believed to be winter weather conditions in mainland Europe and the UK, with birds migrating to milder areas when conditions become too severe.

Figure 4.3 Total number of wintering waterbirds found at principal East Coast sites, 2002/03 to 2008/09

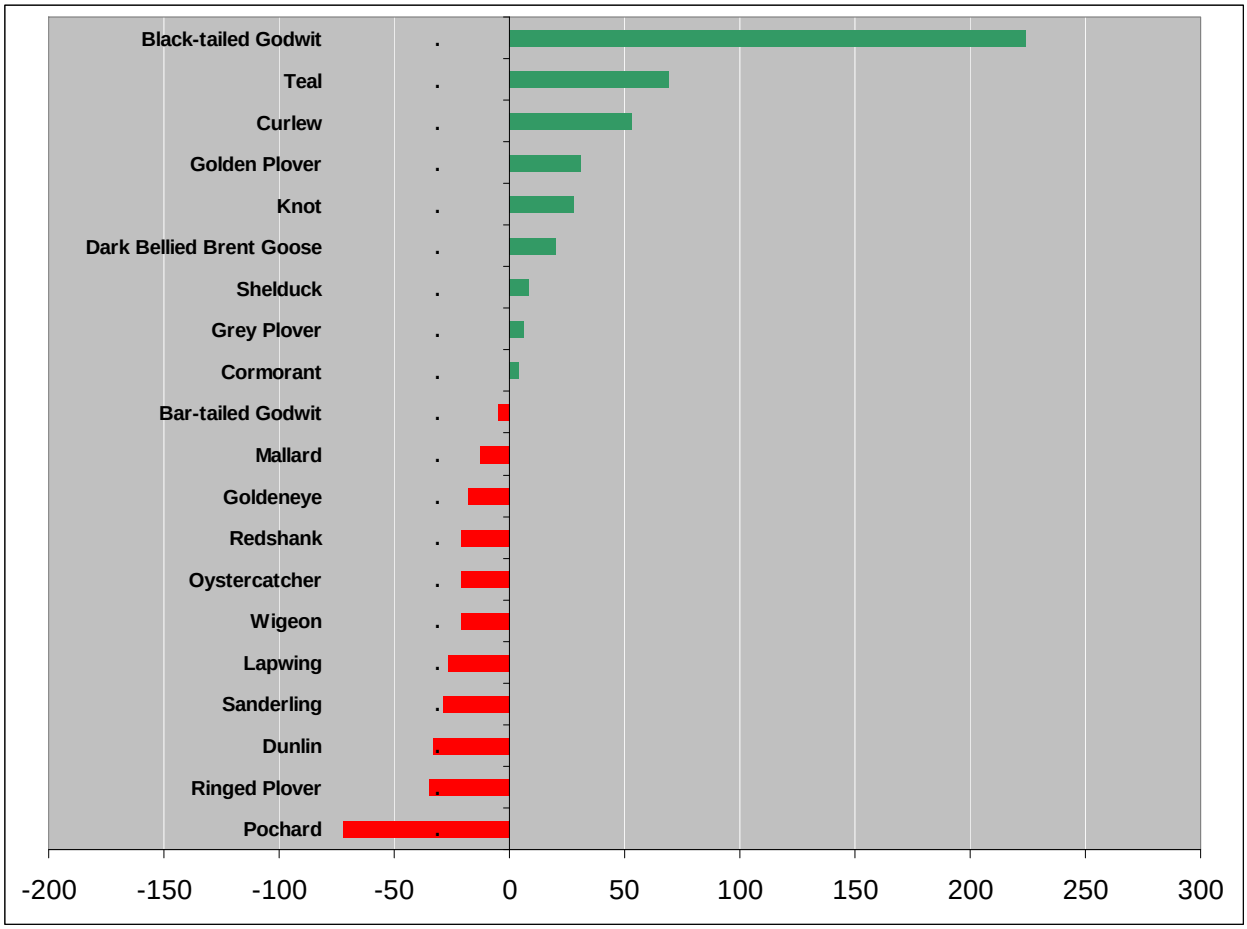


Data Source : Wetland Bird Survey (WeBS). Data values are given in Appendix 1.

The WeBS data is also used to provide information on changes in populations of individual species since designation of the SPA in 1994/5 and over short (5 year), medium (10 year) and long (up to 25 year) timescales.

The medium term changes are illustrated in Figure 4.4 as percentage changes for individual species for the period 1997/98 to 2007/08 [4.4]. This information is further processed to identify significant declines or "alerts" since designation (1994/5) and over short (5 year), medium (10 year) and long (up to 25 year) timescales. Declines of more than 50% are described as a "high alert" and declines of between 25% and 50% are described as a "medium alert".

Figure 4.4 Humber SPA medium term percentage changes in numbers of wintering waterbirds (1997/98 to 2007/08)



Data Source : Wetland Bird Survey (WeBS). Data values are given in Appendix 1.

For monitored species which are internationally important there is one “high alert” and that is for Lapwing based on declines since designation. There are “medium alerts” for Dunlin (medium term, long term and since designation), Bar-tailed Godwit (short term), Redshank (short term) and Lapwing (medium term). The most striking trend is the steady decline in Dunlin on the Humber, but this is less severe than the national decline of this species.

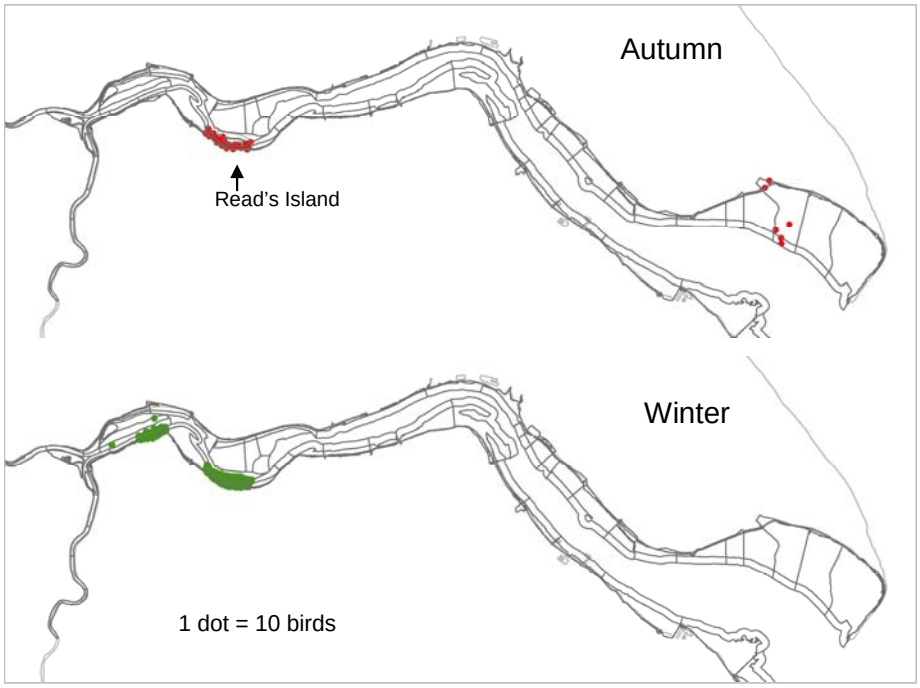
For monitored species that are nationally important there are “medium alert” for Oystercatcher (since designation) Ringed Plover (short term, medium term and since designation), and Sanderling (short term, medium term and since designation).

For other species there are “high alerts” Mallard (long term) and Pochard (medium term and since designation). The decline for Pochard reflects uncharacteristically high numbers in the mid 1990s. The decline in Mallard is something that is occurring nationally although the decline in the Humber is somewhat greater than the national trend. Whilst there is understandable emphasis on species that are declining there are a number of important increases - most notably Black- tailed Godwit and Golden Plover. Overall the Humber SPA provides a good range of intertidal habitat which support large number of wintering waterbirds although sea level rise and industrial / urban development are significant pressures. Birds also face disturbance from transport, fishing and a range of recreational activities but the effects of such disturbance are not yet well understood.

Low tide data was collected on the Humber in 1998/1999 and 2003/04 to gain information on low water activity and spatial distribution. These surveys provided an improved insight into many aspects of bird behaviour and habitat requirements [4.5]. Figure 4.5 below is an example

of the information available and shows the importance of Read's Island and the upper estuary for Pink-Footed Goose.

Figure 4.5 Average Low Tide Counts for Pink-Footed Goose 2003-2004



Data Source : Wetland Bird Survey (WeBS) and Natural England

Managed realignment sites

Coastal squeeze occurs when the presence of sea walls or other defences prevent inter-tidal habitat from retreating inland in response to the rising sea levels caused by climate change. As sea levels rise, there is nowhere for these important wildlife habitats to recreate themselves and they are lost beneath rising waters. For SPA and SAC designations, the Habitats Regulations require such losses to be compensated by creating new inter-tidal habitat.

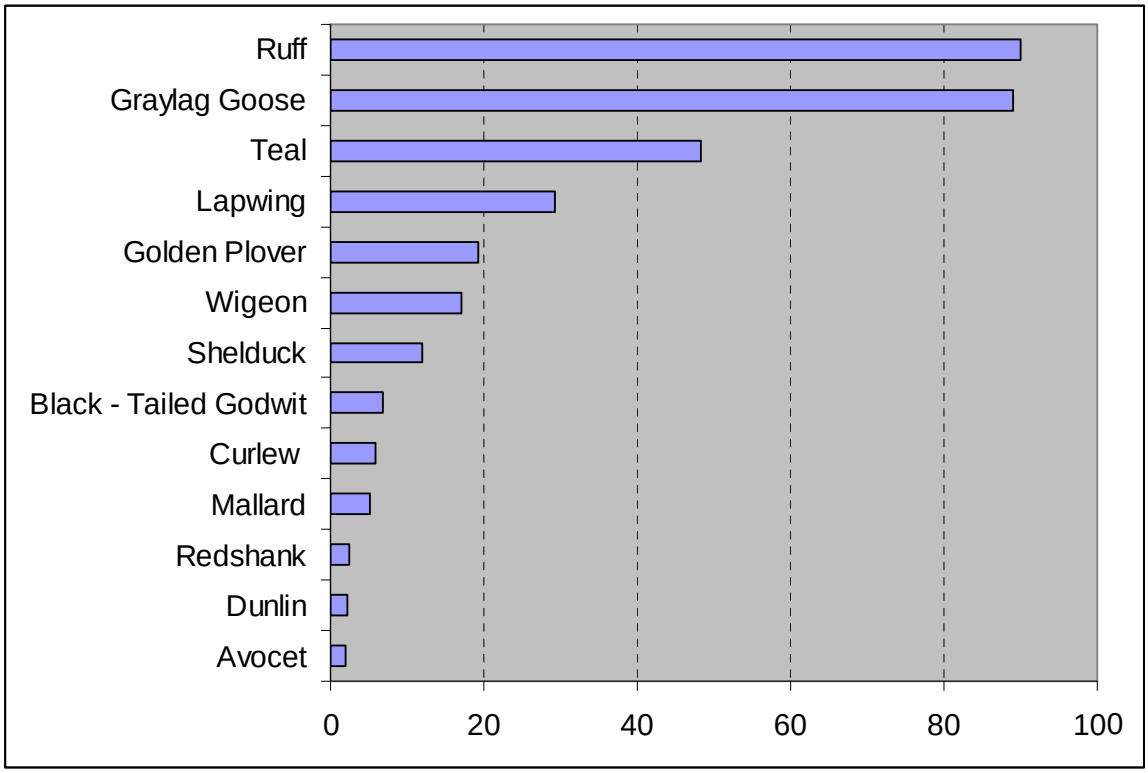
Creation of new inter-tidal habitat is a major feature of the Humber Flood Risk Management Strategy. There is also a requirement to create new habitat for losses associated with improving existing flood defences or building new defences. Inter-tidal Habitat will be created through managed realignment, which is the process of deliberately setting back the line of coastal defences to a new line inland of the original, preferably to rising ground. This allows new inter-tidal habitat on the land between the old and new defences.

The first managed realignment site on the Humber was the creation of 80 hectares (ha) of intertidal habitat in the middle estuary at Paull Holme Strays. The old embankment was breached in September 2003 and the development of the site has been monitored since that time. A detailed assessment has been carried out on data collected up to the end of 2008 [4.6]. Since the breach, sediment has built up rapidly within the estuary and it is predicted that eventually the majority of the site will become saltmarsh with mudflat habitats only persisting in areas close to the breach. After the breach, the site was rapidly colonised by wildfowl but it took more time for the assemblage of waders to develop. However, within the first three years, 19 wader species had been recorded and the site is now regarded as internationally important for Golden Plover, based on winter numbers, and Black-tailed Godwit based on spring/summer numbers. The site also supports a breeding colony of Avocets but as the saltmarsh develops, the habitat will become less suitable for this species.

The largest realignment site is at Alkborough Flats in the upper Humber (440 ha). The development of the site has been intensively monitored since the old embankment was breached in September 2006. Sediment is building up within the site and common reed vegetation is developing rapidly. There are also a number of management actions in progress, including the conversion of many of the arable fields to permanent pasture and the creation of a large new reedbed on the western side of the site. These developments will alter the balance of bird species using the site.

A wide range of data has already been collected and in order to assess the development of Alkborough Flats. This covers wintering birds, breeding birds, plants, butterflies, invertebrates and physical processes but for the purposes of this report only the winter bird surveys have been examined [4.7]. These surveys show that the site is already important for wintering waterfowl and waders. Figure 4.6 shows the winter 2009/10 peak totals recorded at Alkborough as a percentage of the WeBS 5-year-means for the upper estuary [4.5].

Figure 4.6 Alkborough Winter 2009/10 bird counts as a percentage of the upper estuary 5 year mean



Data Source : Alkborough Flats Partnership and Nyctea Ltd. Data values are given in Appendix 1.

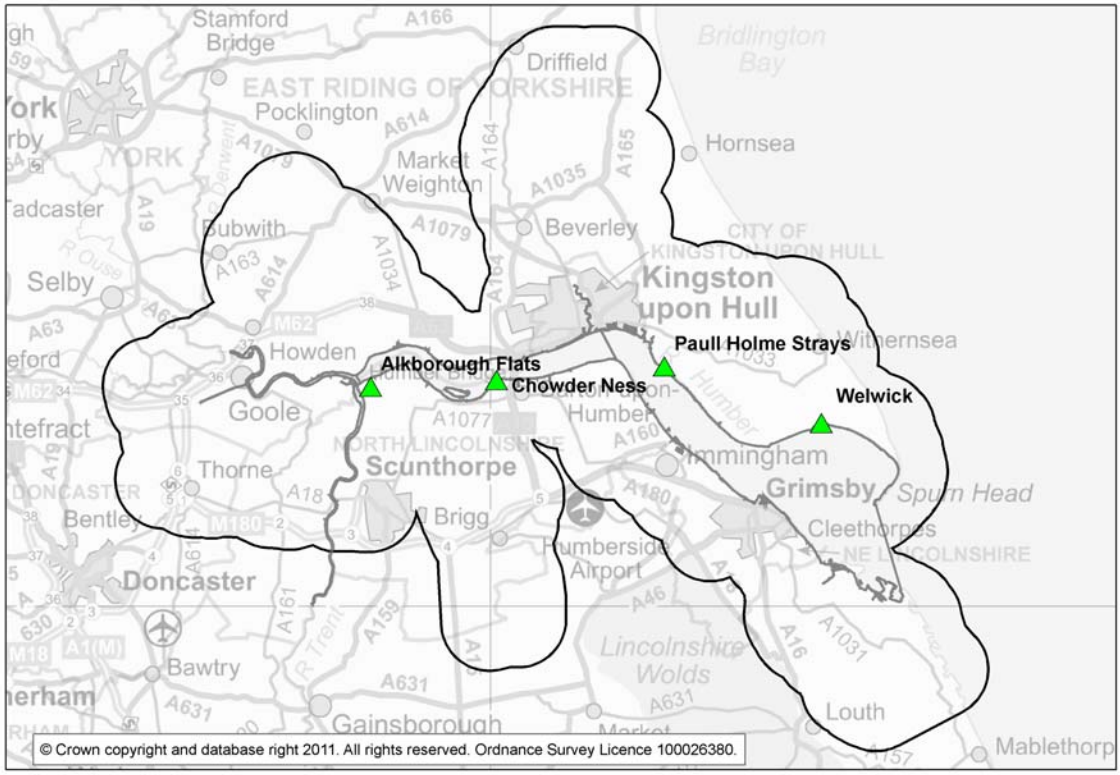
Associated British Ports (ABP) developed two managed realignment sites in 2006 to compensate for intertidal mudflat habitat lost at Immingham harbour through construction of a new Roll-on Roll-off terminal. These are Welwick in the lower estuary and Chowder Ness in the upper estuary.

The 15 hectares (ha) Chowder Ness site was constructed in July 2006, new flood defences were constructed at the rear of the site and most of the existing seawall removed. The objective was to create 10.5 ha of intertidal mudflat, 0.8 ha of saltmarsh and 2.3 ha of grassland.

The Welwick site covers 54 hectares at Oustray Farm on Sunk Island. New flood defences were constructed to the rear of the site and existing flood defences were breached in June 2006. The objective was to create seven to 37 hectares on intertidal mudflat, eight to 32 hectares of saltmarsh, nine to 15 hectares of superlittoral grassland and two saline pools.

An extensive monitoring programme is in place to assess the development of Chowder Ness and Welwick [4.8].

Figure 4.7 Location of current Managed Realignment Sites



Avocets

The Humber is a vital area for Avocets because they use it both for breeding and en route to their wintering grounds. Both the range and population has extended northward over the last decade.

Read's Island in the upper estuary has been the main breeding area for Avocets with around 100 breeding pairs (6% of the UK population). However the island has suffered significant erosion by the tidal forces of the Humber estuary and in 2007, the saline pools, where the birds breed, were lost. The island was restored and protected in 2009. After three years with no breeding success, the breeding season in 2010 was the best on record with more than 200 chicks fledged.

Read's Island may not always be around to provide the specialised habitat required by the birds to breed but it is hoped that managed realignment sites such as Alkborough will provide some additional suitable habitat.

Bitterns

The Bittern (*Botaurus stellaris*) is a very rare bird in the UK; its dependence on reedbeds and very small population make it one of the most threatened species in the UK. The population has been fully surveyed every year since 1990; the survey covers nesting activity and the number of booming males. Numbers in the UK as a whole have increased gradually from a very low base of less than 10 confirmed nests in the early 1990s to 41 nests in 2010 [4.9]. In the 2008 season there were two successful nests in the Humber, one at Blacktoft and one at Far Ings. In 2009 nests were again reported at both sites. 2009/10 was a particularly cold winter and this probably affected the condition of wintering bitterns as they struggled to find food. There was one active nest in the Humber area in 2010. Reedbeds such as Blacktoft are not

ideal for Bitterns as high tides can result in nests being drowned. For this reason, the long term survival of Bitterns depends on establishing large reedbeds inland, which can reliably support breeding populations.

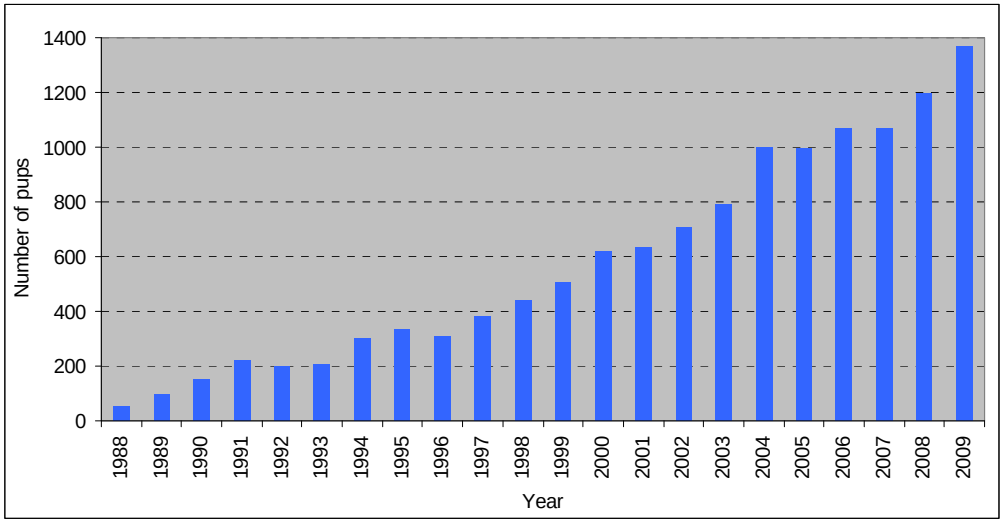
4.5 Mammals

Seals

The seal colony at Donna Nook, on the lower estuary, is of national and international importance for both Common Seals (*Phoca vitulina*) and Grey Seals (*Halichoerus grypus).* They are at the top of the aquatic food-chain, and, as such, the health of the population provides a good indication of the overall health of the estuary and immediate coastal area.

The Grey Seal is the larger and more common of the two species and mainly feeds on fish. They are very conspicuous when they "haul out" at Donna Nook to breed between October and December, most then dispersing to the North Sea for the rest of the year. The colony represents around 1.8% of the UK Grey Seal population, which in turn is 40% of the global and 95% of the EU population. Figure 4.8 shows the trend in the annual number of seals born, and indicates an increasingly healthy colony.

Figure 4.8 Annual Grey Seal pup production recorded at Donna Nook 1988-2009



Data Source: Sea Mammal Research Unit (SMRU) 2010. Data values are given in Appendix 1.

The Common Seal is the smaller of the two species, and feeds on both fish and invertebrates. The UK has 5% of the world population and 50% of the EU population of Common Seals. They are much less conspicuous than Grey Seals at Donna Nook and annual counts are less accurate. Pups in June and July and are able to swim almost immediately.

Table 4.1 Minimum Number of Common Seals at Donna Nook

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Number	390	233	341	231	294	421	299	214	191	267

Source : Sea Mammal Research Unit (SMRU) 2010

Otters

The otter (*Lutra lutra*) is an important biological indicator of the health of our rivers and wetlands. The first otter national survey of England was carried out in 1977-79 and then periodically re-surveyed. This confirmed there had been a major decline in otter distribution since the late 1950s. Over the last 30 years, the range and number of otters has recovered,

mainly as a result of the ban of organochlorine pesticides, legal protection since 1978 and improving water quality [4.10].

There has been a considerable expansion In otter presence in the Derwent catchment, particularly in the lower Derwent.

Table 4.2 Otter presence / absence in the Derwent catchment

Main survey	1977-79	1984-86	1991-94	2000-02	2009-10
Positive sites/total	0/16	1/16	12/16	7/20	15/20

In Hull and East Riding there has been a significant expansion of the range of otters, particularly to the west of Hull but presence is patchy to the eastern part of the area, where streams are generally very small, is still patchy. Otters are using some of the small coastal streams which indicates re-colonisation of the coast in this area. For the first time, otters have been found within the boundaries of the City of Hull.

Table 4.3 Otter presence / absence in the Hull and East Riding catchment

Main survey	1977-79	1984-86	1991-94	2000-02	2009-10
Positive sites/total	0/14	0/14	0/14	6/24	16/24

There were no positive sites in the Grimsby/Ancholme catchment during previous surveys but otters are now using most of the watercourses on the Ancholme system and some of the small coastal streams.

Table 4.4. Otter presence / absence in the Grimsby/Ancholme catchment

Main survey	1977-79	1984-86	1991-94	2000-02	2009-10
Positive sites/total	0/24	0/24	0/24	0/24	12/24

Otters use the lower part of the Trent catchment. They are now widely distributed in the Idle catchment and are also present in the Torne, Eau and Bottesford Beck.

Water voles

Water voles (*Arvicola terrestris*) have declined throughout the 20th Century as a result of habitat destruction through intensification of agriculture. They are found in lowland rivers, drains and streams. Recently the decline has been very rapid with a 90% reduction in numbers since 1990, thought to be mainly due predation by feral American mink (*Mustela vison*). In April 2008 the water vole gained protection against being killed, injured, or taken from the wild under the Wildlife and Countryside Act 1981. Legal protection, habitat creation and mink control measures are helping water voles numbers to recover.

The National Water Vole Database and Mapping project collated most of the existing water vole and mink data and will allow collection of future data in a standardised format. Whilst presence/absence maps have been produced, recording effort varies geographically and from year to year and it is not possible to come to firm conclusions on temporal or spatial trends in recent times. The lowland streams and drains around the Humber provide suitable habitat for water voles. Maps for 2003-2009 indicate that they are present throughout the whole of the lowland area around the Humber at densities broadly comparable with similar lowland areas elsewhere in England [4.11].

4.6 Fish

The Humber is recognised as an important nursery area for Common Sole (*Solea solea*), European Plaice (*Pleuronectes platessa*) and Atlantic Cod (*Gadus morhua*). There are several vessels operating targeting sole during the summer, and from the autumn, the smaller vessels exploit Brown Shrimps (*Farfantepenaeus aztecus*). Significant numbers of fish and range of fish species have been found in annual monitoring trawls within the Estuary (Data Source: Centre for Environment, Fisheries and Aquaculture Science and Environment Agency). Assessments of this data carried out for the Humber River Basin Management Plan indicate that the estuary is currently meeting "good ecological status" in terms of fish (Data Source: Environment Agency 2010). This means that, taking into account the physical conditions in the estuary, the range of species found and their numbers indicate a healthy fishery.

Migratory fish

Lamprey

Lampreys are particularly important for the Humber as they are specified as an "interest feature" of the SAC. River Lamprey (*Lampetra fluviatilis*) and Sea Lamprey (*Petromyzon marinus*), both occur in the Humber Estuary. They are eel-like, jawless, primitive 'fish'. The fully grown adults migrate into rivers, including the Yorkshire Ouse and tributaries (Derwent, Swale, Ure, Nidd and Wharfe) and the Trent, to spawn on stony and gravelly riverbeds. Young adults migrate downstream to the Humber Estuary or North Sea where they parasitise other fish for one to two years before migrating back upstream. Lamprey are good indicators of ecosystem quality because they require good water quality, occupy several habitats during their life cycles and require free passage between them.

River Lampreys are relatively common in the rivers draining into the Ouse but Sea Lampreys are considered to be relatively scarce in the Humber basin as a whole [4.12]. Recent observations on spawning adult sea lampreys suggest that numbers of returning adults in the Humber basin are, at most, three hundred each year [4.13].

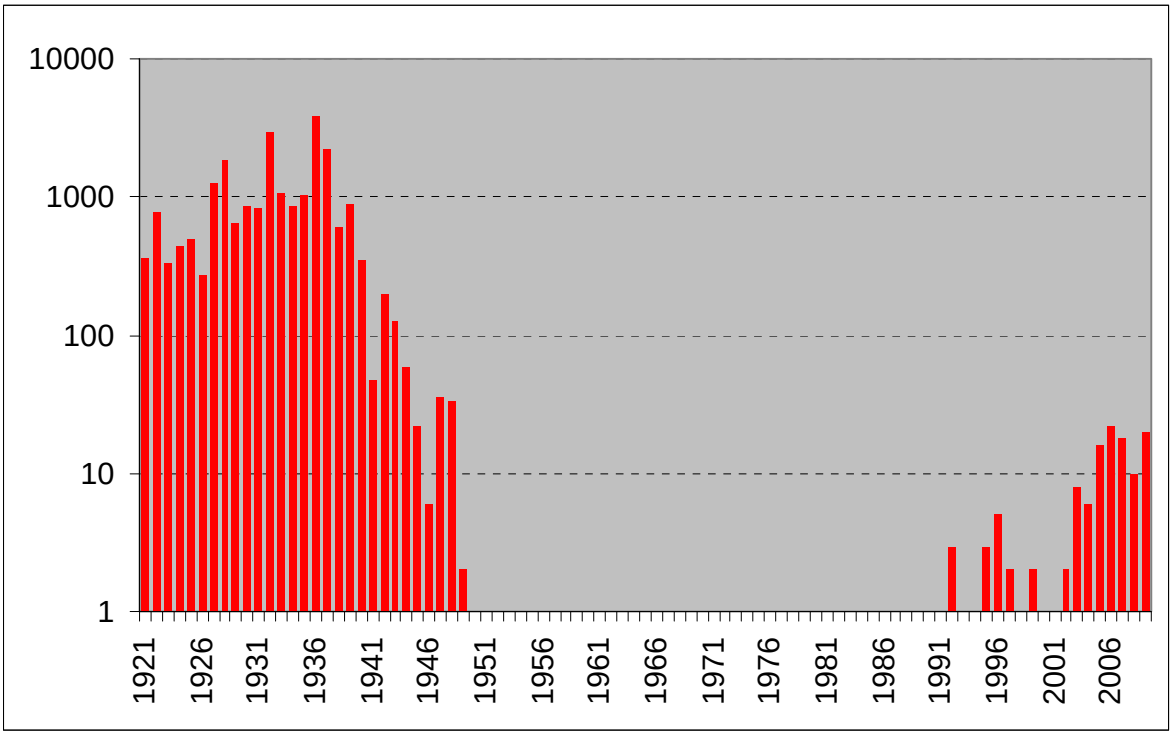
The lamprey population is being actively conserved through measures to reduce the entrainment of lamprey at major abstraction points, improvement of water quality in the tidal Ouse and upper estuary to facilitate migration, and removal of physical obstructions to the migration of adults.

Salmon

Atlantic Salmon (*Salmo salar*) pass through the Humber estuary to reach suitable spawning grounds which are mainly in the upper part of the Ouse catchment. Between the early 1950s and the mid 1990s, poor water quality (low oxygen levels) in the tidal Ouse prevented migration almost completely. The situation is now improving as a result of improved sewage and industrial effluent treatment in the catchments that drain to the Ouse and in the tidal Ouse itself.

Figure 4.8 shows the declared salmon rod catch for the Ouse catchment between 1921 and 2009 (logarithmic scale). Although numbers in recent years are still low, the improvement is encouraging, particularly as there is anecdotal evidence that coarse fish anglers are catching salmon in the Ouse catchment and these numbers are not reported. Our fishery surveys in the Swale, Ure, Nidd and Wharfe, carried out between 2001 and 2009, found salmon in 15% of surveys. By contrast salmon were virtually absent in the Aire, Calder, Derwent and Hull catchments.

Figure 4.9 River Ouse declared salmon rod catch 1921-2009
(Note plot is log Scale)



Data Source : Environment Agency 2010 Data values are given in Appendix 1.

Eels

Since 1970, the number of young eels *(Anguilla Anguilla)* entering the European fishery each year has declined by a dramatic 95-99%. A reduction in the number of eels of this magnitude will have severe effects both on commercial fisheries and aquatic ecology. Eels form a key link in the aquatic food chain and are a major prey item for species of conservation interest such as the bittern and the otter.

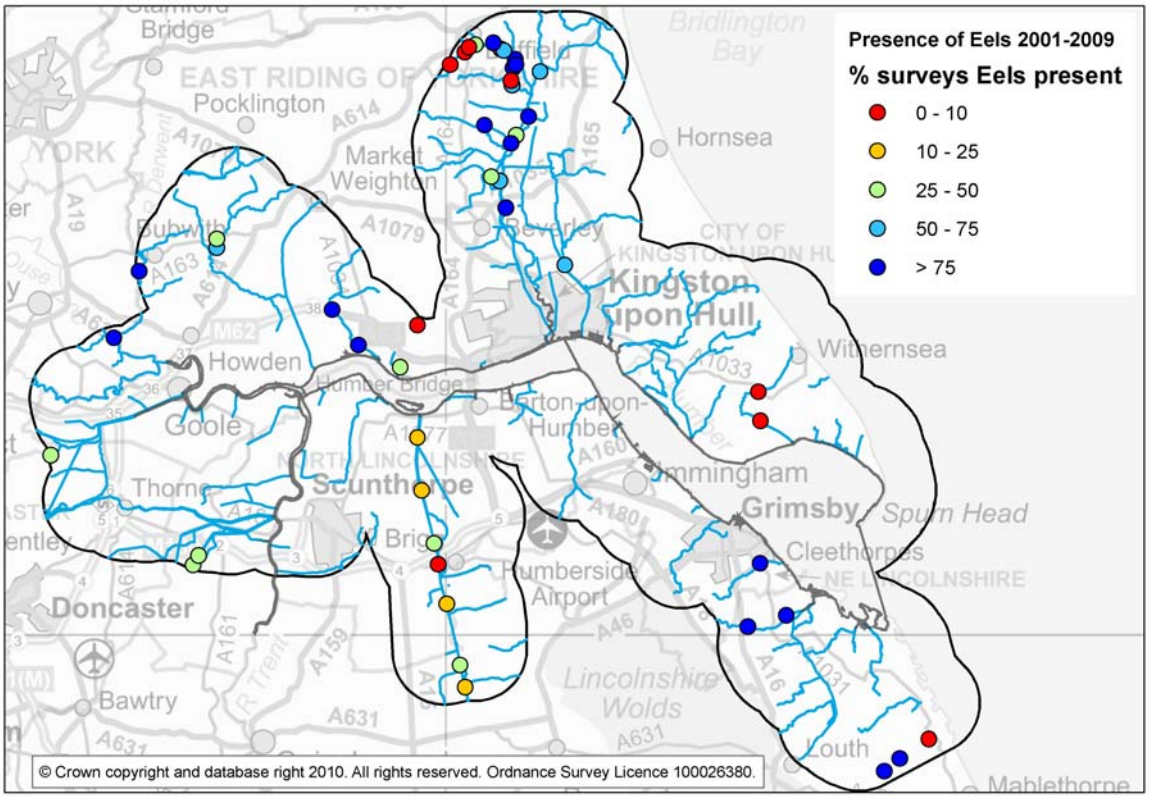
Eels have a complex life cycle. Leaf-shaped larvae drift across the Atlantic from the spawning grounds, between the West Indies and the Azores. When they reach the European coast they transform into their familiar snake-like shape before swimming up rivers. The eels then spend a number of years living and growing in freshwater before returning to the sea as adults and swimming back to the North Atlantic to spawn. All European eels return to the Sargasso Sea to breed and therefore form a single stock.

Likely causes for the current decline in the eel population include:

- Barriers to migration and habitat loss
- Overfishing
- Pollution
- Infestation by the nematode parasite *Anguillicola crassus*
- Climate conditions affecting ocean currents and temperatures

The Eel Management Plan for the Humber River Basin District provides information on the status of eels and provides detailed data for several catchments, including the Hull. Our fishery surveys in rivers, streams and drains close to the Humber (within the study area) between 2001 and 2009 found eels in 58% of the surveys with a discernable trend over this period. The presence of eels at survey sites is shown in Figure 4.8 (where there are at least two surveys over the period).

Figure 4.10 Presence of eels at survey sites 2001-2009



Data Source : Environment Agency 2010

Key data sources

- Condition of SSSIs: Natural England; updated on an ongoing basis
- Total number of wintering waterbirds found at principal East Coast Sites: WeBs; updated annually
- Humber SPA waterbird alerts - Changes in numbers of wintering waterbirds: WeBs; updated annually in arrears
- Annual Grey Seal pup production and minimum number of Common Seals recorded at Donna Nook: Sea Mammal Research Unit, updated annually
- Managed Realignment Sites: Environment Agency, Annual Reports
- River Ouse declared salmon rod catch: Environment Agency, updated annually
- Fish population surveys: Environment Agency and CEFAS, updated annually

5 Water status

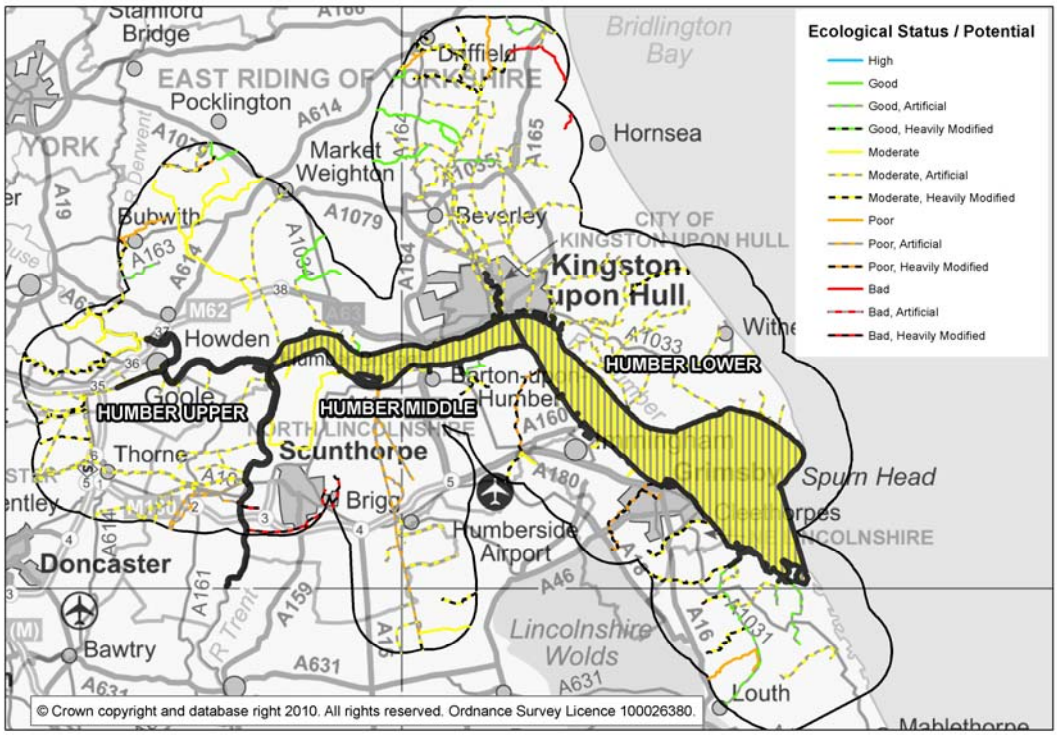
5.1 Water Framework Directive

The monitoring and assessment of water quality and ecological quality of surface waters has changed radically in recent years as a result of the Water Framework Directive and River Basin Management Planning.

The directive requires the physical, ecological and chemical condition of waters to be assessed and plans and actions put in place to improve the condition towards good status. The first River Basin Management Plan for the Humber River Basin District was published in 2009 [5.1]. This incorporated the first assessment of physical, ecological and chemical status and identified a range actions to be carried out to improve water bodies in the Humber catchment and the estuary itself. The assessment methodologies are published by the UK WFD Technical Advisory Group [5.2].

The saline waters of the estuary have been split into three separate "transitional water" waterbodies for assessment purposes – the upper, middle and lower Humber. The overall Ecological Status / potential of water bodies in the study area is shown below in Figure 5.1.

Figure 5.1 Overall ecological status/potential of rivers and transitional waterbodies



Source : Environment Agency 2009

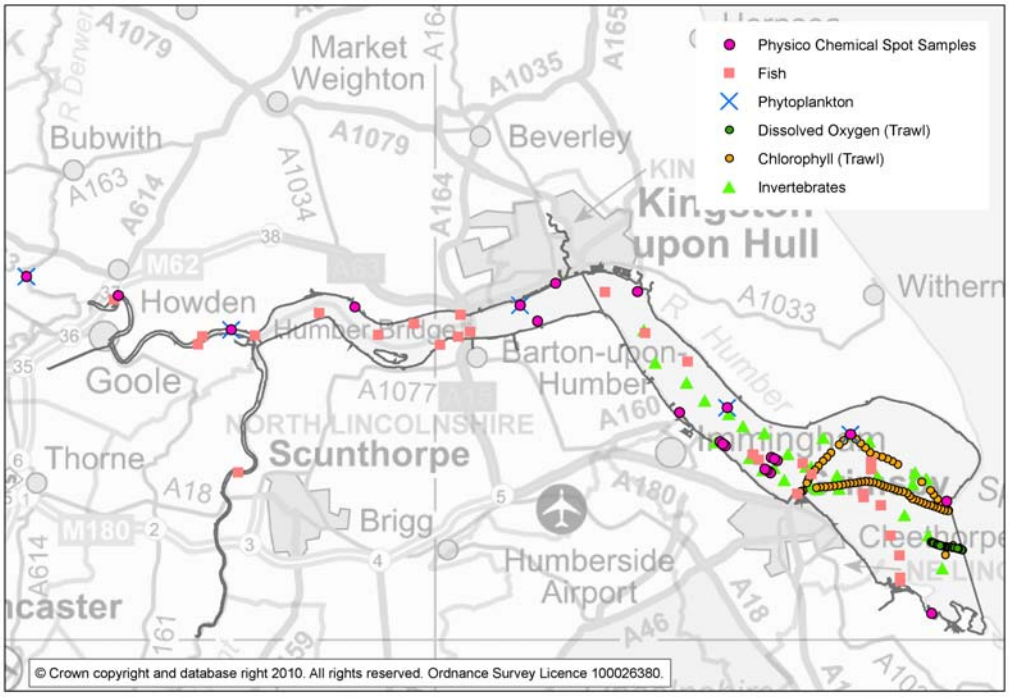
The upper Humber is the saline part of the tidal Ouse and Trent, upriver of Trent Falls; the middle Humber covers the area from Trent Falls to Hull and the lower Humber covers the area from Hull to the sea. The whole of the Humber is regarded as being "heavily modified" from it's natural state as a result of the flood protection structures. In the case of "heavily modified" (and "artificial") waterbodies, the directive requires mitigation measures to be put in place (where practicable and subject to economic assessment) to redress the adverse effects of the man made structures on the ecology. These mitigation measures might include managed realignment and other habitat creation initiatives, fish passes and so on.

For “heavily modified” water bodies it is recognised that the physical modifications may limit the ecology. For this reason, the target is to achieve good ecological potential. In the case of transitional waters, the assessment of ecological potential is based on phytoplankton and a range of physico-chemical/hydrology and chemical (Annex 8) elements that can adversely affect the ecology and the presence/absence of mitigation measures. The classification of status published in the 2009 River Basin Management Plans, was based on data from 2006-2008. The classification has recently been partially updated to 2010 taking into account additional data collected in 2009. The results of this assessment are shown in Table 5.2 and the estuarine monitoring points used are shown in Figure 5.2.

Table 5.1 Humber Estuary transitional waterbodies - status of individual elements

	HUMBER UPPER	HUMBER MIDDLE	HUMBER LOWER
Element	**Status**	**Status**	**Status**
Hydrology (Flow)	Not High	Not High	Not High
Phytoplankton	Not Assessed	High	High
Macroalgae	Not Assessed	Not Assessed	Not Assessed
Invertebrates	Not Assessed	Not Assessed	Good
Fish	Good	Good	Good
Dissolved Oxygen	Good	High	High
Dissolved Inorganic Nitrogen	Not Assessed	Moderate	Moderate
Annex 8 Chemicals	Moderate (due to Copper, Cypermethrin)	Moderate (due to Zinc, Copper)	Moderate (due to Zinc)
Mitigation Measures	Moderate	Moderate	Moderate
Overall Ecological Potential	Moderate	Moderate	Moderate

Figure 5.2 Humber Estuary WFD monitoring points



Overall ecological potential can be one of four categories – “good”, “moderate”, “poor” or “bad”. The upper, middle and lower Humber are all currently at “moderate” ecological potential. Fish and Invertebrates status are included in Table 5.1 but they are not taken into account in the overall assessment of ecological potential (available information on fish and invertebrates indicates good status).

Phytoplankton and dissolved oxygen meet the requirements for good ecological status, where assessed. The levels of dissolved inorganic nitrogen, copper, zinc and cypermethrin (Upper Humber only) do not meet the requirements for good ecological status. Dissolved inorganic nitrogen comes from sewage discharges and use of fertilisers and manures in agriculture (mainly in upstream catchments). This can adversely affect the ecology, sometimes leading to excessive growth of phytoplankton and macroalgae. The elevated levels of copper and zinc are thought to be mainly due to historic contamination of river and estuary sediments. Elevated levels of cypermethrin in the Upper Humber arise from sheep dip chemicals released by the wool scouring industry in West Yorkshire.

Mitigation measures for the Humber have not yet been fully assessed, so this element is classed as moderate until such time it is shown that all practicable measures have been put in place.

The chemical status of the Humber is also assessed based on the list of priority hazardous substances specified in the directive (Annex 10). Out of the 24 chemicals assessed, the Humber failed to achieve good status on just one chemical – tributyl tin (TBT). All three transitional water bodies failed to achieve good chemical status for TBT and this is mainly due to historic contamination of river and estuary sediments through the use of TBT as an antifoulant in paints used on ships.

The default objective within the first River Basin Management Plan is to achieve good ecological status / potential. For the Humber itself the timescale has been set at 2027. Six of the 112 river water bodies within the study area are expected to improve in class by 2015. Further details can be found in the Humber River Basin Management Plan, including assessment of the status of lakes, coastal waters and groundwaters. The status of groundwaters is discussed later, in the water resources section.

5.2 Bathing water quality

The waters of Cleethorpes beach are designated under the European Bathing Waters Directive and bacterial levels are monitored weekly during the bathing season (May to September). Water quality has improved dramatically since the late 1990s as a result of improvements to sewage treatment. The bathing water met the directive “*guideline*” standard (excellent bathing water quality) in 2009 and 2010 and has done so almost every year since 2002.

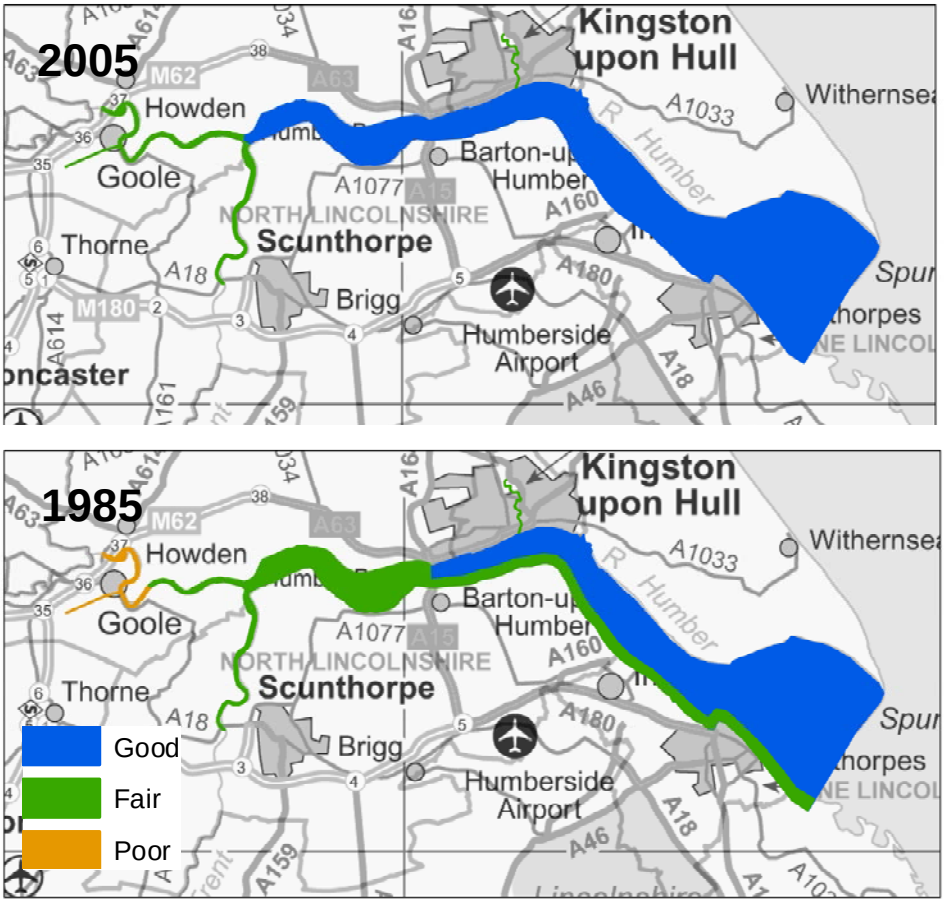
5.3 Estuarine water quality – historical trends

Monitoring of water quality started in the 1970s and at that time water quality in parts of the Humber was poor, as a result of poorly treated sewage and industrial effluents. Since that time there has been a major clean up of effluent discharges, driven by a range of environmental regulations. This has led to corresponding improvements in the ecology, most notably increasing evidence of salmon passage.

From 1985 to 2005 the assessment of overall estuary quality was based on the Classification of Estuaries Working Party Scheme (CEWP) which was a points system considering water quality, ecology and visual appearance. The assessment was carried out every five years and covered saline waters of the estuary from Spurn Point to the upstream saline limits of the

Ouse (Boothferry Bridge, Trent (Keadby), Don (Rawcliffe Bridge) and Hull (Sutton Road Bridge).

Figure 5.3 Estuary quality classification 2005 and 1985



Source : Environment Agency 2006

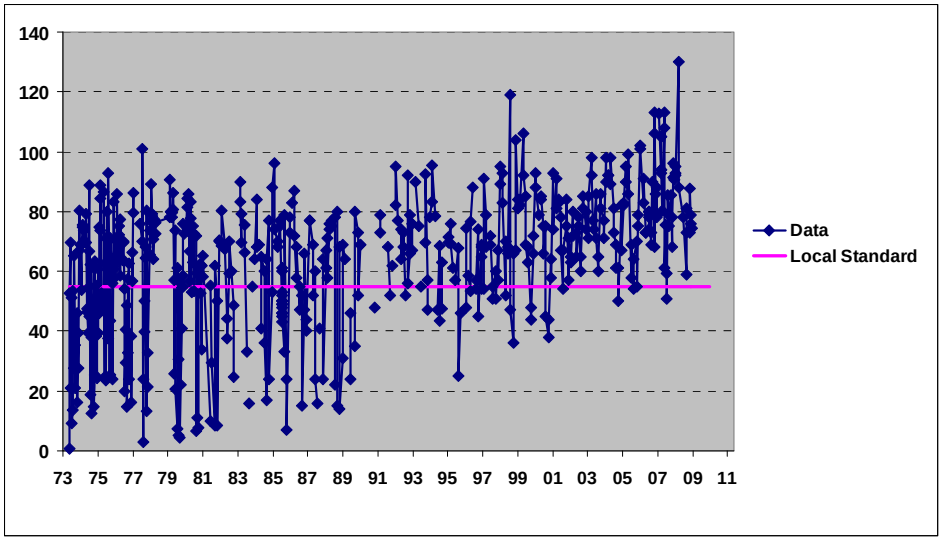
Figure 5.3 shows the improvements made between 1985 and 2005 which were mainly due to better oxygenation in the upper estuary and the elimination of unsightly iron staining on the south bank of the Humber, that had been caused by industrial effluents, particularly from two plants producing titanium dioxide.

Dissolved oxygen

In the 1970s and 80s very low dissolved oxygen levels occurred regularly in the upper estuary during the summer months. The worst conditions occurred in the tidal Ouse, when freshwater flows were low and during spring tides. Under these conditions, strong tidal currents bring very large amounts of sediment into suspension and when temperatures are high, oxygen levels are very low. This produced a zone of deoxygenation, which prevented the passage of migratory fish, such as salmon and lamprey.

Figure 5.4 shows dissolved oxygen data for spot samples taken on the River Ouse at Blacktoft, which is just upriver of the Trent confluence. It can be seen that, in the last 10 years or so, the occurrence of low dissolved oxygen levels has become much less likely, a pattern which is also is also seen at sampling points further upriver (Selby, Drax and Boothferry Bridge). Prior to the development of WFD standards for dissolved oxygen in estuaries there was no national standard. A local standard was derived based on the requirements of migratory fish (dissolved oxygen levels should be greater than 55% saturation at least 95% of the time).

Figure 5.4 Dissolved oxygen level (% saturation) in the River Ouse at Blacktoft 1973-2009



Source: Environment Agency 2010

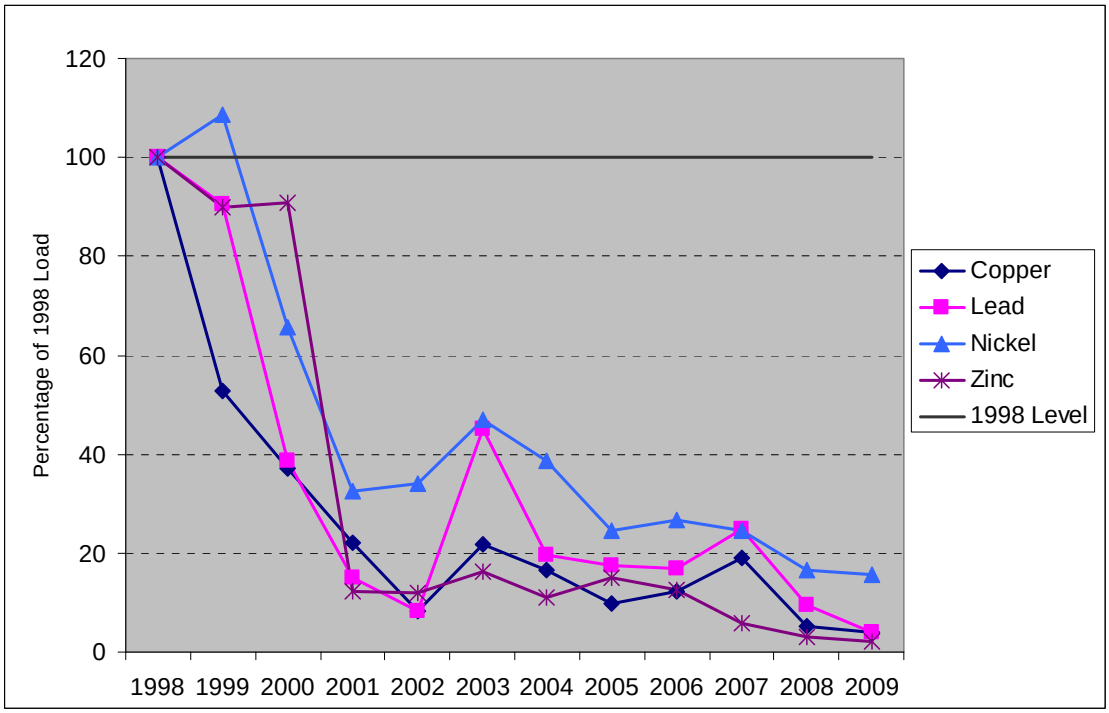
The improvement is a result of better treatment of industrial and sewage effluent discharges and the improved water quality of some of the main tributaries of the Humber, particularly the Aire and Don. Better dissolved oxygen conditions have led to an increase in salmon numbers in the Ouse catchment.

Toxic substances

The Dangerous Substances Directive and other regulations have reduced the loads of many toxic substances entering the Humber and improved compliance with environmental standards set to avoid damage to aquatic life and bioaccumulation in the food chain. These substances include heavy metals, industrial chemicals and pesticides. A wide range of substances have been monitored in the water, sediments, and biota of the Humber and in the industrial and sewage effluent discharges to the Humber.

The loads of many toxic substances have reduced, due to improvements in effluent treatment and, in some cases, factory closures. Figure 5.5 shows the loads of copper, lead, nickel and zinc from effluent discharges direct to the estuary and shows the significant reductions between 1998 and 2009. Heavy metals accumulate in estuary sediments and it can take many years, even decades, for contaminant levels to reduce.

Figure 5.5 Humber Estuary – loads of selected heavy metals from industrial wastewater compared to 1998 baseline (set to 100)



Source: Environment Agency 2008. Data values are given in Appendix 1.

Water samples from the estuary have been examined for a particularly wide range of contaminant substances covering 12 heavy metals and more than 50 organic substances (industrial chemicals and pesticides). The current chemical status is covered in the section on the Water Framework Directive.

Nutrients

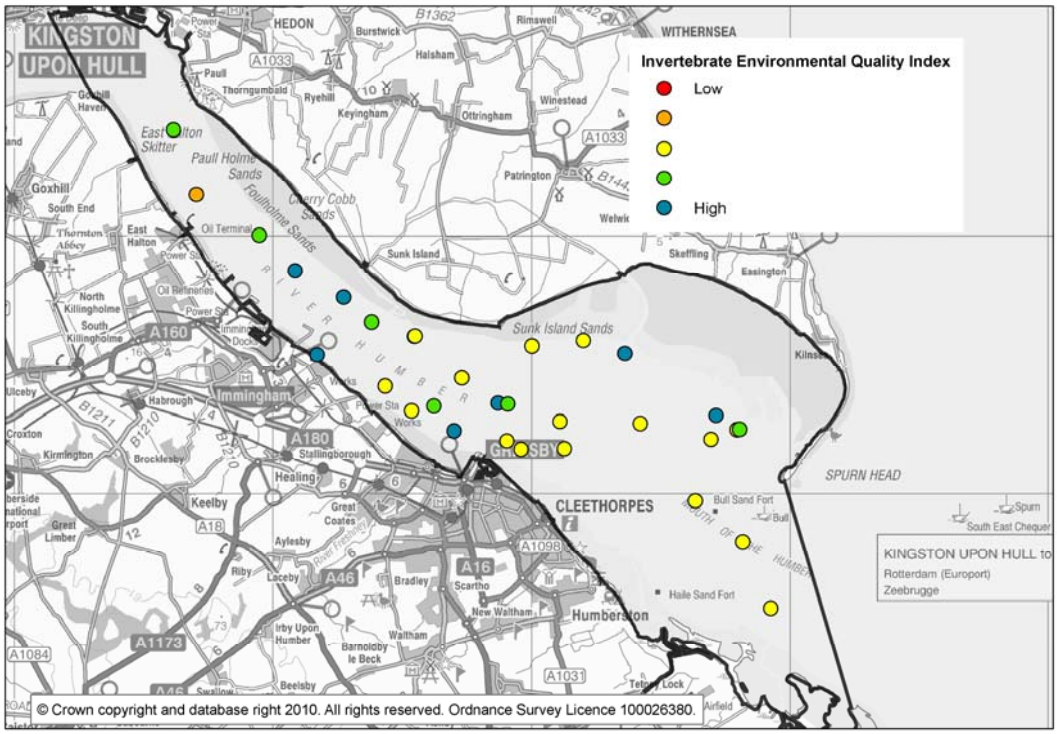
In surface waters, elevated levels of nutrients can lead to excessive growth of macroalgae on the bed of the estuary and blooms of waterborne phytoplankton. Where this results in an undesirable disturbance to the natural ecology, it is termed eutrophication. Usually nitrate is the nutrient that needs to be controlled where eutrophication is a problem in estuarine and coastal waters. The levels of nitrate in the Humber have been high since records began, due mainly to sewage effluents and runoff of nitrate fertilisers from agricultural land. Non-tidal rivers do feed phytoplankton into the tidal system, but levels are low downriver of Trent Falls. There is no evidence of excessive growth macroalgae anywhere in the estuary.

5.4 Biology

There has been extensive monitoring of invertebrate organisms living on the bed of the estuary in the inter-tidal area and below the low water mark since the late 1970s. The information was reviewed in detail as part of the Habitats Directive Review of Consents. The general conclusion from this work was that the range and abundance of organisms found was largely dictated by the physical conditions, rather than water quality, which, has a very limited influence. The Humber is subject to very strong tidal currents, which cause erosion and deposition of bed sediments and rapid changes of salinity. This harsh environment leads to a relatively limited range of invertebrate organisms. There was some evidence of organic enrichment affecting invertebrate communities at some sites in the 1980s and 1990s. This could have been related to poorly treated sewage and industrial discharges, which did exist at that time.

A methodology for classifying biological quality of coastal waters, based on invertebrate data, was developed in 2008, as part of the Water Framework Directive. An environmental quality index is calculated based on the presence / absence of pollution sensitive invertebrate species, taking into account habitat suitability. The overall classification for the water body is based on averaging data for individual sampling points – on this basis the lower Humber was classified as "good" status, based on invertebrate data for 2007-2009. This methodology is not suitable for the middle or upper Humber.

Figure 5.6 Invertebrate environmental quality index for sampling points in the lower Humber 2007-2009



Source: Environment Agency 2010

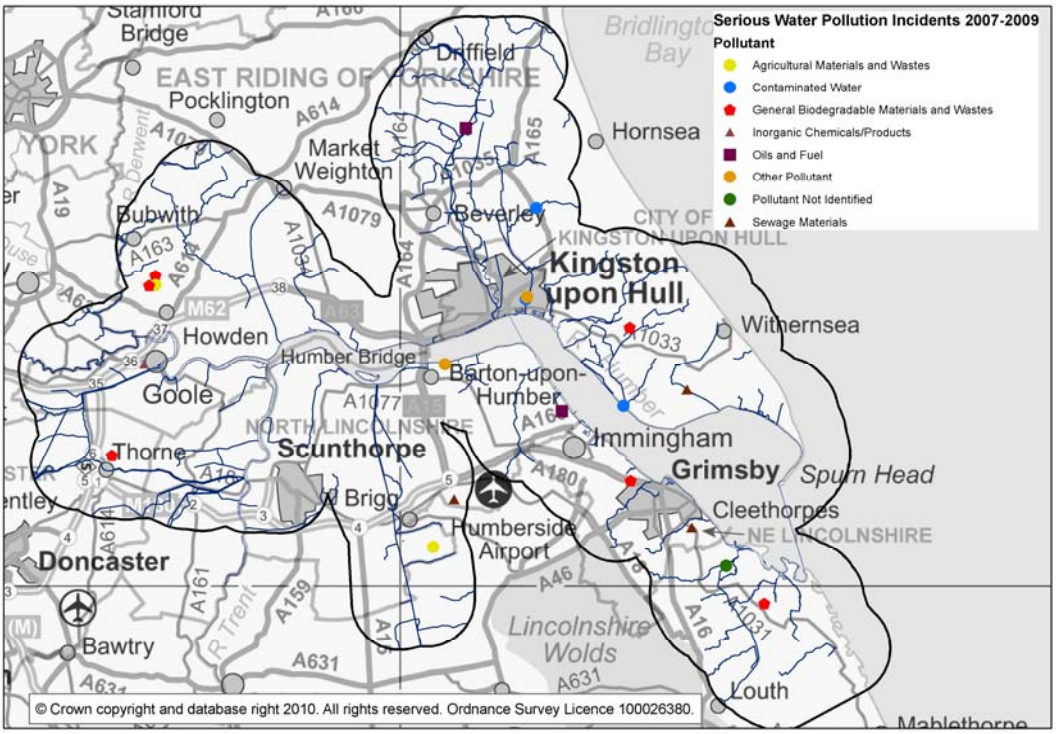
5.5 Water pollution incidents

The Humber is one of the busiest waterways in the British Isles and there are large industrial complexes along the Humber banks, including chemical works, power stations and oil refineries. There is therefore the potential for spillages, leakages, accidents and vandalism to cause pollution in an around the Humber and there are emergency and oil spill contingency plans in place to deal with such incidents.

Information on pollution incidents involving ships and harbour activity is summarised in the Humber Estuary Management Scheme Annual Report [5.3]. In 2005, 2006, 2007, 2008 and 2009 there were 28, 24, 12, 10 and nine reports of spillages respectively, from vessels and harbour installations. These incidents were of a minor nature with two exceptions. In 2006 a vessel lost 100 litres of hydraulic oil between Rosse Reach and Saltend. In 2007, there was an incident at the Tetney Monobuoy involving the loss of approximately 2.5 tonnes of crude oil. In this latter incident, the "Humber Clean" oil spill contingency plan was activated and oil dispersant deployed.

Water pollution incidents, that are reported to us are also recorded. These are largely incidents on rivers which drain to the Humber. There were 21 serious water (Environment Agency Category 1 and 2) pollution incidents reported within the study area in the three year period from 2007 to 2009.

Figure 5.7 Environment Agency recorded serious water pollution incidents 2007-2009



Source: Environment Agency 2010

5.6 Water resources

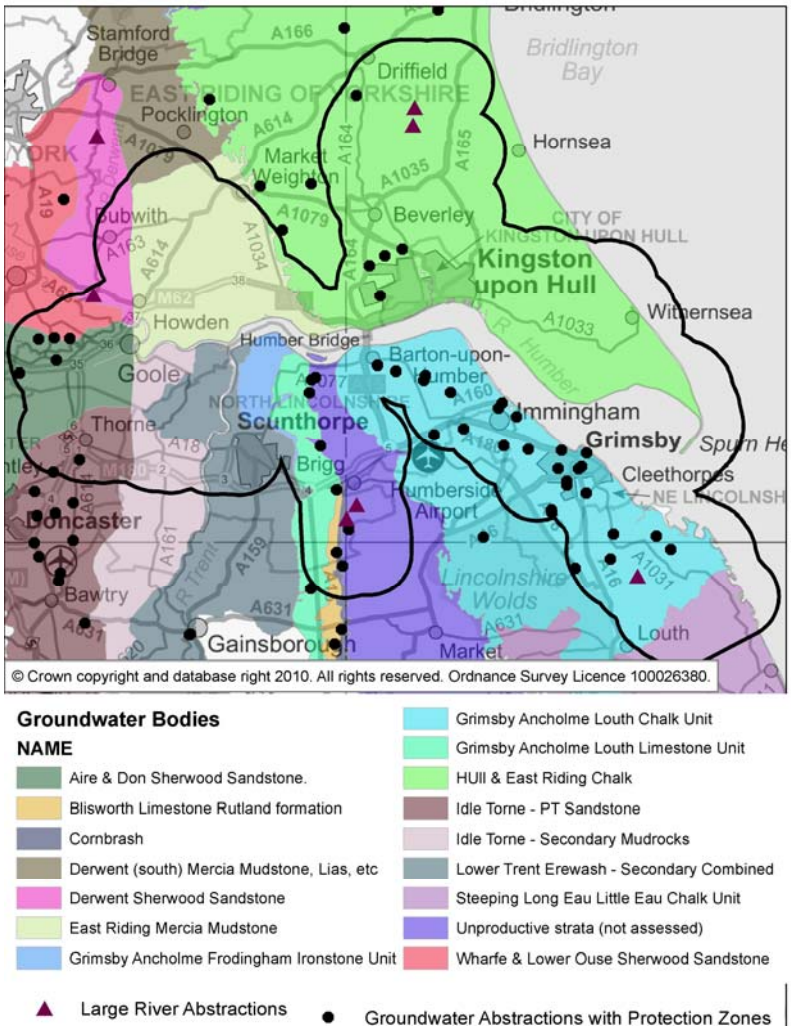
Water is required for public supply, agriculture and industry. We regulate the abstraction of surface and groundwater to ensure water resources are managed sustainably, avoiding unnecessary water use and damage to the environment.

The location of the main river abstractions and groundwater sources are shown in Figure 5.8. The river abstractions on the Ancholme provide potable water and non potable water for industries on the south bank of the Humber Abstractions on the rivers Ouse, Hull and Derwent are particularly important for potable supply on the North Bank of the Humber.

The groundwater sources shown in Figure 5.8 are both for potable water supply and for human consumption in the food and drinks industry. Groundwater source protection zones have been identified around these sources, the closer the activity the greater the risk of pollution. Appropriate pollution prevention and monitoring measures have been put in place to protect these sources.

Groundwater bodies are assessed for chemical and quantitative status as part of the Water Framework Directive. The most important groundwater bodies in the vicinity of the river Humber are the Hull and East Riding Chalk, the Grimsby Ancholme Louth Chalk and the Grimsby Ancholme Louth Limestone. The Hull and East Riding Chalk is at poor chemical and quantitative status, due to saline intrusion and poor drinking water status due to chemicals which could affect potable water supply. The Grimsby Ancholme Louth Chalk is at poor drinking water status, due to chemicals which could affect potable water supply and poor quantitative status due to resource balance (abstraction versus recharge). The Grimsby Ancholme Louth Limestone is at poor quantitative status, due to resource balance.

Figure 5.8 Groundwater Sources and River Abstractions



Source : Environment Agency 2010

The availability of water for abstraction from inland resources is also assessed as part of Catchment Abstraction Management Strategies. To the south of the Humber, a large part of the area is regarded as over abstracted, particularly the chalk aquifer and associated surface water streams [5.4] and [5.5].

Elevated nitrates is a particular concern for potable water supply. Nitrate levels are elevated in many of the groundwater sources and spring fed surface waters, due to the use of fertilisers and manures on farm land. The vast majority of the study area is designated as a Nitrate Vulnerable Zone (NVZ) and this limits the amount of nitrate that can be applied. However, the problem remains that many groundwater sources have nitrate levels higher than the drinking water standard. Water companies blend sources and, where necessary, remove nitrate by treatment in order to meet the required standard [5.6] and [5.7].

Key data sources

- Assessment of Ecological Status / Potential and Chemical Status of the Humber Estuary, rivers and groundwater within the study area: Environment Agency; updated annually
- Bathing Water Quality – Cleethorpes Beach: Environment Agency; updated annually
- Pollution Incidents: Environment Agency and Humber Scheme of Management Annual Reports; updated annually

6 Recreation and leisure relating to the natural environment

6.1 Introduction

The natural environment provides people with a range of benefits and increasing levels of physical activity has been a priority in tackling the nation's obesity and other health problems. The natural environment (the "green gym") of the Humber and its surroundings, provides many opportunities to improve physical and mental well-being, through recreation and leisure.

6.2 Survey information – interaction with the natural environment

A national opinion poll lifestyle dataset indicates the percentage of people living in the Hull and Humber Ports City Region who identified wildlife and the environment as a regular interest, at 26%, is 0.93 of the average across England as a whole. If results for individual authorities are examined, it can be seen that the proportion of respondents in East Riding and East Lindsey is well-above the national average (1.2 and 1.6 respectively). Interest within North East Lincolnshire and Hull is significantly lower (0.8 and 0.7 respectively) while that for North Lincolnshire is close to the national average.

For the specific activity of bird watching the City Region comes close to the national average with East Ridings and East Lindsey higher than average (1.25 and 1.6 respectively) and Hull well-below average (0.7).

Table 6.1 Most popular main hobbies and activities among residents (%)

Activity	E Riding	Hull	North East Lincolnshire	North Lincolnshire	East Lindsey
Wildlife/Environment	31.9	19.1	23.4	27.7	36.2
Bird watching	15.7	8.4	12.2	14.5	20.3

Data source: Acxiom socio-economic data

Of course, many people who take part in activities centered around the natural environment, come from outside the area. An indication of interest among all visitors can be gained from the results of a major visitor survey commissioned by Yorkshire Tourist Board (Welcome to Yorkshire [6.1]) that involved completion of over 10,000 face to face questionnaires between May 2009 and April 2010 by visitors at over 150 locations throughout Yorkshire and Humber (East Lindsey not included). Some of the most popular activities cannot be specified as specifically interacting with the natural environment (stroll around, short walk, long walk) but the tables below attempt to pick out those that do.

Table 6.2 Visitors' main activities (related to the natural environment)

Activity	East Riding	Hull	North East Lincolnshire	North Lincolnshire	Yorkshire and Humber
Visiting historic houses and gardens, heritage sites, etc	48%	2%	54%	3%	30%
Visiting natural attractions (e.g. coastline, countryside, National Parks etc)	39%	13%	28%	33%	24%
Driving around and sightseeing from car	20%	9%	26%	17%	19%
Wildlife watching e.g. bird watching	3%	-	46%	11%	9%
Mountain biking / cycling	0%	-	5%	2%	2%
Water sports (sailing, wind surfing, water skiing)	1%	-	-	1%	1%

Data source: Welcome to Yorkshire, Regional Visitor Survey

Visitors were also asked to identify the most enjoyable aspects of their visit. The top six aspects specified over Yorkshire and Humber overall indicate the importance of the natural environment.

Table 6.3: Visitors' "aspects most enjoyed" - Yorkshire and Humber top 6

Aspect	East Riding	Hull	North East Lincolnshire	North Lincolnshire	Yorkshire and Humber
Scenery/ countryside	19%	3%	32%	10%	27%(1st)
Museum/Galleries	1%	37%	2%	5%	16%(2nd)
Suitable for children/ families	10%	21%	33%	18%	16%(3rd)
Relaxing/ peaceful environment	24%	6%	19%	15%	15%(4th)
Friendly people/ atmosphere	16%	20%	4%	8%	15%(5th)
Walking	11%	5%	36%	24%	12%(6th)

Data source: Welcome to Yorkshire, Regional Visitor Survey

6.3 Nature reserves and centres - visitor numbers

The wildlife species that are protected and can be seen at national and other nature reserves in the area, are described in the Habitats and wildlife section. It is possible to visit most of these sites, although there are often restrictions on where people may go and sometimes the overall numbers allowed. Visitor numbers are recorded by staff at some of the sites. Data collection methods differ and, in some cases, may be estimates that are revised in future reports. However they do give an indication of how much direct recreational and leisure benefit is being gained from these reserves. Waters' Edge Country Park with its collection of ponds, reedbeds, meadows and woodland, offers bird and wildlife viewing opportunities for substantial numbers of visitors - it is therefore included. Monitoring of car and visitor numbers at Alkborough Flats commenced in 2010 – it will be included in future updates.

There is considerable inter-annual variation at some sites because of weather conditions or other events (e.g. building work) but, in summary, it would seem that after a trend over several years of increasing visitor numbers, the sites may be experiencing a levelling-off in recent years.

Table 6.4: Visitor numbers to main nature reserves around the Humber

Reserve	2001 or 2001/02	2002 or 2002/03	2003 or 2003/04	2004 or 2004/05	2005 or 2005/6	2006 or 2006/07	2007 or 2007/08	2008 or 2008/09	2009 or 2009/10	2010 or 2010/11
Spurn Head NNR [6.2] (YWT)	56490	72300	81375	75340	67165	76965	72755	70540	84480	81500 (est Oct-Dec)
Donna Nook NNR [6.3] seal site (LWT)	-	-	-	-	40995	64090	67140	61800	60310	
Humberhead Peatlands NNR [6.4] (NE)	-	-	-	20000 (E)	20000 (E)	25000 (E)	30000 (E)	31000 (E)	32000 (E)	
Blacktoft Sands [6.5] (RSPB)	18602	22086	20760	22775	20568	21036	* 18669	16859	18448	
Far Ings NNR [6.6] (LWT)	43000	48000	55000	62000	70000	71000	71000	74000	75000	
Waters Edge Country Park [6.7]						79004	116057	132949	129893	

Data sources: LWT/YWT = Lincolnshire/Yorkshire Wildlife Trust, NE = Natural England, RSPB = Royal Society for the Protection of Birds

* Blacktoft – weekend-only reception Nov-Mar started from 2007 onwards, so weekday visitors are no longer counted

6.4 Access to woodland

There is a significant body of research indicating that woods and trees are particularly beneficial to our physical and mental health. The Woodland Trust (WT) collects data on accessible woodland each year, defining "accessible" as any site that is permissively accessible to the general public for recreational purposes. This includes sites with restricted access, such as fixed hours or a fee payable, but does not include woods served only by public rights of way.

The WT has also developed two woodland access standards taking into account studies showing there are more frequent visits to woods when they are close to people's homes – 59% of woodland visits entail a round-trip distance of under eight kilometres [6.2]. It has also been shown that people wish to visit sites of at least two hectares (ha) in size with the preferred size between 11 and 40 ha., and that day visits are most likely to be made on foot at a walking distance of about 500 metres. The WT standards, which it describes as "aspirational benchmarks", are therefore that people should have access to a woodland site of at least two hectares within 500 metres and one of at least 20 ha within four kilometers. Ideally, both these standards would be met but, where it is not possible to meet the 500 metres threshold (e.g. in some urban areas), then the 4 kilometres threshold should be the minimum provided.

The WT Space for People Report [6.8] 2009 shows that local authorities in the Study Area are ranked among the lowest in the country against these standards. All fall below the England averages of 14.5% (2ha/500m) and 63% (20ha/4km).

Table 6.5: Population with access to woodland (%)

Standard	England	East Riding	Hull	North East Lincolnshire	North Lincolnshire	East Lindsey
2ha+ within 500m	14.5	2.2	3.3	5.8	6.1	3.8
20ha+ within 4km	63.0	5.1	0.0	52.6	47.9	14.0

Data source: Woodland Trust

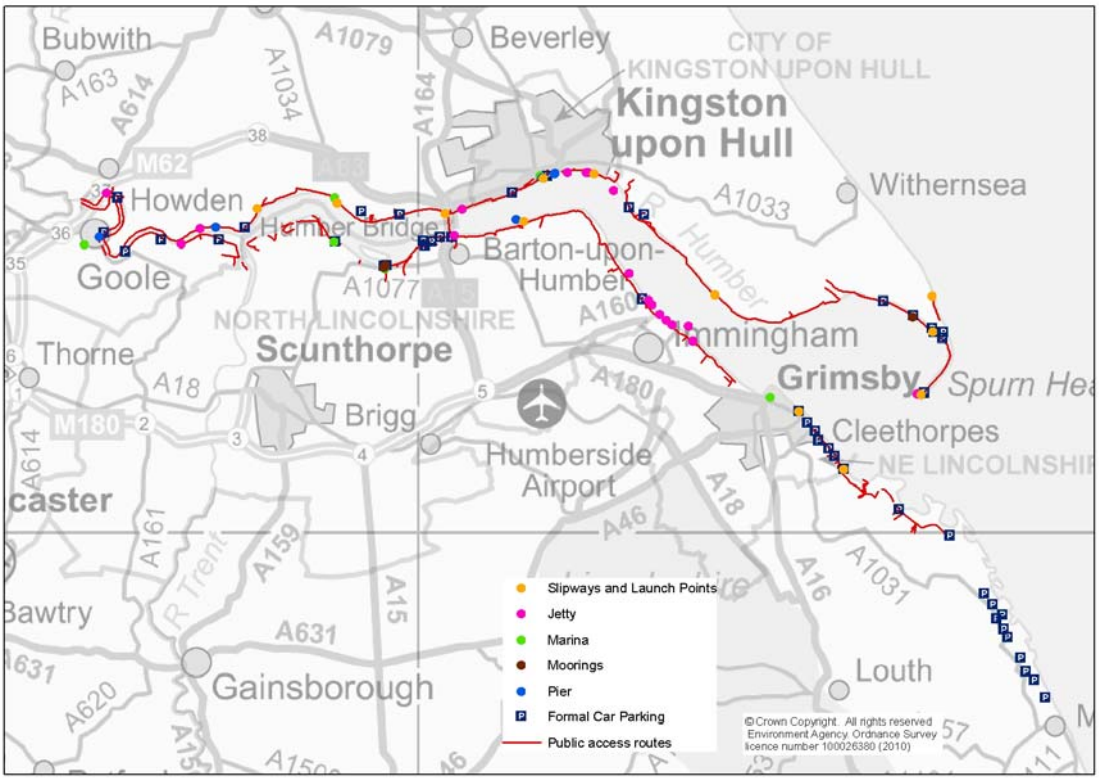
6.5 Recreational Disturbance Study

Overall, increased interaction with the natural environment and the wildlife it supports, is highly beneficial to the health and well-being of the visitors. There are often also benefits for the habitats and wildlife themselves, because contact has the potential to generate both immediate income and increased support for their future protection and enhancement.

However, visitors also bring potential for disturbance, and even damage, as their numbers increase beyond a certain limit, or if particular recreational activities are not controlled. As part of the Humber Estuary Management Scheme, a study [6.9] was commissioned in 2010 to examine the current impacts of recreation on birds in the Humber Estuary Special Protection Area. Disturbance to birds is a complex issue, not only because of the diversity of potential disturbance activities or events, but also because of the range of resulting impacts – from almost insignificant (short-term, temporary relocation to nearby feeding areas) through to severe (permanent loss of habitat and reduction in bird numbers). This complexity is particularly evident in a large estuary such as the Humber.

A report of the study describes and maps the access infrastructure and potential sources of disturbance, such as car-parks, marinas and slipways, equestrian centres, dog walking locations and flying clubs. It then considers shore-based, water-based and airborne activities, including walking, dog walking, horse riding, cycling, bird and seal watching, beach recreation, wildfowling, motorised access and recreation, angling, bait digging, motor cruising, and low altitude flying in microlights, helicopters and small planes.

Figure 6.1: Access infrastructure for recreational activities



Data source: Humber Management Scheme, 2010

It is important to be aware that the report findings on the extent and impact of recreational use mainly came from discussions with local experts and a questionnaire consultation with 17 local experts and four Wetland Bird Survey (WeBS) counters. The respondents know the estuary very well, but the small sample size and subjective nature of the data collected emphasise the need for further more standardised research into this topic.

Overall the report found that the busiest areas and the locations where disturbance to birds has been observed, are those which provide a particular attraction like Spurn Head and Donna Nook, as well as locations close to the larger settlements of Hull, Grimsby and Cleethorpes, where there are higher levels of recreation resulting from local visitor pressure. The report makes recommendations for simultaneous on-site visitor surveys and bird counts, as well as for a programme of further research, making use of visitor, bird, tide and invertebrate data.

Key data sources

- National Opinion Poll Lifestyle data (hobbies and activities): Acxiom; updated annually
- Regional Visitor Survey: Welcome to Yorkshire; updated annually
- Nature Reserve visitor numbers: collected directly from site managers; updated annually

Glossary of terms

Biomass and biofuels

Biomass is a term for any organic material derived from recently living organism, such as wood, crops and other plants, and animal wastes. Producing energy from biomass will release carbon dioxide into the atmosphere but the carbon that produces it was fixed into the physical structure of the organisms relatively recently. If those organisms regenerate or are replaced, for instance trees are replanted, then the replacements will compensate, as they grow, by capturing more carbon. When fossil fuels, such as coal and petroleum, are burned, carbon dioxide is released into the atmosphere that was captured millions of years ago.

Biofuels are fuels, liquid and gas, derived from biomass.

First generation biofuels are derived from sources like starch, sugar, animal fats and vegetable oil, and are obtained using conventional techniques of production. Some of the most popular types of first generation biofuels are: Biodiesel - very similar to the mineral diesel and able to be mixed with it in diesel engines in many countries; Bioalcohols – such as ethanol, butanol and propanol, produced by the use of enzymes and micro organisms through the process of fermentation of starches and sugar; Biogas - mainly produced by the anaerobic digestion of the organic materials; Syngas - a combustion process under conditions of very little oxygen converts organic materials into gases like carbon monoxide and hydrogen which can be used for various purposes.

One of the greatest controversies facing biofuels is that they require the use of major food crops in their production, putting stress on the agricultural sector, resulting in food shortages, or the expansion of farmlands, and consequential loss of biodiversity and environmental degradation. **Second generation biofuels** are manufactured from inedible plant matter or non-food crops as well as the waste biomass produced by the agricultural sector. This includes the left over stalks, stems and leaves from the processing of corn, sugar cane, wheat, soybeans and other food crops. For this reason, they are promoted as a more acceptable and sustainable form of biofuel which avoids the drawbacks of the first generation. Second generation biofuel technologies are not yet commercially available.

Algae fuel is a **third generation biofuel** derived from algae. Research into the use of algae as a source of fuel has shown that it can produce as much as 30 times more energy per unit growing area than land crops (corn, soybeans, wheat, etc.), although this is yet to be commercially implemented.

Ecosystem services

Ecosystem services are defined as services provided by the natural environment that provide outputs or outcomes that directly and indirectly affect human wellbeing. Some of these services are well known, including food, fibre and fuel provision, and the cultural services that provide benefits to people through recreation and appreciation of nature. Others are not so well known and their value to society is largely hidden. These include the regulation of climate, the purification of air and water, flood protection, soil formation and nutrient cycling.

In the UK, there is a real need to ensure that our ecosystems are healthy and resilient, so that the natural environment can continue to support our communities and economy. The Department of Food Environment and Rural Affairs and its partners are working towards implementing an ecosystem approach to conserving, managing and enhancing the natural environment of the UK. This will be achieved by focusing decision-making away from sector specific or habitat specific approaches and towards an integrated approach based on whole ecosystems and ensuring the value of ecosystem services is fully reflected in decisions (Defra Action Plan 2007).

Natura 2000

Natura 2000 is the European Union-wide network of protected areas, recognised as ‘sites of Community importance’ under the EC Habitats Directive (Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) - The EC Habitats Directive.

The Natura 2000 network includes two types of designated areas: Special Areas of Conservation (SAC) and Special Protection Areas (SPA). SACs are designated under the EC Habitats Directive and SPAs are classified under the EC Wild Birds Directive (Council Directive 79/409/EEC on the conservation of wild birds) - The EC Wild Birds Directive (on Europa website).

Ramsar

Ramsar sites are wetlands of international importance, designated under the Ramsar Convention. The Ramsar Convention is an international agreement signed in Ramsar, Iran, in 1971, which provides for the conservation and good use of wetlands. The UK Government ratified the Convention and designated the first Ramsar sites in 1976.

Super Output Area (SOA)

SOAs are a unit of geography used in the UK for statistical analysis. They are developed and released by Neighbourhood Statistics.
SOAs were created with the intention that they would not be subject to frequent boundary change. This makes SOAs more suitable than other geography units (such as wards) because they are less likely to change over time, and thus SOAs are more suitable to change over time analysis.
There are three layers of SOAs (i.e. three different but related geography boundaries). These are:

- Lower Layer - Minimum population 1000, mean population 1500. Commonly known as Lower Layer Super Output Area (LSOA).There are 34,378 LSOAs in England and Wales.
- Middle Layer - Minimum population 5000, mean population 7200. Built from Lower Layer SOAs. Commonly known as Middle Layer Super Output Area (MSOA). There are 7,193 MSOAs in England and Wales.
- Upper Layer - Commonly known as Upper Layer Super Output Area (USOA).

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Appendix I: Tables of values used for graphs

Figure 3.4 Humber and other East Coast sea level records (millimetres)

North Shields

1896	**1897**	**1898**	**1899**	**1900**	**1901**	**1902**	**1903**	**1904**	**1905**	**1906**	**1907**
6793	6872	6822	6822	6818	6812	6839	6902			6779	6795
1908	**1909**	**1910**	**1911**	**1912**	**1913**	**1914**	**1915**	**1916**	**1917**	**1918**	**1919**
6799	6834	6850	6912	6893	6878	6914	6816	6860	6810	6827	6814
1920	**1921**	**1922**	**1923**	**1924**	**1925**	**1926**	**1927**	**1928**	**1929**	**1930**	**1931**
6810	6835	6820	6784	6849	6882	6883	6916	6864	6854	6857	6910
1932	**1933**	**1934**	**1935**	**1936**	**1937**	**1938**	**1939**	**1940**	**1941**	**1942**	**1943**
6883	6858	6860	6898	6950	6916	6924	6896	6878	6863	6878	6911
1944	**1945**	**1946**	**1947**	**1948**	**1949**	**1950**	**1951**	**1952**	**1953**	**1954**	**1955**
6895	6920	6945	6928	6965	6957	6952	6910	6896	6918	6884	6943
1956	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**
6913	6942	6954	6931	6970	6990	6941	6934	6925	6915	7034	7007
1968	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
6980	6985	6955	6966	6941	6977	6940					
1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
	6987	6993		6934	6958	6966	6971	6999	7005	7011	6935
1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
6972		6999	6984	6952	6987		7013	7008	7019	7044	7045
2004	**2005**	**2006**	**2007**	**2008**	**2009**						
7058	7043	7051	7036	7037	7007						

Lowestoft

1956	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**
6949		6982		6989	7023	6997	6956	6971	7003		7014
1968	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
6999	7047	7017	6990	6955	6994	6985	6978	6958	6971	6979	6901
1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
6991	7029	7010	7045	6997		7013	7036	7066	7065	7057	6991
1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
7031	7047	7055	7064	6989	7047	7076	7084	7061	7097	7085	7108
2004	**2005**	**2006**	**2007**	**2008**	**2009**						
7104	7093	7095	7127	7096	7091						

Immingham

1956	**1957**	**1958**	**1959**	**1960**	**1961**	**1962**	**1963**	**1964**	**1965**	**1966**	**1967**
				7005	7031		6998	7007	7026	7111	7049
1968	**1969**	**1970**	**1971**	**1972**	**1973**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**
7056	7061	7042	7039	7008	7014	7011	7022	7002	7041	7016	7030
1980	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**
7087	7096	7104	7095	7015	7051		7064	7062	7097	7091	7018
1992	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**
7035	7037	7058	7074		7065	7093	7084	7063	6979	6979	7030
2004	**2005**	**2006**	**2007**	**2008**	**2009**						
7044	7061	7097	7106	7089							

Data source: Proudman Oceanographic Laboratory (POL,NERC), Permanent Service for mean sea level
Note: Immingham levels are currently being checked by POL for possible measurement errors resulting from variable fresh and saline water effects. They may be revised in future

Figure 4.3 Total number of wintering waterbirds found at principal East Coast sites, 2002/03 to 2008/09

Site	2002/03	2003/04	2004/05	2005/06	2006/07	2007/08	2008/09
The Wash	343,608	338,499	369,627	398,373	380,003	372,405	344,411
North Norfolk Coast	212,440	215,912	221,337	241,410	215,396	142,870	206,843
Thames Estuary	197,462	160,189	172,491	186,385	226,127	186,982	149,746
Humber Estuary	174,930	217,805	163,357	187,065	167,461	145,783	125,257

Data Source : Wetland Bird Survey (WeBS)

Figure 4.4 Humber SPA medium term percentage changes in numbers of wintering waterbirds 1997/98 to 2007/08

Species	% change
Pochard	-72
Ringed Plover	-35
Dunlin	-33
Sanderling	-29
Lapwing	-27
Wigeon	-21
Oystercatcher	-21
Redshank	-21
Goldeneye	-18
Mallard	-13
Bar-tailed Godwit	-5
Cormorant	4
Grey Plover	6
Shelduck	8
Dark Bellied Brent Goose	20
Knot	28
Golden Plover	31
Curlew	53
Teal	69
Black-tailed Godwit	224

Data Source : Wetland Bird Survey (WeBS)

Figure 4.6 Alkborough Winter 2009/10 bird counts as a percentage of the upper estuary 5 year mean

Species	% of 5 year mean
Avocet	1.9
Dunlin	2.2
Redshank	2.3
Mallard	5.0
Curlew	5.8
Black - Tailed Godwit	6.8
Shelduck	11.9
Wigeon	17.1
Golden Plover	19.3
Lapwing	29.3
Teal	48.3
Graylag Goose	89.1
Ruff	90.0

Data Source: Alkborough Flats Partnership and Nyctea Ltd

Figure 4.8 Annual Grey Seal pup production recorded at Donna Nook 1988-2009

1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998
54	94	152	223	200	205	302	334	310	382	439
1999	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
503	618	634	709	792	998	995	1070	1070	1194	1371

Data Source: Sea Mammal Research Unit (SMRU) 2010

Figure 4.9 River Ouse declared salmon rod catch 1921-2009

1921	1922	1923	1924	1925	1926	1927	1928	1929	1930	1931	1932
364	783	326	435	502	269	1275	1872	642	849	823	2946
1933	**1934**	**1935**	**1936**	**1937**	**1938**	**1939**	**1940**	**1941**	**1942**	**1943**	**1944**
1058	852	1051	3873	2244	614	881	349	47	198	127	60
1945	**1946**	**1947**	**1948**	**1949**	**1950-91**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
22	6	35	33	2	0	3	1	0	3	5	2
1998	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**
1	2	0	0	2	8	6	16	22	18	10	20

Data Source : Environment Agency 2010
Note: The salmon rod catch declared in all years from 1950 to 1991 was zero.

Figure 5.5 Humber Estuary – loads of selected heavy metals from industrial wastewater compared to 1998 baseline (set to 100)

Determinand	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Copper	100.0	52.9	37.0	22.0	8.8	22.0	16.8	9.9	12.1	19.0	10.4	7.7
Lead	100.0	90.8	38.4	15.2	9.4	45.2	20.1	17.8	17.0	25.3	18.5	8.0
Nickel	100.0	114.5	68.6	36.8	40.9	51.0	43.4	28.3	27.8	27.9	32.3	30.7
Zinc	100.0	89.9	91.0	12.2	12.1	16.4	11.0	15.1	12.7	5.9	5.8	4.5

Source: Environment Agency 2008

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