**LINCOLNSHIRE WILDLIFE TRUST**

**WRITTEN REPRESENTATION**

**UNIQUE REFERENCE NUMBER: 10015513**

**In respect of**

# APPLICATION BY ABLE HUMBER PORTS LTD FOR THE PROPOSED ABLE MARINE ENERGY PARK ON THE SOUTH BANK OF THE RIVER HUMBER AT IMMINGHAM NORTH LINCOLNSHIRE

**PLANNING INSPECTORATE REFERENCE NUMBER: TF030001**

**June 2012**

## 1. INTRODUCTION

1.1 The Lincolnshire Wildlife Trust (LWT) is the historic county of Lincolnshire's major voluntary organisation concerned with all aspects of nature conservation. With more than 25,000 members, 1,250 active volunteers and its management of 98 nature reserves throughout the historic county, covering more than 3,300 hectares of terrestrial, fresh water and inter-tidal habitat, LWT provides a voice for wildlife from the Humber to the Wash. The mission of the Lincolnshire Wildlife Trust is to safeguard wildlife in Lincolnshire and in the neighbouring sea and estuaries.

1.2 This is a Written Representation produced by the Lincolnshire Wildlife Trust (unique reference number 10015513) in relation to the application by Able Humber Ports Ltd for the Able Marine Energy Park on the south bank of the River Humber at Immingham in North Lincolnshire (Planning Inspectorate reference number TF030001).

1.3 LWT registered an objection to this application in its Relevant Representation submitted to the Planning Inspectorate in March 2012 on the grounds of adverse impacts of the proposed development on internationally, nationally and locally important habitats and species.

## 2. IMPACTS OF THE DEVELOPMENT

### 2.1 Internationally and Nationally Important Habitats

2.1.1 The proposed location for the Marine Energy Park is within and adjacent to the Humber Estuary. The Humber Estuary is internationally important for wildlife, supporting a rich variety of habitats and species. As a result of its importance for wildlife the Humber Estuary is designated as a Special Area of Conservation (SAC), a Special Protection Area (SPA), an internationally important wetland under the Ramsar Convention (Ramsar Site) and a Site of Special Scientific Interest (SSSI).

2.1.2 Given the designations afforded to the Humber Estuary the application must be assessed to determine whether it complies with the Conservation of Habitats and Species Regulations 2010 (the Habitats Regulations) to ensure that there would be no adverse effect on the integrity of the European sites (SAC and SPA). The application must also be assessed for compliance with the Wildlife and Countryside Act 1981 (as amended) to ensure that there would be no adverse impacts on any features of interest of the SSSI.

2.1.3 If the Examining Authority determines that the development is of Imperative Reasons of Over-riding Public Interest (IROPI) and grants consent then compensation measures will be required to maintain the integrity of the European sites. Given that the arguments in favour of IROPI relate to the manufacture of components for the offshore renewable energy sector the Examining Authority must ensure that adequate provisions are made to ensure the area could not be used for purposes that are not of IROPI.

2.1.4 The Lincolnshire Wildlife Trust has serious concerns regarding the impact of the proposed development on the Humber Estuary SAC, SPA, Ramsar Site and SSSI.

Of particular concern is the loss of 45 ha of designated estuarine habitat. This includes 31 ha of the Killingholme Marshes intertidal mudflat habitat (paragraph 6.2.1, Environmental Resources Management Limited, 2011 (Document reference: TR030001/APP/15)). Killingholme Marshes is of particular importance to wintering and migrating SPA wading bird species, such as black-tailed godwit, dunlin and redshank, which have been recorded in numbers greater than 1% of their Humber SPA qualifying populations. 66% of the SPA population of black-tailed godwit has been recorded here (paragraph 6.3.30, Environmental Resources Management Limited, 2011 (Document reference: TR030001/APP/15)).

2.1.5 Killingholme Marshes foreshore is recognised in the Habitats Regulations Assessment Report as one of the most important areas for black-tailed godwits on the Humber Estuary. The development would result in the loss of the majority of this important feeding area, resulting in a significant displacement of black-tailed godwits with no certainty that the birds can be accommodated elsewhere. This could result in the favourable conservation status of this species not being maintained and an adverse effect on the integrity of the European sites (paragraphs 6.3.37 and 6.3.39, Environmental Resources Management Limited, 2011 (Document reference: TR030001/APP/15)).

2.1.6 In addition to direct habitat losses there will also be disturbance to birds using the remaining intertidal habitat from noise, light and visible activity. The actual loss of functional estuarine habitat for SPA birds will therefore be larger than that directly lost to the footprint of the new quay. This will require further assessment. Natural England has advised in paragraph 2.3 of its Relevant Representation that 'there has not been proper consideration of construction and operational disturbance arising from the project on designated site birds utilising the remaining SSSI, SPA and Ramsar intertidal habitat and North Killingholme Haven Pits.'

2.1.7 The proximity of the proposed development to North Killingholme Haven Pits SSSI is also of serious concern to LWT. These large saline lagoons, which are managed as a nature reserve by LWT, support significant populations of SPA species such as black-tailed godwit, dunlin and redshank, with breeding avocet and marsh harrier. North Killingholme Haven Pits is an extremely important roost site for black-tailed godwit on the Humber Estuary. 98% of the SPA population of black-tailed godwit has been recorded roosting at Killingholme Haven Pits (Paragraph 6.3.34, Environmental Resources Management Limited, 2011 (Document reference: TR030001/APP/15)).

2.1.8 North Killingholme Haven Pits SSSI is already surrounded on three sides by development: the proposed quay will increase isolation from the estuary. This, compounded by the loss of a large proportion of the adjacent Killingholme Marshes mudflat which is used for feeding by SPA species, may mean that bird species such as black-tailed godwit stop using Killingholme Haven Pits as a roost site at high tide. We are very concerned that this could significantly impact on the Humber Estuary black-tailed godwit population. The Habitats Regulations Assessment Report states that 'the number of birds which are likely to be lost from North Killingholme Haven Pits is such that the Humber Estuary population would be significantly reduced' (Paragraph 6.3.38, Environmental Resources Management Limited, 2011 (Document reference: TR030001/APP/15)).

2.1.9 We are concerned that there will be disturbance to breeding, wintering and migrating birds using Killingholme Haven Pits from additional noise, light and visible activity. As mentioned in 2.1.6, Natural England has advised that there has not been proper consideration of disturbance on designated site birds using North Killingholme Haven Pits. Natural England therefore goes on to advise in paragraph 2.3 of its Relevant Representation that 'an assessment of terrestrial construction works on the adjacent North Killingholme Haven Pits should be undertaken.' The Lincolnshire Wildlife Trust agrees that such an assessment should be carried out.

2.1.10 In addition to impacts on birds we have concerns regarding impacts on other SSSI interest features such as the specialist saline lagoonal species that occur at the site. The SSSI citation states that nine species of specialist lagoonal species have been recorded in the pits and include the polychaete worm *Alkmaria romijni*, which is known from just four sites in Great Britain. As suggested by Natural England in paragraph 2.12 of its Relevant Representation, impacts on the saline lagoon specialist species could result through entrainment of the thermal plume or increased sedimentation within North Killingholme Haven Pits. These and other potential impacts on the features of interest of North Killingholme Haven Pits SSSI and the Humber Estuary SSSI will need to be assessed by the Examining Authority under Section 28I of the Wildlife and Countryside Act 1981 (as amended) as advised by Natural England in paragraph 2.12 of its Relevant Representation.

2.1.11 In addition to the loss of estuarine habitats, the development would also result in the loss of farmland habitat, some of which is used by SPA bird species for roosting and feeding at high tide. We note that curlew are present in notable numbers on the farmland habitat to be developed. We therefore welcome the proposed Mitigation Area A to provide feeding and roosting habitat for curlew and other SPA wader species. Further comments are made on the proposed mitigation in Section 3 below.

2.1.12 The farmland habitat at the compensation site at Cherry Cobb Sands will also be lost when the site is flooded. This terrestrial habitat is also utilised as a high tide roost by SPA birds including curlew in notable numbers. We understand from paragraph 2.11 of Natural England's Relevant Representation that the applicant has provided an additional report to assess the loss of this habitat. The Examining Authority must be satisfied that sufficient mitigation is proposed to ensure that there is suitable alternative habitat to provide feeding and roosting habitat for SPA birds.

## 2.2 **Locally Important Habitats**

2.2.1 LWT is concerned over the proposed loss of Station Road Field Local Wildlife Site (LWS). This site was assessed against the Lincolnshire Local Wildlife Site Guidelines (Lincolnshire Biodiversity Partnership 2008) and selected by the Lincolnshire Biodiversity Partnership Steering Group on 9 December 2008 as a Local Wildlife Site for its mosaic of habitats, in particular neutral grassland habitat (Lincolnshire Biodiversity Partnership 2012). Neutral grassland is a priority habitat in the UK Biodiversity Action Plan and the Lincolnshire Biodiversity Action Plan: it is estimated that only 724ha remains in the historic county (Lincolnshire Biodiversity Partnership 2011).

2.2.2 Section 41(3)(a) of the Natural Environment and Rural Communities (NERC) Act 2006 requires the Secretary of State to 'take such steps as appear to the Secretary of State to be reasonably practicable to further the conservation of the living organisms and types of habitat included in any list published under this section'. The NERC Act 2006 Section 41 list – Habitats and Species of Principal Importance in England, includes lowland meadows and therefore encompasses neutral grassland.

2.2.3 Policy LC4 of the North Lincolnshire Local Plan refers to the protection of Sites of Importance for Nature Conservation (SINC). Policy LC4 states that 'any development which is likely to have an adverse impact on a Site of Importance for Nature Conservation will not be approved unless it can be clearly demonstrated that there are reasons for the proposal which outweigh the need to safeguard the intrinsic nature conservation value of the site'. SINC is the name previously given to LWSs. Policy LC4 should therefore be taken into account in relation to impacts on Station Road Field LWS.

2.2.4 Policy CS17 of the North Lincolnshire Council Core Strategy relates to biodiversity and refers to maintaining a network of local wildlife sites, ensuring development retains, protects and enhances features of biological interest, and ensuring development seeks to produce a net gain in biodiversity by designing in wildlife and ensuring any unavoidable impacts are appropriately mitigated for.

2.2.5 Should this development be consented, the loss of this site must be suitably compensated for in line with the NERC Act 2006 and North Lincolnshire Council Core Strategy Policy CS17. Comments on the proposed compensation are made in Section 4 below.

## 3. MITIGATION

3.1 The applicants are proposing to manage an area of wet grassland in Mitigation Area A (47.8 hectares) to mitigate for the loss of habitat of value for feeding, roosting and loafing estuarine birds. LWT is satisfied that this proposed mitigation appears to fit in with the South Humber Gateway mitigation principles drafted by the South Humber Bank Ecology Group. We note that it is Natural England's advice 'that the proposed wet grassland mitigation (Area A – 16.7ha core area surrounded by 150m buffers) is adequate to mitigate for the loss of waterbird feeding and roosting habitat lost from Killingholme Marshes' (paragraph 1.16.1, Natural England Relevant Representation).

## 4. COMPENSATION

4.1 To compensate for the loss of intertidal mudflat, saltmarsh and subtidal estuary habitats the applicants are proposing a 100ha managed realignment site at Cherry Cobb Sands on the north bank of the Humber Estuary. The compensation package also includes the creation of a temporary wet grassland habitat at Old Little Humber Farm to the north of the managed realignment site to provide a feeding area for SPA birds whilst the managed realignment site develops benthic invertebrates.

4.2 LWT considers that the loss of estuarine habitat is likely to damage the integrity of the Natura 2000 site and is not yet convinced that the proposed compensation would deliver the habitat types in the ratios to compensate for those lost, and also the functionality to provide a feeding resource needed by SPA birds such as black-tailed godwit.

4.3 We understand that further modelling work is being undertaken by the applicant to predict ground levels and hence mudflat development within the managed realignment site for the first 10 years (paragraph 2.10, Natural England Relevant Representation). This information will be required up front to assess the likely effectiveness of the proposed compensation site. The compensation site must deliver areas of mudflat and saltmarsh to sufficiently compensate for the areas of these habitats to be lost as a result of the development. The European Commission has produced guidance on the implementation of the Birds and Habitats Directives in estuaries and coastal zones. This guidance states that compensation measures 'should accomplish the ecological functions necessary to support the affected species and habitats' (paragraph 3.3.4, European Commission 2011).

4.4 LWT is particularly concerned regarding the provision of mudflat at the compensation site and its maintenance in the long term. The development will result in the loss of mudflat used by significant numbers of SPA birds, in particular black-tailed godwit which feed at this location in high densities and in numbers of international importance. Existing managed realignment sites are showing a trend towards progression to saltmarsh habitat. Paull Holmes Strays managed realignment is a case in point where it was initially anticipated that the site would ultimately create approximately 45 ha of mudflat and 35 ha of saltmarsh. However, monitoring at the site indicates that the majority of the site will become saltmarsh (Environment Agency 2009).

4.5 Whilst saltmarsh is a valuable habitat in its own right, if the compensation site was to develop mostly into saltmarsh it would not be providing the compensatory mudflat habitat required or the functionality to provide a feeding resource for SPA birds. We note that Natural England has some residual concerns regarding the predictions for the managed realignment site and that the compensation habitat provided may not protect the coherence of the Natura 2000 network (paragraphs 1.16.2 and 1.18.1, Natural England Relevant Representation).

4.6 To demonstrate its ability to function, the compensation site should be delivered before development begins at Killingholme Marshes. This is supported by European Commission guidance, referred to above in 4.3, which states 'The compensation scheme should be 'effective' at the time the negative effects occur on the site concerned' (paragraph 3.3.4, European Commission 2011). As there are uncertainties over the ability of the compensation site to deliver the required habitats in the quantity and quality required effective monitoring must be carried out.

4.7 If the results of monitoring show that the compensation site is not delivering the habitats as required in form or function, and therefore not providing a feeding resource for SPA birds, in particular black-tailed godwits, then remedial action would be necessary to ensure that the managed realignment site meets its objectives. A contingency plan accompanied by a guarantee that resources will be available for implementation, should therefore be a condition of any approval to

ensure adequate compensation is delivered in the event that the compensation proposed is inadequate. The European Commission guidance referred to above states 'In case of any remaining scientific uncertainty with regard to the effects of mitigation or compensatory measures, the measures must include a pre-defined and validated scheme to monitor the actual impacts and a framework, such as a Natura 2000 management plan, integral plan or a programme of measures, to adapt mitigation and compensation measures to the actual impacts' (paragraph 3.4, European Commission 2011).

4.8 Given the importance of North Killingholme Haven Pits SSSI as a roost site for black-tailed godwit, we have concerns that the proposed compensation package includes compensatory mudflat habitat on the north bank for feeding without any provision for the birds to roost at high tide. Whilst there is the chance that black-tailed godwits may feed on the north bank and fly back across to North Killingholme Haven Pits to roost, this is not certain. The applicant must demonstrate to the Examining Authority that there would be sufficient roosting habitat on the north bank for black-tailed godwits in the event that they no longer use North Killingholme Haven Pits.

4.9 LWT understands that Natural England is working with the applicant and the Humber Industry and Nature Conservation Association to develop three Ecological Management and Monitoring Plans (EMMPs) for terrestrial, marine and the compensation site. LWT welcomes the development of these EMMPs and agrees with Natural England that 'These plans need to be worked-up to a sufficient level of detail to give a sufficient degree of confidence as to the adequacy and efficacy of the proposed measures, and be secured by requirements on the DCO, before consent is granted' (paragraph 3.1, Natural England Relevant Representation).

4.10 We note and support Natural England's advice that 'the wet grassland habitat at Old Little Humber Farm would be required in order to support the compensation package provided in accordance with the Habitats Regulations. Management measures and monitoring requirements for the wet grassland should therefore be included in the Compensation Site Ecological Management and Monitoring Plan. This should be required until it is demonstrated through monitoring and reporting that the managed realignment compensation site at Cherry Cobb Sands is meeting its compensation objectives and that the Old Little Humber Farm site is no longer required' (paragraph 3.1.2, Natural England Relevant Representation).

4.11 To compensate for the loss of Station Road Field Local Wildlife Site, paragraph 11.7.36 in Chapter 11 of the Environmental Statement explains that within Mitigation Area A an area of equal size (at least 1.7ha) would be managed to provide neutral grassland of similar quality and function of that to be lost. This proposal requires further examination as this area should be managed as wet grassland to provide feeding and roosting habitat for birds such as curlew. LWT considers that an area of species rich neutral grassland at least double that to be lost should be created and managed without compromising the functioning of Mitigation Area A for SPA birds. We would agree with Natural England that 'Additional details should be included in the Terrestrial Ecological Management and Monitoring Plan to provide sufficient confidence that adequate and effective mitigation can be provided and maintained in the long-term at Mitigation Area A for

all its various objectives' (paragraph 3.8, Natural England Relevant Representation).

## 5. CONCLUSION

5.1 Based on the information submitted, LWT is not satisfied that the mitigation and compensation measures proposed are sufficient to fully mitigate and compensate for the adverse impacts that would be caused to international, national and locally important habitats and species. Granting of consent in this case would be contrary to the Conservation of Habitats and Species Regulations 2010 and the Wildlife and Countryside Act 1981 (as amended).

5.2 It is for these reasons that the Lincolnshire Wildlife Trust objects to the proposed Able Marine Energy Park and contends that the development should not be granted consent.

## 6. REFERENCES


Environment Agency, 2009, *Paull Holme Strays Environmental monitoring report, Part of the Humber Estuary Flood Defence Strategy.*

Environmental Resources Management Limited, 2011, *Able Marine Energy Park: Habitats Regulations Assessment Information*. (Document reference: TR030001/APP/15)

European Commission, 2011, *The implementation of the Birds and Habitats Directives in estuaries and coastal zones with particular attention to port development and dredging.*

Lincolnshire Biodiversity Partnership, 2008, *Local Wildlife Sites - Guidelines for their Identification & Selection in the Historic County of Lincolnshire (Lincolnshire, North Lincolnshire & North East Lincolnshire)*. (Available to download from www.lincsbiodiversity.org.uk)

Lincolnshire Biodiversity Partnership, 2011, *Lincolnshire Biodiversity Action Plan 2011-2020, 3nd Edition*. (Available to download from www.lincsbiodiversity.org.uk)

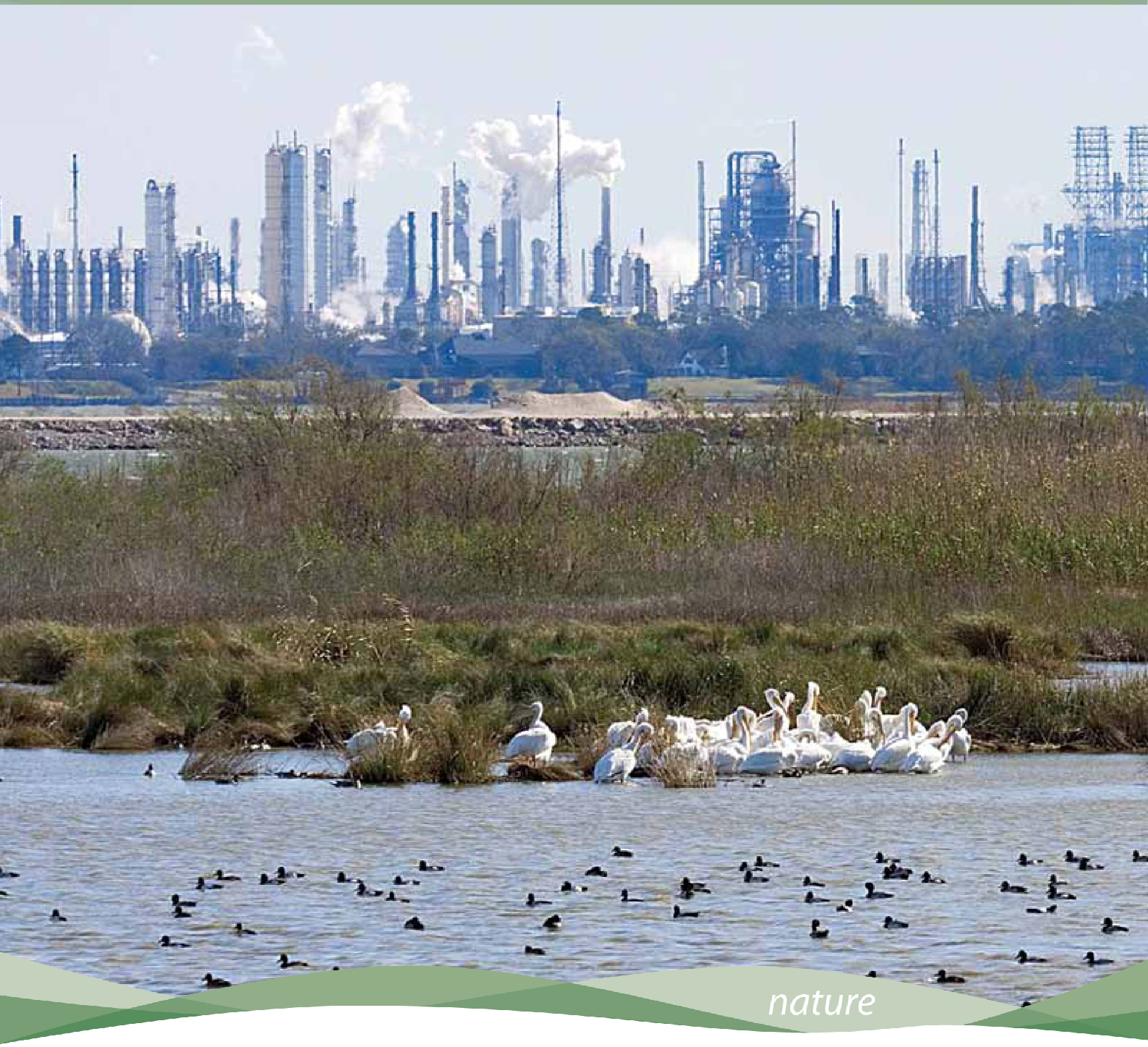
Lincolnshire Biodiversity Partnership, 2012, *Station Road Field LWS Citation.*

NATURA 2000

# GUIDANCE DOCUMENT

# The implementation of the Birds and Habitats Directives in estuaries and coastal zones

with particular attention to port development and dredging



nature

EUROPEAN COMMISSION

environment

# GUIDELINES ON THE IMPLEMENTATION OF THE BIRDS AND HABITATS DIRECTIVES IN ESTUARIES AND COASTAL ZONES

with particular attention to port development and dredging

*This document reflects the view of the Commission services and is not of a binding nature.*

*European Commission, January 2011*


Photo: istockphoto

It has greatly benefitted from discussions with and information supplied by experts from Member States and key stakeholder groups, within the framework of the EC Estuaries and Ports Working Group.

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# EXECUTIVE SUMMARY

This document provides sector specific guidance on the implementation of the Birds and Habitats Directives in estuaries and coastal zones. The guidance has benefitted from discussions held in the context of a specific working group with representatives from Member States, stakeholder organisations and environmental NGOs.

Its development followed a request of the ports and maritime services sector. Ports, especially in Western Europe, are often situated in or near estuaries. These are dynamic and highly productive ecosystems and in many cases designated Natura 2000 sites. Estuaries provide the necessary shelter and suitable conditions for maritime access to ports.

Ports fulfil a strategic role in the development and realisation of global trade and they periodically need to expand. Previously not subject to many environmental requirements, the application and interpretation of environmental legislation, including the EU nature directives, has presented new challenges to the sector which, in recent years, has sometimes resulted in delays in port development projects.

Ports play an essential role in economic development and seek legal certainty as a prerequisite for new development projects. The European Port's policy, as formulated by the European Commission, has recommended reviewing legal constraints that may hinder development projects ('fast track procedure'). The present guidance document provides a number of recommendations and elements of good practice to enhance port development and management in or near Natura 2000 sites.

Some key recommendations are:

- The design of plans or projects should always be based on mutually beneficial strategies with a view to achieving dual goals of both Natura 2000 conservation objectives and socio-economic objectives, according to the 'working with nature' concept.
- Damage prevention or avoidance measures should always be preferred to compensation measures.
- Pre-assessments to evaluate the potential for impact of a plan or project on Natura 2000 sites should always be foreseen. This is necessary in order to decide whether a plan or project is likely to have significant effects on a Natura 2000 site and whether an 'appropriate assessment' in the sense of Article 6(3) of the Habitats Directive is required.
- Thorough and timely stakeholder consultation is always recommended in order to prevent the raising of objections during the project permitting process.
- Maintenance of ports and navigational access should be dealt with in the context of integrated management plans for the entire waterway or the affected Natura 2000 site. Capital dredging operations should be designed as a part of sustainable dredging and sediment management schemes.
- In case of any remaining minor scientific uncertainty with regard to the effects of a plan or project or the related mitigation or compensatory measures, the measures should include a pre-defined and validated scheme to monitor the actual impacts and a framework to adapt the mitigation and compensation measures to the actual impacts.

## Introduction

Estuaries and coastal zones are among the most productive ecosystems in the world, with both high ecological and economic values. They are of prime importance for wildlife, especially migrating and breeding birds and of major value in terms of their rich natural resources (e.g. as nursery grounds for commercially important fish). In addition, they also offer a wide variety of ecosystem services such as shoreline stabilization, nutrient regulation, carbon sequestration, detoxification of polluted waters and supply of food and energy resources (Millennium Ecosystem Assessment, 2005).

As a result they provide a wide range of economic benefits to many sectors, including fishermen, industrial complexes and amenity services such as tourism and recreation. Estuaries are also often ideal locations for ports, harbours and shipyards as they provide the necessary shelter for ships as well as access further inland along major rivers.

Estuaries and coastal zones are however also amongst the most dynamic and complex ecosystems in the world. They are made up of a wide range of different habitats, which exist in an ever-changing mosaic structure. Typical habitats that make up an estuary include sand banks, mudflats and sand flats, salt marshes and at their coastal edge sand dunes, coastal lagoons, shallow inlets and bays, reefs, islets and small islands, sandy beaches, sea cliffs.

Most of these habitat types are protected under Directive 92/43/EEC on the conservation of natural habitats and wild flora and fauna (commonly referred to as 'the Habitats Directive'). Shorebirds are dependent on estuaries and coastal zones during their migrations from breeding to wintering grounds. Furthermore, numerous bird species breed in estuarine and coastal habitats. As a result, many estuaries and coastal areas are also protected under Directive 2009/147/EC on the conservation of birds (commonly referred to as 'the Birds Directive').

Over a long history and even more so today, many of Europe’s ports are logistic hubs handling cargo from all over the world. The importance and demand for maritime transport has increased significantly in the last 30 years and is likely to continue to do so in the future. The European Commission supports this transport network through its ports policy, and through the promotion of the “Motorways of the Sea” and Short Sea Shipping.

As stated in the Communication on a European Ports Policy[1], more than 1 200 merchant ports cover some 100 000 km of European coasts. They are key points of modal transfer and are of vital interest to handle 90% of Europe's international trade. In support of the EU’s general transport policy[2], they handle 40% of the volume of tonne-kilometres carried out in intra-Community trade. The European Commission has recognized this fact through its Communication on ‘An Integrated Maritime Policy for the European Union’ which states that seaports and shipping allow Europe to benefit from the rapid growth in international trade and to play a leading role in the global economy[3].

Maritime ports, especially those connected with or situated far inland in estuaries connected with navigable inland waterways and railways, can also play a significant role in reducing $CO_2$ emissions, but will also have to face the effects of climate change.

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[1] COM(2007) 616
[2] COM(2006) 314.
[3] (EC, 2007)

Inevitably there will be occasions where port and fairway developments and maintenance and Natura 2000 designation overlap and at times fail to coincide. The Habitats and Birds Directives do not, a priori, preclude the possibilities for further development and use of estuaries and coastal zones within or around Natura 2000 sites. Instead they lay down stepwise procedures to ensure that any such developments are done in a way that is compatible with the protection of species and habitats of European importance for which the sites have been designated. In the case of projects of overriding public interest, and in the absence of alternative solutions, the Directive provides a mechanism that can allow damaging developments, provided that compensation and adaptation ensures that the overall coherence of the Natura 2000 Network is not compromised.

The pressure on coastal zones and estuaries has encouraged a shift towards more integrated and efficient spatial planning. This, combined with early stakeholder dialogue, has proven over the years to be an effective way to promote sustainable development in line with the EU environmental legislation (including for nature protection, water and the marine environment), the European port policy and the European Integrated Maritime Policy.

**Purpose of this document**

The European Commission has already published several guidance documents to support Member States in implementing the Birds and Habitats directives in the protection of Natura 2000 (see annex 1); this guidance also helps citizens and stakeholders in better understanding key provisions of the Directives. However, there is a need for further clarifications, explanations and even prospective views on the application of the EU nature legislation to port development and the management of estuaries and coastal zones, especially in light of their importance as access-routes for seagoing ships.

The aim of the present guidance document is to explain the protection regime, defined under Article 6 of the Habitats Directive that applies to Natura 2000 sites in the specific context of estuaries and coastal zones. The primary focus is on clarifying, explaining and elaborating on the implementation of EU nature legislation for Natura 2000 sites located in estuaries and overlapping with, fairway channels and coastal zones, with particular attention to port-related activities, including dredging and industry (e.g. shipyards).

Other environmental legislation such as the Water Framework Directive (200/60/EC), the Marine Strategy Framework Directive (2008/56), the directive 2001/42/EC on strategic environmental assessments (SEA) or the directive 85/337/EEC on environmental impact assessments are beyond the scope of this document and therefore not addressed in detail in this document. Aspects related to urbanisation, agriculture or other developments in the same areas or related to pressures resulting from inland waterborne transport are not considered in this work, but these activities will also need to be considered in management plans for estuarine Natura 2000 sites and in integrated coastal zone management as well as when assessing cumulative effects of different activities.

The present guidelines have benefited from discussions within a specific working group on estuaries, coastal zones and ports established by the European Commission (DG ENV and DG TREN). This group included stakeholders from different sectors and met six times during 2007-2009. In addition to the guidelines, a supporting technical document with technical and scientific background information has been prepared.

The Technical Supporting Document includes general information on the study approach, the literature used and the results of the exchange of information between the Working Group and the consultancy firm that was in charge of the overall coordination. The Technical Supporting Document can be downloaded from the public Circa Platform: http://circa.europa.eu/Public/irc/env/estuary/home.

The present guidelines are intended to be faithful to the text of the relevant Directives and the wider principles underpinning EU law on the environment and port-related activities. They are not legislative in character, they do not provide any new rules but give further clarification, building on existing guidelines. The guidelines reflect the views of the Commission services on the implementation of the directives in estuaries and coastal zones.

They are not of a binding nature. It should be stressed that any interpretation of EU legislation rests exclusively with the EU Court of Justice. The guidelines are intended to respect the existing case law and may need to be adapted in light of any emerging new jurisprudence of the Court.

The present guidelines have the ambition to reconcile the needs for port development and for environmental protection. The target audiences and users of these guidelines are local, regional and national or federal competent authorities, port and waterway authorities, operators, industries, dredging companies and associations, maritime service industry, Environmental NGOs, Conservation agencies and Natura2000 site managers.

# 1. POLICY BACKGROUND

## 1.1. Estuaries, coastal zones and the EU Nature legislation,

In response to the rapid global decline in biodiversity, the European Union has set itself the goal, at the European Summit in Gothenburg in 2001, "to halt the decline of biodiversity in the EU by 2010"[4] and to "restore habitats and natural systems"[5]. This commitment is now firmly embedded in all aspects of EU policy. 'Nature and biodiversity' is one of four priority areas for action under the 6th Environment Action Programme (6th EAP)[6], which sets out the framework for environmental policy-making in the EU for the period 2002-2012. The 6th EAP also advocates, in accordance with the Treaty, the full integration of environmental protection requirements, including those related to biodiversity conservation, into all other EU policies and actions.

Together, the "Birds" and "Habitats" Directives are the cornerstones of EU biodiversity policy. They enable EU Member States to work together, within the same strong legislative framework, to protect Europe's most valuable species and habitats across their entire natural range within the EU, irrespective of political or administrative boundaries.

Both directives require Member States to designate specific terrestrial and marine sites, which together constitute the Natura 2000 network. This network consists of Special Protected Areas (SPAs) -protecting bird species and Special Areas of Conservation (SACs) - protecting habitats and other species of EU conservation concern. The aim of the Natura 2000 network is to assure the long-term survival of Europe's most threatened species and habitats. Other provisions of the directives include a strict system of species protection, as well as monitoring and reporting schemes.

Article 6 of the Habitats Directive plays a crucial role in the management and sustainable use of the sites that make up the Natura 2000 network. In the spirit of integration, it provides a series of procedural safeguards to ensure that economic development goes hand in hand with nature conservation. It is the responsibility of the Member States to transpose the directives into their respective national legislation and to put in place appropriate mechanisms to implement the provisions in practice.

Article 6 of the Habitats Directive includes three types of measures:

1. Positive conservation measures for the Special Areas of Conservation (SACs) as foreseen by article 6.1 involving e.g. management plans and statutory, administrative or contractual measures[7],
2. Preventive measures for all sites as foreseen under article 6.2 to avoid the deterioration of natural habitats (as well as significant disturbance of species) and under article 6.3, to assess the effects of new plans and projects,
3. Procedural safeguards, including a derogation and compensation regime, under article 6.4 for authorising plans or project that are likely to have adverse effects on Natura 2000 sites.

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[4] Presidency Conclusions, Göteborg European Council 15 and 16 June 2001
[5] COM (2001) 264 final
[6] Decision No 1600/2002/EC, OJ L 242, 10.9.2002, p.1
[7] For SPAs, obligations of article 4.1 & 4.2 of the birds directive will apply and there are considered as positive measures also.

***Article 6 of the ''Habitats'' Directive 92/43/EEC***

***1.*** *For special areas of conservation, Member States shall establish the necessary conservation measures involving, if need be, appropriate management plans specifically designed for the sites or integrated into other development plans, and appropriate statutory, administrative or contractual measures which correspond to the ecological requirements of the natural habitat types in Annex I and the species in Annex II present on the sites.*

***2.*** *Member States shall take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of this Directive.*

***3.*** *Any plan or project not directly connected with or necessary to the management of the site but likely to have a significant effect thereon, either individually or in combination with other plans or projects, shall be subject to appropriate assessment of its implications for the site in view of the site's conservation objectives....competent authorities shall agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site....*

***4.*** *If, in spite of a negative assessment of the implications for the site and in the absence of alternative solutions, a plan or project must nevertheless be carried out for imperative reasons of overriding public interest, including those of social or economic nature, the Member State shall take all compensatory measures necessary to ensure that the overall coherence of Natura 2000 is protected....where the site concerned hosts a priority natural habitat type and/or a priority species, the only considerations which may be raised are those relating to human health or public safety....*

Coastal and estuarine habitats protected under the Habitats Directive cover a total area of more than 45,000 km² of the EU territory (see Table 1, only the marine and intertidal part, excluding dune systems or other related fresh wetlands).

These protected habitats also provide resting areas for birds and seals, spawning areas for fishes, feeding areas for mammals as well as specific plant habitats. Estuarine and coastal ecosystems can also include other protected habitats of Community interest, such as Grey Dunes (habitat code 2130).

***Table 1****: Area of coastal and estuarine habitats protected under EU Nature legislation (according to the Natura 2000 Database – November 2009)*

| **Coastal and estuarine Natura 2000 habitats of relevance to the present document** | **Total area in the EU-27 territory (2009)** |
|---|---|
| Estuaries – habitat code: 1130 (306 sites) | 643.704,44 ha |
| Coastal lagoons*– habitat code: 1150 (644 sites) | 503.263,71 ha |
| Large shallow inlets and bays – habitat code: 1160 (373 sites) | 1.250.743,52 ha |
| Sandbank which are slightly covered by sea water all the time – habitat code: 1110 (517 sites) | 2.436.613,35 ha |
| Mudflats and sand flats not covered by seawater at low tide – habitat code 1140 (422 sites) | 809.204,53 ha |
| **Total** | 5.643.529,55 ha |

The following EU environmental directives on environmental assessments are also directly relevant to development plans and projects in estuaries and coastal zones (see chapter 3.3.3):

- Directive 2001/42/EC on the evaluation of the effects of certain plans and programmes on the environment (commonly referred to as the '**SEA' Directive**)[8] The purpose of the SEA Directive 2001/42/EC is to ensure that the environmental consequences of ***certain plans and programmes*** are identified, assessed and taken into account during their preparation and before their adoption.

[8] OJ L 197, 21.7.2001, p. 30–37 – see http://ec.europa.eu/environment/eia/home.htm

- Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, as amended in 1997 (97/11/EC), 2003 (2003/35/EC) and 2009 (2009/31/EC) – (commonly referred to as the '**EIA' Directive**[9].) While the SEA process operates at the level of public plans and programmes, Environmental Impact Assessments (EIA) operate at the level of ***individual public and private projects***.

Estuaries and coastal water bodies are also of interest under the **Water Framework Directive 2000/60/EC** (WFD). The WFD establishes a framework for the protection of all surface waters (rivers, lakes, transitional and coastal) and groundwater at EU level and aims to achieve a good ecological status (or a good ecological potential for heavily modified water bodies) and a good chemical status by 2015.

Estuaries and coastal waters are identified as transitional or coastal water bodies. According to the WFD their deterioration should be prevented and their aquatic ecosystem status protected and enhanced. There is frequently a geographical overlap between Natura 2000 sites and WFD water bodies in estuarine and coastal ecosystems. Although the principal aim of the WFD and the Nature directives is to protect ecosystems, their objectives, measures and tools are not entirely complementary. Attention should be given to the synergies between the nature Directives and the WFD where they both apply.

Under the Water Framework Directive, a Common Implementation Strategy (CIS) was developed in order to address the challenges in a co-operative and coordinated way and a series of guidance documents have been produced (see annex 1). It is important to remember that Article 4(2) of the WFD states that if the conservation objectives of the Habitats Directive are more stringent than the requirements of the WFD then those of the former will apply. The same is also true of the converse. Detailed information and guidelines on the implementation of the WFD can be found on the following website: http://ec.europa.eu/environment/water/water-framework/index_en.html

**The Marine Strategy Framework Directive (MSFD, 2008/56/EC)** provides a more comprehensive view and deals also with ecosystem services in marine areas. It establishes a framework for the protection and restoration of marine ecosystems. According to this directive, Member States must take the necessary measures to achieve or maintain a good environmental status (GES) in the marine environment by the year 2020. The geographical scope of the MSFD overlaps with the WFD in coastal waters. The MSFD environmental status only applies in the latter insofar as particular aspects of the environmental status of the marine environment are not already addressed through that Directive (e.g. litter, noise, cetaceans). The MSFD, however, does not apply to transitional waters such as estuaries.

The two more recent directives complement the nature directives by putting increased emphasis on the role of ecosystems. As mentioned above, estuaries are ecosystems with very dynamic characteristics: they are subject to daily and seasonal changes as well as hydro-morphological evolution. Their biodiversity parameters and typical species will also evolve over time. Although concern for biodiversity is a common denominator, it is not difficult to imagine that, while habitats change in response to morphological evolution, some habitats may even disappear or change significantly. Especially in estuaries it is important to recognize the dynamic nature of this environment.

[9] OJ L 156, 25.6.2003, p. 17, OJ L 140, 5.6.2009, p. 114 – see http://ec.europa.eu/environment/eia/home.htm

## 1.2. The Integrated Maritime Policy and the European Ports Policy

The economic importance of the European coastline was underlined in the Commission's Communication on an Integrated Maritime Policy[10]; Maritime regions account for some 40% of the EU's GDP and population. Shipbuilding and shipping, ports and fisheries remain key maritime activities, but offshore energy and coastal and maritime tourism generate massive revenues. According to the European Maritime Policy, the capacity development of ports and coastal fairway channels must mirror the growth of Europe's domestic and international trade and occur in a way that is compatible with related EU policy objectives, in particular its environmental and competitiveness goals.

The Communication on a European Ports Policy[11] aims at a performant European port system able to cope with the future challenges of European transport needs. One of the objectives of the action plan under this Communication is to increase the carrying capacity of ports in order to allow a further increase of maritime and fluvial transport. There are more than 1200 merchant ports in Europe, comprising key points of modal transfer and of vital economic interest as they handle 90% of Europe's international trade. Even if these figures will fluctuate due to economic ups and downs, the long term trends remain one of continued growth; at the same time waterborne transport features low $CO_2$ emission rates, compared to other transport modes (mainly road but also railways).

During the consultation phase, prior to the adoption of the Communication on a European Ports Policy, the issue of environmental concerns in ports emerged. Port stakeholders expressed fears about legal uncertainty in relation to the implications for their activities arising from the Birds and Habitats Directives. On the other hand: in order to generate a license for growth, ports are increasingly embracing a more sustainable development approach.

Many ports and navigation channels are located in estuaries and coastal zones that host environmentally sensitive areas with high ecological value. The need to designate Natura 2000 sites in estuaries and coastal zones and the need to increase the carrying capacity of ports in order to meet the European transport needs is proving to be a challenge to many Member States; this has resulted in local disputes and several EU Court of Justice decisions and jurisprudence. However, in response to this challenge some Member States have already developed approaches to facilitate port development in line with the requirements of the Habitats Directive.

In its Communication on a European Ports Policy the Commission recognized the challenges in combining port infrastructures and environmental Directives. Consequently, the Commission services have responded to the request by port industry to provide guidelines on the interpretation of both nature Directives. This constitutes the policy background to the present guidelines, which have the ambition to reconcile the need for port development with EU environmental protection standards.

[10] European Commission, (2007), An Integrated Maritime Policy for the European Union, COM (2007) 575
[11] European Commission, (2007), Communication on European Ports Policy, COM (2007) 616, 18.10.2007

# 2. ISSUES OF CONCERN

## 2.1. Pressures on estuaries and coastal zones

Human activities in coastal and estuarine areas include navigation, dredging, aggregate and sand extraction, fisheries, aquaculture, industry (including oil and gas extraction, wind farms development), drainage of sewage and waste water, water extraction (e.g. for power stations and industry), safety (including sea defence and flood protection), recreation including bird watching and hunting, urbanisation, cover for cables, pipes and tunnels, military activities and research activities.

All these activities taken individually or in combination can potentially generate significant effects on the nature conservation objectives of estuaries and coastal zones. Impacts directly related to waterways and port related activities are illustrated below.

1. Dredging operations

Capital and maintenance dredging and the relocation of dredged material affects the hydrodynamic regime and geomorphology of the estuary: Natural sedimentation takes place in estuaries depending on the hydraulic forces in the basin and the amount of sediment available. Sediment is either supplied from erosion in the catchment area or from the marine environment or both. Beyond a certain point, a sort of balance is reached and the estuary begins to release sediment, rather than retain it. Any factor influencing the hydrodynamic regime and/or the geomorphology may modify the balance and the flux of sediments and lead to modifications in the localisation of habitats composing estuarine and coastal ecosystems (e.g. mudflats or sandbanks).

Capital dredging needs special attention because it may reverse the trend of estuarine infilling and affect the equilibrium state of the estuary. This occurs because deepening an estuary may permit a salt wedge intrusion to travel further upstream, increase shoreline wave action, change tidal range and tidal currents, and suspended sediment load and sedimentation. Additionally, the hydrodynamic changes and their effect on sediment erosion, deposition and transport may cause secondary geomorphological changes away from the dredging location, including the potential erosion of mudflats and salt marshes.

Maintenance dredging is the periodic or continuous activity necessary to maintain the navigable depth in an estuary or on the open coast. The effects of maintenance and capital dredging on a site can be similar. The critical difference is that whilst capital dredging imposes the major change, maintenance dredging prevents the system from returning to its original state, albeit in smaller stages. This means that there will be ongoing issues that will need to be addressed if habitats and species are to be maintained at favourable conservation status. Some of these impacts can be rectified by modifying dredging practices and by using sediment feeding techniques, but they are not universally applicable.

There are also circumstances where dredged materials can be put to beneficial uses such as increasing sediment supplies to beaches, although care needs to be taken to avoid smothering of important sub-tidal communities. This illustrates the need for careful assessment of hydrodynamic effects in estuaries and coastal waters. Careful design of dredging and relocation of dredged material is an integral part of sediment management schemes.

2. Maintenance activities

Maintenance activities other than maintenance dredging, such as the maintenance or replacement or installation of navigation marks, piles, lights, vessel traffic schemes and moorings, the extension of slipways and jetties and the maintenance of soft sea walls, flood defences and wave screens may have adverse effects on conservation objectives in estuaries and coastal zones.

3. Commercial shipping operations

Commercial shipping operations within ports can be divided into two broad categories, vessel operation and movements and cargo operations. The movement of ships through estuarine and coastal waters may potentially affect the characteristics of a habitat both through the generation of waves and propeller-induced turbidity in the water column. The effects of vessel movement can either be harmful, e.g. intertidal erosion of estuaries and/or putting sediments back into suspension, or beneficial, e.g. aeration of the water column.

Noise (above and under water) associated with shipping has the potential to cause disturbance to protected marine animals. The anchoring of vessels (outside an anchoring area) may disturb or damage animals and plants on the seabed (e.g. shellfish beds, soft corals, sea grasses). Ship emissions into the air, waste handling and ballast water treatment can have an impact on nearby coastal habitats.

Cargo handling of dry bulk cargos may cause dust emissions and air pollution (nitrogen, sulphur). Handling of liquid bulks may require discharge through pipelines, which provides a potential risk for leaks, emissions and spillages. Accidental release of cargoes into the marine environment may have important environmental effects. The spread of invasive alien species imported via ballast water or otherwise by vessels can also have a negative influence on protected areas. Last but not least vessel movement poses a risk of disasters (oil or cargo spilling).

Operational aspects of commercial shipping (waste handling, ballast water management, air pollution…) are subject to national or international rules and regulations (such as the ballast water treaty of the International Maritime Organization and MARPOL protocols annex 1-6). In addition there is a voluntary port authorities initiative to promote “Green shipping” by developing an Environmental index. This index is focusing mainly on air pollution coming from sea going vessels.

4. Port reclamation and land use

The port itself may have impacts on Natura2000 because it leads to the building of new infrastructures (terminals, rail, pipeline, roads, new industries and large areas for logistic companies) that may affect nearby Natura 2000 sites. In certain areas the available space is insufficient and ports may need to reclaim land from the sea. Land reclamation in Natura 2000, be it on land or on sea, will in most cases, require nature compensation schemes.

5. Industrial complexes

Port areas often include industrial complexes such as refineries, energy plants, dry and wet bulk hubs and container terminals. The cumulative effects of industrial operations, shipping and traffic can lead to adverse ecological effects on nearby Natura 2000 sites. Environmental issues such air quality, noise and waste are regulated by specific legislation and policies which is not, however, covered by the present guidelines. The use of the best available

technologies is often mandatory and can as such limit environmental pressure on protected sites as well.

## 2.2 Main concerns of the port sector with regard to the implementation of the Birds- and Habitats directives

One of the key issues for port sector development is the capability to plan new projects well ahead and securely. Delays in the planned dates for terminal extension have been experienced in various European ports during recent years. The European Sea Ports Organisation (ESPO) attributes these delays to a number of different causes, ranging from internal politics within the port, environmental objections, investigations into market share implications, funding difficulties, court cases, etc.(ESPO, 2007).

ESPO has already published in 2007 its Code of Practice on the Birds and Habitats Directives (ESPO, 2007), which contains a number of recommendations to port authorities faced with the legal implications of the provisions of the Birds and Habitats Directives in their wider port development areas. The last chapter of the Code of Practice presents a list of topics for which further guidance from the European Commission was invited.

The following are some concerns presented from a port authority point of view when it comes to the development and operation of ports near or in a protected estuarine or coastal zone. With the exception of the issue of cost sharing among relevant stakeholders, most of these concerns are being addressed in the present guidance document.

1. How could a proactive approach and integral planning lead to more legal certainty?
2. How can early agreements between all stakeholders be reached through wide public consultation and involvement of interested parties in project design?
3. How can costs be shared amongst all relevant stakeholders who can benefit from integrating socio-economic development objectives with nature conservation objectives in Natura 2000 areas?
4. How can compensation requirements be avoided through the systematic application of efficient mitigation measures, in a way that negative effects can be avoided beforehand?
5. How can the cooperation between project developers, environmental agencies and NGOs be enhanced with a view to promoting flexible approaches and mutual benefit situations?

Another important issue for port and waterway operators is how to handle maintenance activities such as dredging within or adjacent to Natura 2000 sites. Whereas extensive guidelines in relation to Article 6 of the Habitats Directive already exist for new plans and projects, ongoing activities have so far been less covered. Chapter 3.3.4 will therefore provide further guidance on this issue.

For port developers it is also important to know how much detail is actually necessary to sufficiently assess the potential effects of new plans or projects in order to comply with the requirements of the Birds and Habitats directives. Guidance on how to deal with uncertainties is an important issue in this regard. ESPO produced a checklist that is useful as a self guidance document (se Annex 3).

### 2.3 Climate change: A particular issue of concern for estuaries and coastal zones

Coastal zones and floodplains are among the most vulnerable areas to climate change as they are vulnerable to sea level rise combined with increased risks of storms, intense rainfall and flash floods leading to widespread damage to built-up areas and infrastructure.

Flood protection measures such as dyke construction, land reclamation and other types of sea defences may lead to the "coastal squeeze" phenomenon whereby less and less space is available for natural coastal processes to accommodate eroding forces or adjust to changes such as sea-level rise. "Coastal squeeze" occurs especially in low-lying and inter-tidal areas, which would naturally adjust to the changes in sea level, storms and tides, but cannot do so due to the construction of inflexible barriers such as roads, dykes, urbanisation, port and industrial infrastructure.

Innovative measures to prevent coastal squeeze should be taken in estuaries and coastal zones. Natural squeeze with similar effects occurs where the coast abuts rising ground and there is nowhere for eroded habitats to be displaced onto because the land is rising.

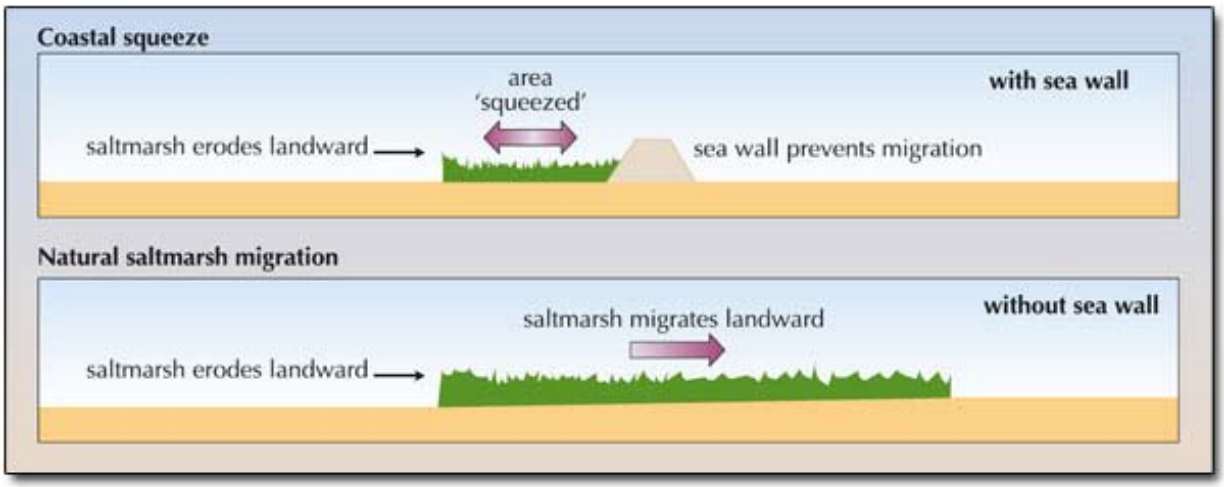


*Figure 1: Coastal Squeeze is created when habitat migration (in response to sea-level rise) is prevented by tidal/flood defences (Environment Agency, UK, 2005).*

Climate change will heavily affect Europe's natural environment and nearly all sections of society and the economy. Sea-level rise will reduce the sheltering effect of breakwaters and quay walls, but also periods of decreased precipitation in the river catchment areas can lead to lower rates of freshwater run-off and higher sedimentation rates within the estuary. As a result low river water levels during dry summer periods can hamper inner shipping to inland ports as well.

Sea level rise induced by climate change obviously leads to changing tidal characteristics like higher tidal amplitude and resulting current velocities. This may lead to a further increase of tidal pumping, an effect that can further reduce valuable shallow water areas and cause unwanted sedimentation even leading to a loss of biodiversity and last but not least increase the need for dredging. But the main problem with sea level rise is that there may not be sufficient sediment to allow mudflats and sandflats to keep pace with sea level rise. In such cases this is likely to lead to an increase in sub-tidal habitats. There may be a problem in a very small number of European ports from sub-tidal sedimentation but there is a greater problem with possible sediment export and increased erosion because of insufficient accommodation space to allow rollover to take place.

# 3. GUIDELINES

The present guidelines are intended to provide national competent authorities, port and waterway authorities and operators as well as environmental NGOs with a practical set of recommendations on the implementation of the Birds and Habitats Directives in estuaries and coastal zones with special attention to port development and dredging operations. The following main aspects have been covered: Conservation objectives in dynamic environments, integrated planning, new developments and adaptive strategies. The application of these guidelines should lead to more efficient planning and development approaches and support "fast-track procedures" for port expansion, according to the Communication on strategic goals and recommendations for the EU's maritime transport policy until 2018, COM (2009) 8.

Practice has shown that early cooperation among interested and affected parties is often a prerequisite for successful planning and elimination of delays. Estuaries and coastal zones are very complex and dynamic environments that attract interest from a wide range of sectors. They generally have an exceptionally rich nature conservation and socio-economic interest. This makes the planning of development projects a complex process but one that can nevertheless be carried out in a balanced, cost-effective, timely and integrated manner. A key objective is, provided all parties are aware of the obligations imposed on them under law, the basic understanding of how estuaries function as ecosystems.

## 3.1. Conservation objectives in dynamic environments

### 3.1.1. Understanding and managing estuaries and coastal zones as complex and dynamic ecosystems

Before setting conservation objectives in dynamic environments such as estuaries and coastal zones, it is important to understand how such complex ecosystems function, how they evolve "morphologically" and how they may be influenced by anthropological pressures and climate change. The balance between the different components (physical, chemical, biological and hydro morphological) of the estuarine and coastal ecosystems is very complex and can be easily affected by human activities such as port related activities, agriculture or flood alleviation measures. Both ecological and economic values of such ecosystems will have to be maintained in order to satisfy societal needs.

An Ecosystem approach, as outlined in the Marine Strategy Framework Directive[12], is well adapted to the management of complex systems such as estuaries and coastal zones. The ecosystem approach considers the ecosystem as an ecological entity with typical structure, processes and functions that interact with the surrounding environment. The ecosystem approach brings the analysis to a higher spatial level than just the habitats/ water body approach. Climate change will have potential impacts on the biodiversity and hydromorphology of estuarine and coastal areas, as well as on human activities such as port development and operation.

[12] 2008/56/EC (Official Journal of the EU of 25.6.2008): General provisions, article 1.3: ecosystem-based approach to the management of human activities, ensuring that the collective pressure of such activities is kept within levels compatible with the achievement of conservation objectives, good ecological and good environmental status, and that the capacity of estuarine, coastal and marine ecosystems to respond to human-induces changes is not compromised, while enabling the sustainable use of marine goods and (ecosystem) services by present and future generations.

*Guidelines for planning and decision-making based on ecosystem knowledge*

- The physical processes and morphological evolution of the specific estuaries and coastal zones should be investigated in detail. A best available and sound scientific knowledge on these elements should be established by the competent authorities as a basis for the establishment of nature conservation objectives for such ecosystems.
- Before setting conservation objectives in estuaries and coastal zones designated as Natura 2000 sites, the presence, geographic distribution and actual conservation status of all habitats and species protected under the nature directives, as well as the potential threats to which those elements are exposed, should be established in detail.
- Integrated management plans for estuaries should be established and implemented as an important instrument to conserve and protect critical processes, areas and species whilst providing space for sustainable economic development. Where possible these management plans should be part of the overall river basin management plan.
- Nature conservation objectives and socio-economic development objectives should be considered together for the establishment of integrated management plans for Natura 2000 sites. An ecosystem-approach should be applied which enables the sustainable use of goods and services that fully respects the site's conservation objectives.
- When an estuary or a coastal zone evolves, the presence or absence of species and habitats will also evolve. Therefore, the conservation objectives and measures for Natura 2000 sites should take into account the system-specific dynamics and evolutionary trends. There is also a need to take account of the difference between natural trends and those driven by human influences, namely coastal squeeze and morphological changes imposed by channel deepening.
- Where uncertainties or lack of knowledge on physical, morphological or biological processes still exist, these should be minimized as far as possible by additional research; where uncertainty remains adaptive monitoring programmes should be foreseen. New evidence and scientific information should be fed back into the management plan and where necessary lead to an appropriate adaptation of the management measures and monitoring schemes.
- Possible adaptation measures to climate change should also be considered when developing conservation objectives. In particular, regional sediment unbalance should be addressed. Shortage of sediment may lead to further erosion, e.g. from marshes, Wadden Sea areas (1110, 1130, and 1140), sandbanks, beaches and dunes.
- Proactive and strategic approaches to coastal management should be developed, giving priority to increasing coastal safety and ecosystem resilience and to maintaining a good sediment balance in the coastal and estuarine systems.
- Where possible, nature areas should be expanded proactively rather than reacting to catastrophic or climate change impacts. Dispersal corridors for species should be foreseen as an important adaptation tool.
- Where changes in sedimentation rates lead to loss of important habitats such as shallow waters, adapted sediment management schemes should be considered as an instrument to achieving conservation objectives.

### 3.1.2. Protecting habitats and species of Community interest

On the North-East Atlantic coast, estuaries are subject to the tide. River estuaries are coastal inlets where, unlike 'large shallow inlets and bays' there is generally a substantial freshwater influence. The mixing of fresh water and seawater and the reduced current flows in the shelter of the estuary lead to deposition of fine sediments, often forming extensive intertidal sand and mud flats. Estuarine ecosystems are characterized by subtidal and intertidal habitats (slikke) including salt marshes (shore). Baltic, Mediterranean and Black sea river mouths are considered as being estuary subtypes with brackish water and nearly no tide.

Estuaries and coastal zones are dynamic systems consisting at the same time of several habitat types and habitats of species. Sand banks (1110[13]), sand flats and mudflats (1140), reefs (1170) and salt marshes (1310 to 1330) may also be a component part of habitat 1130 Estuaries. They also include corridors for migratory species (as fishes) and resting areas for many birds. Estuaries and coastal zones are sometimes related to coastal lagoons (1150*) or to large shallow inlets and bays (1160).

Channels and/or shipping lanes, where present, form an integral part of the habitat type 'Estuaries' in all geographical conditions; they play a role in the hydrological functioning of estuaries and nearby coastal zones, including the circulation of water and the deposition of sediments.

An estuary is generally to be considered as a complex of different habitats. Other adjacent coastal areas must be considered when setting conservation objectives for estuaries or coastal zones. For the definition of habitats, further guidance is provided by the Interpretation Manual of European Union Habitats. The manual was revised in 2007 for some habitats (e.g. marine habitats 1110, 1170 and 1180). Some national guidance documents also exist. However, for the habitat-type estuaries-1130, different definitions/interpretation exist, depending on the Member States.

Several key parameters determine the biological functioning within estuaries and coastal zones. The presence or absence of species (angiosperms, benthic invertebrate fauna, fish fauna, birds and mammals…) depend on the system's behaviour and its ecological food web. They are influenced by physical parameters such as turbidity and salinity. Significant changes in the physical elements of estuaries and coastal zones, such as port and waterway development projects, can possibly affect the survival of specific species in the food chain.

Regarding specific aquatic habitats targeted by the Habitats Directive, the chemical, biological and hydromorphological elements covered by good ecological status according to the Water Framework Directive (WFD) already contribute towards the achievement of the objectives of the nature directives. Some of the typical species of Annex 1 habitats are used as indicators for the assessment of ecological status under the WFD (angiosperms, benthic fauna, fish).

The conservation status of species and habitats protected under the nature directives may not entirely rely on the good ecological quality of water bodies as defined under the WFD, even if this is certainly a key contribution. The local conservation status of species may rely on other specific elements that have to be defined on a case by case basis.

[13] Habitat code according to the Habitats Directive

Additional measures to those foreseen by the WFD but possibly required under the birds or habitats directive could be for example: quiet resting areas for seals or feeding zones on intertidal habitats for otter or for birds at low tide or even the creation of suitable nesting sites for birds. Main challenge should be to look for an approach generating mutual benefits and to harmonize goals, objectives, and measures from both WFD and Natura2000 at an early stage.

*Guidelines on the designation Natura 2000 sites and integration with the WFD*

- An estuary or coastal zone forms an ecological unit with the surrounding terrestrial and subtidal coastal habitat types. In terms of nature conservation, these different habitat types should not be treated separately, and this reality should be taken into account when defining the site boundaries.
- Navigation channels and/or shipping lanes remain an integral part of designated Natura 2000 sites and should be covered by the management plans.
- Member States and local authorities should coordinate the setting of conservation objectives and the implementation and monitoring of measures under the Nature and Water Framework Directives. Where possible integrated WFD and Natura 2000 management plans should be established.

### 3.1.3. Setting conservation objectives for the estuarine and coastal habitats

The development of conservation objectives for estuaries and coastal areas is a real challenge as these areas are very complex and dynamic ecosystems. The final responsibility for developing appropriate conservation objectives, priorities and instruments that are adapted to national, regional and local contexts always lies with the Member States.

The following questions may arise in this context:

- How are conservation objectives set at national/ local level?
- How can Natura 2000 management plans follow an ecosystem approach and yet assist in quantifying conservation objectives and establishing conservation measures for habitats and species?
- How can socio-economic objectives be integrated within the Natura 2000 conservation objectives and management plans?

Conservation objectives and conservation measures have to be established both at the national and at the site level. According to Article 2.1 of the Habitats Directive, the aim of the Directive is to contribute towards ensuring bio-diversity through the conservation of natural habitats and of wild fauna and flora in the entire "European territory of the Member States to which the Treaty applies".

According to Article 4.4 of the Habitats Directive, the Member States must designate the sites of Community importance as special areas of conservation, "establishing priorities in the light of the importance of the sites for the maintenance or restoration, at a favourable conservation status, of a natural habitat type in Annex I or a species in Annex II and for the coherence of Natura 2000, and in the light of the threats of degradation or destruction to which those sites are exposed."

According to Article 6.1., Member States must establish conservation measures for each particular special area of conservation. Specific site level conservation objectives take into account the priorities established according to Article 4.4. They will help to determine specific site-related conservation measures.

Conservation objectives at Member state level and site level have a complementary nature because Natura 2000 is a network where each site will have a specific function in the overall coherence of the system. It means that conservation objectives at site level will also contribute to achieving conservation objectives at the national level.

When determining the specific conservation measures at the site level, Article 2.3 of the Habitats Directive allows "*to take account of economic, social and cultural requirements and regional and local characteristics*". This consideration cannot , however, jeopardize the overall objective of the Natura 2000 network which is *'to enable the natural habitat types and the species' habitats concerned to be maintained or, where appropriate, restored at a favourable conservation status in their natural range*". All the sites will have a specific contribution to this objective, but the contributions of all sites are not necessarily equivalent.

Three kinds of obligations can be described for the SACs: proactive conservation measures as foreseen by article 6.1, preventive measures as foreseen by article 6.2 to avoid the deterioration of natural habitats and specific measures for assessing and authorising new plans and projects as foreseen by article 6.3 & 6.4. The conservation objectives for a specific site have to consider all these obligations. The special conservation measures under Article 4 of Birds Directive require equivalent measures to Article 6(1) Habitats Directive for Special Protection Areas. The provisions under Article 6.2, 6.3 and 6.4 also apply to Special Protection Areas under the Birds Directive.

*Guidelines for setting conservation objectives*

- Once a site of Community importance has been adopted in accordance with the procedure laid down in Article 4(2) of the Habitats Directive, the Member State concerned shall designate that site as a special area of conservation as soon as possible and within six years at most, establishing priorities in the light of the importance of the sites for the maintenance or restoration, at a favourable conservation status, of a natural habitat type in Annex I or a species in Annex II and for the coherence of Natura 2000, and in the light of the threats of degradation or destruction to which those sites are exposed (Article 4.4 of the Habitats Directive).
- When considering conservation objectives, the national competent authorities should consider the dynamic nature of estuaries and coastal waters and the related natural range of fluctuations of protected species and habitats types.
- Consideration of conservation objectives should have full regard to the morphological, chemical and biological processes. The ecological functions of estuaries und coastal waters should be recognised, such as hydrological functions, function as spawning area, nursery or seasonal habitats for migratory species.
- Conservation objectives and measures for a Natura 2000 site should be based on the assessment of the local conservation status of protected habitats and species, the relative importance of the site for the coherence of Natura 2000 and for the maintenance or restoration, at a favourable conservation status of such habitats and species. They should also reflect the threats of degradation or destruction to which the site is exposed. The effects of a plan or project on the integrity of the site must be assessed (art. 6.3) in the light of the site's conservation objectives.
- The conservation status at the date of designation of the site should be used as a reference value for evaluating its deterioration (art. 6.2). In this context, gains made as a result of restorative measures taken or other improvements e.g. bird population increases, due to pressure elsewhere or response to climate change, as well as

losses caused by natural developments or climate change also need consideration. The site's Standard Data Form (SDF) remains an important reference document with this regard.

- Port and waterway authorities should be consulted in the early processes of the development and implementation of conservation measures for those Natura 2000 sites situated near ports or connected with navigational access. When establishing conservation measures for a particular site, economic, social and cultural requirements and regional and local characteristics such as the actual situation in ports and the expected future economic developments should be taken into account while not jeopardizing the contribution of the respective site to achieving the overall objective of the Natura 2000 network and the coherence of the Natura 2000 network.
- Conservation objectives should not be static; on the contrary, they need to be adapted to the actual evolution of the conservation status of species and habitats and to the evolution of other ecological factors in a complex and dynamic environment.
- Monitoring schemes should be established to monitor short and long term evolution, such as morphological dynamics and sediment circulation/ re-distribution. On the basis of measured trends the conservation objectives and management measures can be revisited where and when necessary (applying the principles of adaptive management).

## 3.2. Integrated planning

### 3.2.1. Management plans

Management plans are recommended for Natura 2000 sites but not mandatory under the Habitats Directive. They appear to be an appropriate solution to reflect transparent conservation objectives and develop measures to preserve or enhance the natural values in line with the system's processes. A management plan creates opportunities to reconcile sustainable economic development, safety issues, accessibility with nature conservation objectives. It offers the possibility to integrate recurring and routine maintenance activities with conservation objectives.

Management plans also provide an appropriate tool for reconciling recurring and routine activities, such as maintenance dredging, with environmental protection and for engaging port authorities and other stakeholders in the management of Natura 2000 sites.

If maintenance activities are directly connected with the management of the site and as such integrated into a Natura 2000 management plan they will be designed in such a way that they are not likely to have adverse effects on the integrity of the site or compromise its conservation objectives. In this case, such activities can be authorised without appropriate assessment according to Article 6(3) of the Habitats Directive.

The integration of Strategic port plans, WFD river basin management plans and Natura 2000 management plans may offer opportunities for reducing administrative burden, delays and legal uncertainties.

*Guidelines for Natura2000 management plans:*

- Integrated management plans should be established for Natura 2000 sites, in particular for sites that are adjacent to port operations or other industrial activities.
- Port and waterway authorities should be actively involved in the setting up of management plans for Natura 2000 sites near ports and related waterways.
- Strategic port plans, WFD river basin management plans and Natura 2000 management plans should be coordinated and where possible integrated, so as to fully benefit of potential win-win situations.
- Recurring maintenance activities necessary to facilitate port operations and navigational access should be integrated into the management plans and designed in a way that they are not detrimental to the conservation objectives of the site.

### 3.2.2. Spatial planning

Spatial planning and integrated management, based on prospective and proactive approaches, can help achieve implementation of conservation measures on the sites and greater legal certainty for port development projects. Integrated planning is a way to look for synergies and complementarity ; it provides a tool to promote social responsibility and sustainable development. It should help to avoid paradoxes, conflicts, and ultimately competition for space. Anticipating frictions will save time and avoid procedural 'battles'.

The European Commission Recommendation 2002/413/EC on Integrated Coastal Zone Management (ICZM) paves the way for better strategic planning. Integrated Coastal Zone Management shall implement an « *environmentally sustainable, economically equitable, socially responsible, and culturally sensitive management of coastal zones, which maintains the integrity of this important resource while considering local traditional activities and customs that do not present a threat to sensitive natural areas and to the maintenance status of the wild species of the coastal fauna and flora* » (Janssen, 2005).

The strategic approach proposed by ICZM emphasizes the protection of the coastal environment (based on an ecosystem approach preserving its integrity and functioning) but also the threat posed by climate change or unsustainable economic activities and employment options. ICZM Recommendation proposes some principles as the "use of a combination of instruments designed to facilitate coherence between sectoral policy objectives and coherence between planning and management".

Similarly, the Marine Strategy Framework Directive 2008/56 (MSFD) requires Member States to adopt by 2016 programmes of measures, which can include "spatial and temporal distribution controls: management measures that influence where and when an activity is allowed to occur" (Annex VI). It thereby provides a regulatory basis for maritime spatial planning for marine waters under the scope of the MSFD.

Integrated spatial planning offers opportunities for anticipating difficulties and adverse environmental impacts and avoiding potential conflicts and delays in project development. Resolving problems at a spatial level means that individual projects will have to face fewer difficulties for consent if the project leaders and the permitting authority can rely on those overarching plans during a decision making process based on a pre- or appropriate assessments that have been carried out at the spatial level.

Spatial and integrated planning is not in contradiction with the concept of fast track procedures proposed by the European Commission[14] as anticipation may solve problems encountered later on. Better planning needs some additional time, but as a consequence, it allows the avoidance of conflicts during the authorization procedures and finally it contributes to eliminating "uncertainties" and causes for delays.

Land-use plans and sectoral plans, including flood risk management plans are of obvious relevance. Some have direct legal effects for the use of land, others only indirect effects. For instance, regional or geographically extensive spatial plans are often not applied directly but form the basis for more detailed plans or serve as a framework for development consents, which then have direct legal effects. Integrated strategic plans are designed to ensure in advance that the baseline conditions exist to undertake integrated projects. Such plans should be submitted to strategic environmental assessments and appropriate assessments in the framework of Article 6.3 of the Habitat Directive.

Land use planning is an integrative process, in which different claims of utilization are subject to an evaluation process. Appropriate assessments according to Article 6(3) of the Habitats Directive critically evaluate the potential impacts of the plan on Natura 2000 sites and identify possible amendments to policies or proposals so that adverse effects on Natura 2000 sites can be avoided. One of the key benefits of the appropriate assessment at plan level is that it requires decisions to be made on the content of the plan that will help avoid possible significant negative effects on Natura 2000 sites and therefore also possible conflicts and delays at the project level. In this sense, the provisions of Article 6 are not only a legal requirement but also a valuable tool in strategic planning.

The resilience of estuarine and coastal ecosystems can be strengthened by proactive nature development measures. Such measures can also be implemented on land owned by port or waterway authorities and which are dedicated to future port or waterway development but not currently in use for such a purpose or land owned by other parties (government, nature conservation organizations or private landowners). Integrated management plans for Natura 2000 estuaries offer a framework for dealing with the management and protection to be applied to such areas.

Finally, it is important to emphasize that involvement of the public and NGOs through a participatory approach is fundamental for a successful planning process. Transparency and a qualitative approach should facilitate public involvement and appropriation, even if this will not necessarily prevent the risk of contentious actions.

*Guidelines for spatial planning*

- Land use planning should be based on a solid and well substantiated knowledge base that includes all necessary information, both on nature conservation objectives and on ports and port-related development objectives. Economic need for additional capacity on waterways and in ports is a crucial issue that should be clearly demonstrated through middle/long term strategic planning and the use of existing capacities should be optimised (including improved coordination of infrastructures and capacities between different European ports).
- Spatial planning should be carried out at the appropriate level (competent national, regional or local authorities, port authorities…).

[14] European Commission, (2009), Strategic goals and recommendations for the EU's maritime transport policy until 2018, Communication from the Commission to the Council, The European Parliament, the European Economic and Social Committee and the Committee of the Regions, 13 p.

- Integrated spatial planning, submitted to strategic environmental assessment should be applied wherever possible as a way for anticipating difficulties and adverse environmental impacts and avoiding potential conflicts and delays in project development.
- For better integration of nature and port policies, strategic planning should be developed for the most accurate ecological unit (e.g. estuary, river basins,…).
- Spatial planning should make a clear distinction between the strategic level and the project level. Assessments at the strategic plan level can be simplified when the consideration of mere project-related details is avoided.
- Integrated spatial plans should find the right balance between economic and nature conservation objectives. They should be considered as instruments of reconciliation and integration of business and biodiversity goals.
- The national, regional and local competent authorities responsible for Natura 2000 site selection and management should work in close cooperation with the authorities in charge of spatial planning. All relevant stakeholders including port and waterway authorities, terminal operators, environmental NGOs and other public stakeholders should be involved from an early planning phase, with the objective of reconciling social and economic interests with nature conservation objectives in or nearby Natura 2000 sites.
- Port authorities and waterway administrations should be involved in all relevant planning exercises (including Natura 2000 management plans) as strategic planning will help to secure synchronized investments, to solve cross border issues, to identify less damaging alternative solutions and, where justified, imperative reasons of overriding public interest and to promote pro-active nature development.
- If a strategic plan or programme does not contain enough details to undertake a full appropriate assessment according to Article 6(3) of the Habitats Directive, the environmental report prepared for the Strategic Environmental Assessment (SEA) should help pave the way to make, at project level, an appropriate assessment and, if needed, to help prepare a derogation procedure following Article 6.4 of the Habitats Directive. In this case the SEA should already identify projects likely to have significant negative effects on Natura 2000 sites and which would need to be subject to an appropriate Art. 6(3) assessment during the project authorisation process.
- Cumulative effects of projects should best be identified and assessed already during the elaboration of spatial plans.
- Port and waterway authorities should aim for efficient land use by optimising space allocation of port industrial activities and making optimal use of different transport modes such as shipping, inland navigation and rail.
- Port and waterways authorities should consider the possibility of proactive nature development measures aimed at improving the resilience of estuarine ecosystem. The creation of temporary nature areas should be considered where land dedicated to port development is temporarily not used for such purpose. The management and protection of such land should then be dealt with in the context of integrated management plans.

### 3.2.3. Benefiting from partnerships and public participation

*Guidelines for public participation:*

- Developers of new projects should pre-assess the effects of the development and consult the competent nature conservation authorities on whether the plan is likely to have significant negative effects on the integrity of Natura 2000 site or its conservation objectives. Planning authorities should start consultation with competent authorities and non-governmental organisations (NGOs) early in the plan-making process.
- Given the complexity of environmental and zoning law, structured consultations and communication processes between various competent authorities, stakeholders and NGOs are recommended. Transport and environment administrations should be in regular communication and cooperate to ensure that the process runs efficiently at both plan and project levels. Port and waterway authorities, operators or users as well as environmental NGOs should be represented in implementation processes, including in transboundary conditions.
- Special consideration needs to be given to plans and projects that will have an impact across national borders. Neighbouring countries should inform each other and cooperate early on in the planning process.

## 3.3. Project development and maintenance activities

A widespread misunderstanding is that the EU nature directives are based on a “no-unless” approach. This is an interpretation based on the view that environmental policy objectives always take precedence over economic policy objectives. This approach is in contradiction with sustainable development principles, which balances environmental benefits and societal and economic requirements (see article 2.3 of the Habitat Directive). Early integral planning and the development of integrated projects are crucial, as they will promote a “yes, if” approach and pave the way for win-win solutions.

In the field of waterways and ports, the EU TEN-T status or other national priorities should help projects to qualify as being of overriding public interest. Nevertheless, if a plan or a project is being authorised on the basis of imperative reasons of overriding public interest (IROPI), then the Habitats Directive demands a justification of the arguments for IROPI.

Alternative solutions with less or no adverse effects must always be considered in sufficient detail beforehand and a plan or project with significant adverse effects on a Natura 2000 can only be authorised in the absence of such alternative solutions. Permitting procedures may cause legal uncertainty since permits may need to be reviewed, updated or eventually also be terminated. However a correct application of the provisions of the Habitats Directive and the integration of nature conservation objectives from a very early planning phase will reduce uncertainty.

The following guidelines propose recommendations on the concept of integrated projects, the correct use of the appropriate assessments and “significant impact” issues, the use of adaptive management and the assessment of compensation needed as a last resort.

### 3.3.1. Integrated projects and working with nature

In 2008, PIANC, the world association for waterborne transport infrastructure[15], published a position paper entitled "*Working with Nature*". It calls for an important shift in thinking in the approach to navigation development projects to help deliver mutually beneficial solutions. It promotes a proactive, integrated approach which focuses on:

- achieving the project objectives in an ecosystem context rather than assessing the consequences of a predefined project design;
- identifying mutually beneficial solutions rather than simply minimising ecological harm.
- "*Working with Nature*" thus considers the project objectives firstly from the perspective of the natural system rather than from the perspective of technical design. It is an approach which needs to be applied early in a project when greater flexibility is still possible. A proactive approach such as "*Working with Nature*" should not only be applied at project level but also to the development of strategic plans and programmes (see integrated planning).

If the design concept for a project has progressed before environmental issues are considered, the environmental impact assessment necessarily becomes an exercise of mitigation or damage limitation, potentially resulting in sub-optimal solutions and missed opportunities. "*Working with Nature*" is about more than avoiding or mitigating the environmental impacts of a pre-defined design. Rather, it sets out to identify ways of achieving the project objectives while working with natural processes and delivering environmental protection, restoration or enhancement outcomes.

A similar approach has also been tested within flood alleviation projects in the Netherlands and developed within the Interreg SAND project. It was called "*Integral Design*" and was based on different plans, which are integrated in a way that maximizes the benefits for all whilst delivering the overall objective in a cost-effective and efficient approach.

This general approach can be strongly recommended as it is in coherence with the principle that environmental damage should as a priority be avoided or rectified at the source. It is in line with the Habitats Directive. Appropriate assessment, however, still needs to be applied (article 6.3) if significant effect on a Natura 2000 site cannot be excluded. As a general rule prevention or avoidance measures are to be preferred to compensation.

*Guidelines for working with nature:*

- Project design should aim to be based on win-win strategies with a view to achieving dual goals of both Natura 2000 conservation objectives and socio-economic objectives.
- Projects should be 'designed' using the 'working with nature' concept. This means that the relevant Natura 2000 conservation objectives should be considered together with the technical project objectives from an early stage in project design and development.
- As a general rule, damage prevention or avoidance measures should always be preferred to compensation measures.

[15] http://www.pianc.org

### 3.3.2. How to handle 'appropriate assessment' and 'likely significant impact'?

The European Commission has already published guidance documents to assist Member States and operators to understand and apply Article 6 of the Habitats Directive (see annex 1). The present guidelines specify recommendations for waterways and port-related activities.

Ecology and biodiversity depend on local conditions (variability and complexity of abiotic and biotic factors), as well as on evolution in space and time. The words “appropriate” or “significant” are not normative concepts and assessments have to consider local conditions (case-by-case basis). As highlighted by Stojanovic & al. (2006), the “fact that each port is unique in terms of its geography, hydrography and commercial profile means that a “one-size-fits-all” strategy of prescribed environmental management response may not be appropriate even though there are many issues in common”.

The same can be said for the management of estuaries, as ecosystem features are depending among others on the geographical location of the estuary. Therefore a site-specific analysis is always necessary. An "appropriate" assessment means that it is an assessment which takes into account all local factors and conservation objectives. It also has to be based on the best available scientific evidence.

### 3.3.3. The relationship between SEA, EIA and Appropriate Assessments (AA)

There are many similarities between the procedures for SEA and EIA, and the Appropriate Assessments carried out for plans or projects affecting Natura 2000 sites under the Habitats Directive. But this does not mean they are one and the same, as there are also some important distinctions. Therefore, an SEA or an EIA cannot replace, or be a substitute for, an Appropriate Assessment as neither procedure overrides the other.

They may of course run alongside each other or information pertaining to the Appropriate Assessment may form part of the EIA/SEA process but, in such cases, the Appropriate Assessment should be clearly distinguishable and identifiable in the SEA’s Environmental Report or in the EIA’s Environmental documentation, or should be reported on separately so that its findings can be differentiated from those of the general EIA or SEA.

One of the key distinctions between SEAs/ EIAs and Habitats Directive’s Appropriate Assessments, apart from the fact that they measure different aspects of the natural environment and have different criteria for determining ‘significance’, is how the outcome of the Assessment is followed. In this regard, the assessments under the SEA and EIA lay down essentially procedural requirements and do not establish obligatory environmental standards; on the contrary, the assessment under the Habitats Directive lays down obligations of substance, mainly because it introduces an environmental standard, i.e. the conservation objective of a Natura 2000 site and the need to preserve its integrity.

In other words, if the Appropriate Assessment can not ascertain that the plan or project will not adversely affect the integrity of a Natura 2000 site, the authority cannot agree to the plan or project as it stands unless, in exceptional cases, they invoke special procedures for plans or projects for which there are no less damaging alternative solutions and which are deemed to be of overriding public interest.

The SEAs/ EIAs on the other hand are designed to make the planning authorities fully aware of the environmental implications of the proposed plan or project so that these *are taken into account* in their final decision. The considerations above are summarised in the table in Annex 4.

*Guidelines for assessments:*

- The significance of the effects of a plan or a project is strongly dependent on the site's characteristics and conservation objectives (which will be outlined in the Standard Data Form, Special Area of Conservation designation acts, conservation priorities, management plan…).
- When a port or related waterway development project is proposed, in a first step a pre-assessment must be carried out. If this pre-assessment demonstrates that there will be no likely significant effect on Natura 2000 sites, the competent authority may remove the obligation of going through an appropriate assessment of its implications for the site in view of the site's conservation objectives, according to Article 6(3) of the Habitats Directive. The assessment of the risk of significant effects must be made on the basis of scientific criteria and in the light inter alia of the characteristics and specific environmental conditions of the site concerned by such a plan or project. Factors such as the extent, the magnitude, the complexity, the probability, the duration, the frequency and the possible reversibility of the impact should be considered. This exercise should be done by the competent authorities.
- If it cannot be excluded, on the basis of objective information, that a project will have a significant effect on a Natura 2000 site, either individually or in combination with other plans or projects then the project is to be subject to a proper Article 6(3) assessment.
- Following a thorough appropriate assessment that includes collecting all relevant data, and subject to the reversibility of actions, minor remaining uncertainties should however not block or restrain projects indefinitely. This needs to be judged on a case by case basis. In case of uncertainty on particular mechanisms of complex estuarine or coastal ecosystems port and waterway developers should assess the nature of the remaining uncertainties and manage them through targeted monitoring and adaptive strategies. Monitoring schemes should be designed in a way that they signal any unexpected developments at a stage where effective corrective measures can still be taken.
- The absence of adverse effects is sometimes related to predicted effects not exceeding specified threshold values; the monitoring of effects relative to the threshold is then important. The threshold values should always be justified on the basis of scientific criteria.
- In the context of an appropriate assessment, information should be provided on the full characteristics of the project or plan which may affect the site, the total range or area that will be affected, the characteristics of other projects or plans which may cause cumulative impacts with the project, any planned or existing nature conservation initiatives likely to affect the status of the site in the future, the relationship (e.g. distances…) between the project or plan and the Natura 2000 site, the requirements (e.g. EIA/SEA) of the authorisation body or agency.
- Information on the protected site should include: the conservation objectives of the Natura 2000 site, the conservation status and other key attributes of Annex I habitats or Annex II species on the site, the physical and chemical characteristics of the site that may be affected by the project, the dynamics of the habitats, species and their

ecology, aspects of the site that are sensitive to change, key structural and functional relationships that create and maintain the site's integrity, other conservation issues relevant to the site, including likely future natural changes taking place and the degree to which those changes need to be managed to deliver the site's conservation objectives.

- Measures to eliminate or reduce significant effects (mitigation) should be foreseen during the project design phase. If necessary, they can be completed during the appropriate assessment (design revision, complementary mitigation). The project can then possibly reach a level where it will have no adverse effects on the integrity of the site.

### 3.3.4. Compensation schemes and their follow-up

Important notice: The Commission has issued guidelines directly related to the provisions of Article 6.4 of the Habitats Directive which should be read in conjunction with the following section (see Annex 1 for references).

*Guidelines for compensation:*

- In instances where damaging developments are, in the absence of alternative solutions, to be allowed to proceed there will be a need for compensation measures to fully offset any loss or damage to the site. These should be precisely adapted to the type of impact predicted and should be focused on the coherence of the Natura 2000 network and the particular elements affected at site level. This requires that measures refer to the structural and functional aspects of the site integrity, the related types of habitat and species populations that are affected and the contribution of these elements to the overall coherence of the Natura 2000 network.
- Compensatory measures must be feasible and operational in protecting the overall coherence of the Natura 2000 network. The estimated timescale and any maintenance action required to enhance performance should be specified as early as possible in the project. Once the compensation scheme is agreed, the permits granted and a monitoring programme in place, unforeseen uncertainties should in principle not significantly hamper the core of a plan or project. Such possible new uncertainties should, however, trigger targeted investigations and if necessary extended monitoring and adaptive or corrective measures.
- 'Losses' should be quantified with respect to key habitats and species: according to current knowledge and expert judgement. Compensation measures must be designed on the basis of best scientific knowledge and should accomplish the ecological functions necessary to support the affected species and habitats.
- Environmental damage/ environmental benefit from compensation ratio should be assessed: there is wide acknowledgement that compensation/ damage ratios should be generally well above 1:1. Thus, compensation ratios of 1:1 or below should only be considered when it is demonstrated that such measures will be 100% effective in restoring good structure and functionality within a short period of time.
- Appropriate compensation sites should be selected by considering the following:
  (a) Compensation within the Natura 2000 site if the necessary elements to ensure ecological coherence and network functionality exist within the site.
  (b) Compensation outside the Natura 2000 site if the same contribution to the ecological network is feasible. The new location can be another site designated as

Natura 2000 or a non-designated location. In the latter case, the area has to be designated as a Natura 2000 site itself.

- The compensatory measures must ensure the continuity of the ecological processes essential for maintaining the overall coherence of the Natura 2000 network. The compensation scheme should be 'effective' at the time the negative effects occur on the site concerned. Early implementation is of the essence. The application of specific mitigation measures to overcome possible interim losses may be necessary.
- All necessary provisions, technical, legal or financial, necessary to implement the compensatory measures should be completed before implementation of the plan or project starts, so as to prevent any unforeseen delays that may hinder the effectiveness of the measures.
- Financing, monitoring and reporting: Compensatory measures imply that a sound legal and financial basis for long-term implementation, protection, monitoring and maintenance be secured in advance.

### 3.3.5. Addressing dredging and maintenance activities

In the case of ports situated in or near estuaries, it is common that the navigational access runs through designated Natura 2000 sites. For most ports dredging is a necessity to keep the waterways and shipping lanes accessible. Potential conflicts with the obligation to preserve the integrity of a Natura 2000 site may come up. Nevertheless, maintenance dredging activities such as continuous or periodic maintenance dredging can usually be designed in a way that they do not adversely affect the integrity of Natura 2000 sites or their conservation objectives.

There are possibilities to deal with dredged materials in an estuary-friendly way. If appropriate sediment placement strategies are applied (e.g. in case of relocation of sediments in a part of an estuary where there is a lack of sediments) dredging operations can even have positive effects on the conservation status of estuaries. Recent knowledge and best practices have shown that a well-thought out relocation plan can help rebuild valuable morphological structures inside estuaries with interesting environmental benefits.

The development of innovative dredging concepts accompanied by strict monitoring schemes can contribute to achieving both navigation objectives and Natura 2000 conservation objectives. In the context of finding appropriate solutions for sustainable maintenance dredging the concept of a sustainable dredging and sediment management scheme is favoured. Such schemes will help avoiding problems, conflicts and delays and, where possible, maximising potential positive effects on the conservation status of estuaries and coastal zones.

The use of sustainable dredging and sediment management practices will further mitigate the potential impact of maintenance operations in the navigation channels. This will not, however, automatically obviate the need for assessment under Article 6(3) of the Habitats Directive. Sustainable dredging strategies should provide the necessary background information for the competent authority to make a judgement on the likelihood of possible adverse effects on a Natura 2000 site.

As a recurring activity, maintenance dredging and relocation of sediments can be used in the context of a sustainable dredging and sediment management scheme for both achieving navigation objectives and contributing to Natura 2000 conservation objectives.

The following six steps are essential in the preparation and implementation of sustainable dredging and sediment management schemes:

- Understanding of the physical setting (morphology, hydrology, salinity, etc) of the area concerned.
- Collecting the necessary information on the dredging operation in order to assess the environmental impact in detail.
- Proceeding with the assessment of the impacts of the dredging operation on the natural environment (on estuarine morphology and hydrodynamics, on sensitive habitats and species, in the short and the long term).
- Selecting optimal practices, describing all possible solutions for mitigating adverse effects and, as a last resort, examining possible compensatory measures that would be undertaken if not all significant adverse effects can be avoided through the application of mitigation measures.
- Implementing a monitoring programme determining the achievement of environmental objectives.
- Ensuring stakeholder participation all along the process in order to avoid complaints and delaying of the procedure.

The assessment of dredging operations and disposal of dredged material in marine environments is regulated under international conventions such as the London Convention, OSPAR, HELCOM, the Barcelona and Bucharest Conventions.

*Guidelines for capital dredging*

- Capital dredging operations should be designed as part of sustainable dredging and sediment management schemes. Where significant effects on a Natura 2000 site cannot be excluded, also in combination with other plans or projects, they must be subject to an appropriate assessment according to Article 6(3) of the Habitats Directive.
- The application of smart dredging and relocation strategies should help mitigate adverse effects and where possible restore or develop valuable morphological structures and, thus, generate ecological benefits ("working with nature").
- Dredging and sediment relocation strategies should be designed in a way that their potential positive effects are maximized. They should be underpinned by effective monitoring schemes.

*Guidelines for recurring maintenance activities including maintenance dredging:*

- Recurring maintenance activities should be designed and performed in a way to ensure that they do not adversely affect the integrity of Natura 2000 sites or their conservation objectives. Where possible, their potential positive effects on the conservation status of estuaries and coastal zones should be maximised through the application of sustainable sediment management strategies.
- Recurring maintenance activities where applicable should be included in integrated Natura 2000 management plans, equivalent management plans or river basin management plans to make sure that they are being assessed and reviewed in a structured manner in the overall context of the conservation of the sites.
- Maintenance operations in or near a Natura 2000 site should be specifically designed for each estuary or coastal zone and underpinned by a monitoring scheme that

enables the detection and timely correction of unforeseen adverse effects on conservation objectives.

- If, having regard in particular to the regularity or nature of maintenance operations or the conditions under which they are carried out, such operations can be regarded as constituting a single operation, in particular where they are designed to maintain a navigable channel at a certain depth by means of regular dredging necessary for that purpose, those maintenance works can be considered to be one and the same project for the purposes of the Habitats directive.

  In that case, if such a project has been authorised before the expiry of the time-limit for transposing the directive, it will not be subject to the prior assessment of the implications of the project for the site concerned. Nevertheless, in a Natura 2000 site, the carrying out of maintenance works will be subject to a general obligation of protection under Article 6(2) of the Habitats Directive consisting in avoiding deterioration of natural habitats and species' habitats and significant disturbance that affects the species for which the site has been designated[16].

- Maintenance operations, at the time of each intervention in the navigable channel, may sometimes need to be regarded as constituting distinct projects for example because of changing techniques, conditions or regularity under which they are carried out. In such a case each of those projects must, to the extent that they are likely to have a significant effect on the site concerned, undergo an assessment of their implications pursuant to Article 6(3) of the Habitats Directive.

- As the provisions of Article 6(2) always remain applicable, the Member States should review whether ongoing operations are likely to give rise to deterioration of habitats, or habitats of species and, where necessary, take appropriate steps to avoid such deterioration.

### 3.4. Dealing with uncertainties: adaptive management

In carrying out appropriate assessments for plans or projects in the sense of Article 6(3) of the Habitats Directive, it may be necessary to take recourse to the precautionary principle. The focus of the assessment should be on objectively demonstrating, with supporting evidence, including undertaking the necessary studies, and based on best available scientific knowledge, that there will be no adverse effects on the integrity of the Natura 2000 site. However adaptive management also helps to address situations when, because of science limits or uncertainty about the functioning of complex and dynamic ecosystems, it is not possible for the competent authorities to fully ascertain the absence of adverse effects.

When the absence of significant adverse effects of a plan or a project on a Natura 2000 site cannot be ascertained, the derogation scheme under article 6.4 of the Habitats Directive foresees that the plan or project can only be authorised in the absence of alternative solutions, if the plan or project is justified by imperative reasons of overriding public interest and if the necessary compensatory measures are undertaken to protect the overall coherence of the Natura 2000 network. If a plan or project falls under these provisions (which is likely for most port development projects), then it is essential that the different aspects are clarified at a very early stage in the plan or project development, as they are key elements for its design, financing, and, last but not least, permitting procedure.

[16] See also judgement of the Court of Justice of the European Union of 14 January 2010 in Case C-226/08 (Stadt Papenburg v Bundesrepublik Deutschland).

An adaptive approach for the implementation of a plan or project or a compensation scheme may be particularly useful to address cases where, due to uncertainty associated with different contributory factors (location, confidence, unexpected delays), it is impossible to define all the effects of the plan or project or of a compensation scheme in sufficient details and if such uncertainty cannot be factored in through increased ratios. In such a situation, a rigorous monitoring scheme and a pre-defined validated package of appropriated corrective measures must be foreseen. Such measures must allow to adjust mitigation and/or compensatory measures to the reality of the impacts and by that way, make sure that the initially unforeseen adverse effects are being neutralized.

Extensive guidance on the concept of imperative reasons of overriding public interest and on how to examine alternative solutions has already been published in existing guidance documents (see annex 1).

*Guidelines for adaptive management:*

- If significant negative impacts cannot be avoided even with mitigation measures, the decision to authorise the project is ultimately driven by the existence of imperative reasons of overriding public interest and the absence of less damaging alternative solutions according to the provisions of Article 6(4) of the Habitats Directive.
- In case of any remaining scientific uncertainty with regard to the effects of mitigation or compensatory measures, the measures must include a pre-defined and validated scheme to monitor the actual impacts and a framework, such as a Natura 2000 management plan, integral plan or a programme of measures, to adapt mitigation and compensation measures to the actual impacts.

*Guidelines for considering alternative solutions*

- Where negative effects are predicted, a range of alternative solutions of achieving the objectives of the plan or project should be identified and these alternatives should be assessed against their likely impact upon the conservation objectives of Natura 2000 sites.
- The competent authorities should not limit their consideration of alternative solutions to those suggested by the project or plan proponents. It is the competent authority's responsibility to consider alternative solutions.
- When assessing alternative solutions all relevant agencies and other bodies should be consulted. Detailed information on the alternative solutions and their impact on affected Natura 2000 site should be provided with indication of sources. The precautionary principle should be applied when assessing alternatives.

# Annex 1: European Commission Communications and guidance documents

**EC guidance documents related to the Birds and Habitats Directives**

- European Commission, (2000), Managing Natura 2000 sites: the provisions of Articles 6 of the habitats directive 92/43/EEC. Luxembourg: Office for official publications of the European Communities.

  http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/provision_of_art6_en.pdf

- European Commission, (2002), Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of articles 6(3) and (4) of the Habitats Directive 92/43/EEC. Luxembourg: Office for official publications of the European Communities. http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/natura_2000_assess_en.pdf

- European Commission (2007), Guidance document on article 6(4) of the 'Habitats Directive'92/43/EEC. Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the Commission.

  http://ec.europa.eu/environment/nature/natura2000/management/docs/art6/guidance_art6_4_en.pdf

- European Commission (2007), Guidance document on the strict protection of animal species of Community interest under the Habitats Directive 92/43/EEC, 87 pp. http://circa.europa.eu/Public/irc/env/species_protection/library?l=/commission_guidance/english/final-completepdf/_EN_1.0_&a=d

**Main EC guidance documents related to the Water Framework Directive**

- European Commission, (2003), Common implementation strategy for the water framework directive (2000/60/EC), Transitional and coastal waters-Typology, Reference conditions and classification systems, Guidance Document No 5, Luxembourg: Office for official publications of the European Communities, 116 pp.

  http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title

- European Commission, (2003), Common implementation strategy for the water framework directive (2000/60/EC), Identification and Designation of Heavily Modified and Artificial Water Bodies, Guidance Document No 4, Luxembourg: Office for official publications of the European Communities, pp.14.

  http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/guidance_documents&vm=detailed&sb=Title

- European Commission (2006), Common Implementation Strategy for the Water Framework Directive. Exemptions to the environmental objectives under the Water Framework Directive allowed for new modifications or new sustainable development activities (WFD Article 4.7), policy paper.

  http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/environmental_objectives&vm=detailed&sb=Title

- European Commission (2006), WFD and Hydro-morphological pressures: Focus on hydropower, navigation and flood defence activities Recommendations for better policy integration, Policy Paper, 44pp.

  http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/hydromorphology&vm=detailed&sb=Title

- European Commission (2006), WFD and Hydro-morphological pressures, Good practice in managing the ecological impacts of hydropower schemes; flood protection works; and works designed to facilitate navigation under the Water Framework Directive, 68 pp.

  http://circa.europa.eu/Public/irc/env/wfd/library?l=/framework_directive/thematic_documents/hydromorphology&vm=detailed&sb=Title

**EC Policy documents related to maritime and ports policies**

- European Commission, (2006) Towards a future Maritime Policy for the Union: A European vision for the oceans and seas, Green Paper, 49pp. COM (2006) 27

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0275:FIN:EN:HTML

- European Commission, (2006), Motorways of the Sea: Shifting freight off Europe's roads, Luxembourg: Office for Official Publications of the European Communities, 6 pp.
  http://ec.europa.eu/transport/intermodality/motorways_sea/doc/2006_motorways_sea_brochure_en.pdf

- European Commission, (2007), An Integrated Maritime Policy for the European Union, 17 pp. COM (2007) 575

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0575:FIN:EN:PDF

- European Commission, (2007), Communication on European Ports Policy, 16 pp. COM (2007) 616.

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2007:0616:FIN:EN:PDF

- European Commission, (2009), Strategic goals and recommendations for the EU's maritime transport policy until 2018, Communication from the Commission to the Council, The European Parliament, the European Economic and Social Committee and the Committee of the Regions, DG Transport and Energy, 19 p.

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0008:FIN:EN:PDF

**EC guidance documents related to ICZM and coastal areas**

- European Commission, (2002), Recommendation concerning the implementation of integrated coastal zone management (2002/413/EC).

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2002:148:0024:0027:EN:PDF

- European Commission, (2004b), Living with coastal erosion in Europe-Sediment and Space for Sustainability, EUrosion, Luxembourg: Office for official publications of the European Communities, 44 pp. http://www.eurosion.org/project/eurosion_en.pdf

**Other EC guidance documents**

- European Commission, (2004), Development of a Guidance Document on Strategic Environmental Assessment (SEA) and Coastal Erosion, Luxembourg: Office for official publications of the European Communities, 72 pp.

  http://ec.europa.eu/environment/iczm/pdf/coastal_erosion_fin_rep.pdf

- European Commission, (2006), Halting the loss of biodiversity by 2010-And beyond, sustaining ecosystem services for human well-being, Luxembourg: Office for official publications of the European Communities, 15 pp. COM (2006) 216.

  http://eur-lex.europa.eu/LexUriServ/site/en/com/2006/com2006_0216en01.pdf

- European Commission, (2007), Adapting to climate change in Europe-options for EU Action, Green Paper, 27 pp. COM (2007) 354.

  http://eur-lex.europa.eu/LexUriServ/site/en/com/2007/com2007_0354en01.pdf

- European Commission, (2007), Agenda for a competitive and sustainable European tourism, Communication from the Commission, COM (2007) 621final.

  http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=CELEX:52007DC0621:en:HTML

- European Commission, (2010), Europe, the World's No 1 tourist destination – a new political framework for tourism in Europe, Communication from the Commission, COM (2010) 352 final.

  http://ec.europa.eu/enterprise/sectors/tourism/files/communications/communication2010_en.pdf

## Annex 2: Selected private initiatives involving the port sector

**1. Ecoports** (see www.ecoports.com)
Ecoports is a research and development project launched in 2002 and initially co-funded by the European Commission and 12 ports and port organisations. The main goal of Ecoports was to harmonise the environmental management approach of port administrations in Europe, through the establishment of an environmental management system as well as the exchange of experiences and the implementation of good practices in respect of port-related environmental issues.

**2. ESPO, Environmental Codes of Practice** (see www.espo.be)
In 1994, the European Sea Ports Organisation (ESPO) published its first European Environmental Code of Practice, which was intended to be an expression of the collective commitment of the port administrations to environmental improvement. It therefore made a series of recommendations on the integration of environmental protection policies into all aspects of their operations. In 2002, ESPO carried out a survey on the impact of the Birds and Habitats Directives on port development. The main findings and recommendations were published in 2007 in the ESPO Code of Practice on the Birds and Habitats Directives.

**3. Paralia Nature** (see www.imiparalianature.org)
The Paralia Nature project was set up in December 2000 as an informal platform for the discussion of the Habitats Directive and related issues and projects. It is intended to bring about a broad multidisciplinary cooperation between governments, ports, universities, NGOs and knowledge centres in terms of exchanging experiences and information.

**4. NEW! Delta project** (Interreg IIIB - North West Europe, see www.newdelta.org)
The NEW! Delta project, which was launched in July 2004, also focused on the implementation of the Birds and Habitats Directives. The project brought together 10 partners from 4 countries in North-West Europe (England, France, Belgium and The Netherlands) including port authorities, regional administrations and research institutions.

**5. SedNet** (5th RTD Framework Programme, see www.sednet.org)
The Sediment Network (SedNet) is a European network, whose purpose is to incorporate sediment-related issues and knowledge into European strategies to support environmental goals and to develop new tools for sediment management.

**6.TIDE** (Interreg IV B North Sea Programme,see www.tide-project.eu/)
The Interreg project TIDE was set up in September 2009. It aims at the integrated management of estuaries serving as shipping channels to important sea ports with strong tidal influence and considerable sediment transport rates. A partnership of port authorities, environmental agencies and Science from the Elbe, Scheldt, Humber and Weser estuaries will exchange experience and develop tools and pilot measures for an integrated estuary management.

## Annex 3: ESPO checklist on good practice for balancing Natura2000 with port and waterway development and operations (December 2009)

This checklist can be seen as an example that Member States may consider to adopt in order to provide guidance and legal certainty to the activities of port and waterway developers and operators.

**Spatial and integrated planning**

- Existing Port and waterway activities are thoroughly assessed, considered and weighed within all relevant levels of spatial planning.
- New developments and future growth of existing ports and waterways are an integral part of the relevant spatial planning processes.
- Port and waterways activities are thoroughly considered and weighed within a balanced and integrated Natura 2000 management plan.

**Planning of new port and waterway projects**

- Sustainable port development is a key element of a license for growth of port related activities (optimising port-industrial use and space, improving operation of scale, efficient use of transport modes).
- Effects of sea going shipping activities in or nearby ports are subject to international regulation schemes and treaties (UNCLOS, IMO, MARPOL). Sustainable shipping is promoted through voluntary schemes (e.g. Environmental Ship Index).
- Shareholders´, public and stakeholders' opinions are considered from the beginning using a well defined stakeholder process. Agreements on all relevant issues have been reached as far as possible using the best available scientific knowledge.
- If a significant effect can not be excluded in a pre-assessment, then the further steps of Art. 6 of the HD are followed (full assessment, alternatives, mitigation, compensation - see ESPO Code of Conduct and specific EU-guidelines).
- Competent authority shall approve and underpin the results of the stakeholder process and the port development assessments and incorporate and secure those (including decisions made during the process) in the relevant integrated plans.

**Maintenance dredging**

- A maintenance dredging strategy has been set up taking into account hydro-morphological and ecological aspects.
- Based on latest information and a feedback-process involving all relevant stakeholders, dredging activities are – in compliance with economical and legal requirements - aiming to achieve the least impact on Natura 2000 conservation objectives possible.
- A sustainable maintenance dredging strategy or scheme is part of an integral management plan. Based on general principles in compliance with conservation objectives, dredging is flexible according to the requirements of a dynamic tidally influenced estuarine, river or costal system.
- Dredging activities have been optimized according to the following order:
    - Technical feasibility, availability of dredgers

- Safety, nautical requirements, navigability
- Legally binding ecological requirements (BHD, WFD, etc.)
- Administrative regulations (e.g. management plans, site specific objectives)
- Full integration of long-term comprehensive hydro morphologic, sediment-related and ecological criteria
- short-term and/or local criteria
- cost-effectiveness
- other non-binding aspects such as agreements with stakeholders

**Natura 2000 site management and maintenance measures**

- The aim should be to meet feasible conservation objectives for sites in balance with long term ports and waterways development.
- Port and waterways authorities should be actively involved in the setting up of management plans from the start.
- In dealing with uncertainties (ecosystem knowledge, cause-effect relationship), research and monitoring schemes should be included as part of the management plan.

## Annex 4: Comparison of procedures under AA, EIA and SEA

| | AA | EIA | SEA |
|---|---|---|---|
| Which types of developments are targeted? | Any **plan** or **project** which - either individually or in combination with other plans/projects - is likely to have a significant effect on a Natura 2000 site (excluding plans or projects directly connected to the management of the site for conservation). | All **projects** listed in Annex I.<br><br>For projects listed in Annex II the need for an EIA shall be determined on a case by case basis and depending on thresholds or criteria set by Member states (taking into account criteria in Annex III). | Any **Plans** and **Programmes** which are<br>(a) prepared for agriculture, forestry, fisheries, energy, industry, transport, waste management, water management, telecommunications, tourism, town and country planning or land use and which set the framework for future development consent of projects listed in Annexes I and II to Directive 85/337/EEC, or<br>(b) which, in view of the likely effect on sites, have been determined to require an assessment pursuant to Article 6 or 7 of Directive 92/43/EEC. |
| Which impacts need to be assessed relevant to nature? | The Assessment should be made in view of the site's conservation objectives (which relate to the species/ habitat types ***for which the site was designated.***)<br><br>The impacts should be assessed to determine whether they will not adversely affect the integrity of the site concerned, or otherwise. | Direct and indirect, secondary, cumulative, short, medium and long-term, permanent and temporary, positive and negative significant effects on ….'fauna and flora'. | Likely significant effects on the environment, including on issues such as biodiversity, population, human health, fauna, flora, soil, water, air, climatic factors, material assets, cultural heritage including architectural and archaeological heritage, landscape and the interrelationship between the above factors. |
| Who carries out the Assessment? | It is the responsibility of the competent authority to ensure that the AA is carried out. In that context the developer may be required to carry out all necessary studies and to provide all necessary information to the competent authority in order to enable the latter to take a fully informed decision. In so doing the competent authority may also collect relevant information from other sources as | The developer. | The competent planning authority. |

| | | | |
|---|---|---|---|
| | appropriate. | | |
| Are the public/ Other authorities consulted? | Not obligatory but encouraged ('if appropriate'). | Compulsory consultation to be done before adoption of the development proposal.<br><br>Member States shall take the necessary measures to ensure that the authorities likely to be concerned by the project by reason of their specific environmental responsibilities are given an opportunity to express their opinion on the request for development consent.<br><br>Ditto for the public | Compulsory –consultation to be done before adoption of the plan or programme.<br><br>The authorities and the public shall be given an early and effective opportunity within appropriate time frames to express their opinion on the draft plan or programme and the accompanying environmental report before the adoption of the plan or programme or its submission to the legislative procedure.<br><br>Member States must designate the authorities to be consulted which, by reason of their specific environmental responsibilities, are likely to be concerned. |
| How binding are the outcomes ? | Binding. The competent authorities can agree to the plan or project only after having ascertained that it will not adversely affect the integrity of the site. | The results of consultations and the information gathered as part of the EIA ***must be taken into consideration*** in the development consent procedure. | The environmental report, as well as the opinions expressed ***shall be taken into account*** during the preparation of the plan or programme and before its adoption or submission to the legislative procedure; |

# GLOSSARY

**Alternative solutions**: Different ways of achieving the objectives of a plan or project. The Commission services suggest that 'they could involve alternative locations, different scales or designs of development, or alternative processes (EC guidance on art. 6 (3) and (4), 2001).

**Appropriate Assessment (AA)**: The process under Article 6(3) of the Habitats Directive by which the potential effects of a plan or project upon a Natura 2000 site are assessed in view of the site's conservation objectives in order to ascertain whether the plan or project will not adversely affect the integrity of the site.

**Compensatory measures**: A requirement set out in Article 6(4) where damage to a European site has been justified in the absence of alternatives and for imperative reasons of overriding public interest (IROPI). Compensatory measures must be designed to protect the overall coherence of the Natura 2000 network. This normally entails the creation of appropriate habitat as close as possible to where the damage will occur and fully functioning before the damage occurs.

**Cumulative impacts**: Impacts that accumulate over space and time from multiple plans/projects.

**Deterioration**: physical degradation affecting a habitat, or a breeding site or resting place of a species. In contrast to destruction, such degradation may occur slowly and gradually reduce the functionality of the site in terms of quality or quantity and might over a certain period of time lead to its complete loss.

**Disturbance**: A temporary or permanent change in environmental conditions (e.g. by noise, source of light) that may have a negative effect on a natural habitat or a species. Disturbance may be detrimental for a protected species e.g. by reducing survival chances, breeding success or reproductive ability and may give rise to additional indirect effects (e.g. increased competition for food resources).

**Favourable Conservation Status:** The conservation status of a natural habitat will be taken as "favourable" when: its natural range and areas it covers within that range are stable or increasing; the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future; and the conservation status of its typical species is favourable (Article 1.e of the Habitats Directive).

The conservation status of a species will be taken as "favourable" when: viable population is maintained on a long-term basis; the natural range of the species is neither being reduced nor is likely to be reduced in the future; and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

**Habitat of Community Interest:** a natural habitat type in Annex I of the Habitats Directive.

**Imperative Reasons of Overriding Public Interest (IROPI)**: A requirement set out in Article 6(4) which, in limited circumstances, permits a plan or project to go ahead even after an AA has failed to ascertain that the integrity of a Natura 2000 site will not be adversely affected.

**Mitigation**: Measures aimed at minimising or even cancelling the negative impact of a plan or project, during or after its completion.

**Monitoring:** Collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a management objective.

**Natura 2000 site**: sites designated to form the Natura 2000 network, which include Special Protection Areas (SPA) and Sites of Community Importance (SCI) approved by the European Commission and declared as Special Areas of Conservation (SAC) by the Member States.

**Offset**: Biodiversity offsets are conservation actions intended to compensate for the residual, unavoidable harm to biodiversity caused by development projects, so as to aspire to no net loss of biodiversity.

**Precautionary principle**: where scientific evidence is insufficient, inconclusive or uncertain and there are indications through preliminary objective scientific evaluation that there are reasonable grounds for concern that the potentially dangerous effects on the environment, human, animal or plant health may be inconsistent with the chosen level of protection, lack of scientific knowledge shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation (Rio Declaration, 1992 & EC, 2000).

**Qualifying Interest**: a natural habitat type listed in Annex I or a species listed in Annex II of the Habitats Directive, a species listed in Annex I of the Birds Directive or regularly occurring migratory species not listed in Annex I, for which a Natura 2000 is designated.

**Site of Community Importance (SCI):** it is defined in the Habitats Directive (92/43/EEC) as a site which, in the biogeographical region or regions to which it belongs, contributes significantly to the maintenance or restoration at a favourable conservation status of a natural habitat type in Annex I or of a species in Annex II and may also contribute significantly to the coherence of Natura 2000, and/or to the maintenance of biological diversity within the biogeographical region or regions concerned. SCIs are proposed to the Commission by the Member States and once approved, they must be designated as Special Areas of Conservation (SACs) by the Member States.

**Special Area of Conservation (SAC)**: site of Community importance designated by the Member States through a statutory, administrative and/or contractual act where the necessary conservation measures are applied for the maintenance or restoration, at a favourable conservation status, of the natural habitats and/or the populations of the species for which the site is designated.

**Special Protection Area (SPA)**: Protected area designated in accordance with the Birds Directive for species listed on Annex I of the Directive and/or regularly occurring migratory species, and included in the Natura 2000 network.

**Species of Community Interest:** a species listed in in Annex II and/or Annex IV or V of the Habitats Directive.

**Stakeholders**: People or organisations that will be affected by, or will influence a programme, project or action.

**Surveillance**: An extended programme of surveys systematically undertaken to provide a series of observations to ascertain the variability that might be encountered over time.

nature

EUROPEAN COMMISSION

environment

The Humber Strategy
Managing the rising tides

Environment Agency

# Paull Holme Strays
# Environmental monitoring report

Part of the Humber Estuary Flood Defence Strategy

March 2009

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**ACKNOWLEDGEMENTS**

The Environment Agency wishes to thank the volunteers who have helped with monitoring at the site. Thanks to their effort, we have gained an in-depth look at the wildlife that has used the site over the five years since the breach. Particular thanks go to Mr Roy Lyon from Hull Valley Wildlife Group who has not only collected a large amount of data but has also collated the information his co-volunteers collected.

Bird and benthic invertebrate surveys were conducted by the Institute of Estuarine and Coastal Studies under the direction of Dr Nick Cutts:

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Accretion/erosion monitoring and vegetation monitoring were undertaken by Dr Sue Brown:

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Freshwater invertebrate monitoring was conducted by Mr Martin Hammond, Ecological Consultant, 110 Kingsway West, Acomb, York YO24 4QB.

## SUMMARY

### Background

Paull Holme Strays (PHS) is the site of the first major managed realignment scheme on the Humber. Created by the Environment Agency as part of the Humber Estuary Flood Risk Management Strategy, the site provides approximately 80 ha of new intertidal habitat and is fronted by the extensive Paull Holme Sands mudflat. It was initially anticipated that the PHS site would ultimately create approximately 45 ha of mudflat and 35 ha of saltmarsh. The site is adjacent to the Humber Estuary Special Protection Area (SPA), Ramsar site and candidate Special Area of Conservation (cSAC). These designations form part of the Natura 2000 network of 'European Sites' and illustrate the international importance of the estuary for, amongst other things, intertidal habitats and the wildfowl and waders they support. Nationally, the Humber Estuary is also designated as a Site of Special Scientific Interest (SSSI) for its mudflats, sandflats and saltmarsh habitats.

The main objectives of the PHS managed realignment project were to:

- Provide cost effective flood risk management for the area;
- Create intertidal habitat to compensate for that lost through implementation of this and other flood defence schemes in the middle estuary;
- Address additional habitat losses arising from coastal squeeze as identified in the Coastal Habitat Management Plan (CHaMP). These losses occur, when tidal defences prevent intertidal habitats migrating inland, in response to rising sea levels.

A five-year monitoring programme began in late 2003 to monitor the accretion and erosion at the PHS site and to assess the development of intertidal habitat and associated assemblages especially benthic invertebrates, birds and vegetation using complementary methods. The results of the fifth year of monitoring in the context of changes over the five year monitoring period are summarised in this report and will be used to inform management at the site as well as the design of further managed realignment projects in the Humber and elsewhere.

### Accretion, Erosion and Vegetation

Accretion of sediments within the PHS realignment site was high and continued five years after breaching. Whilst the rate of annual increase had slowed since the first years after the breach, accretion at low elevations inside the realignment were still

three times higher than in less sheltered areas outside the site. At high elevations, rates inside and outside were comparable. Over the entire monitoring period from May 2004 to September 2008, the lower elevation areas of the site (survey stations at 2.0-2.3mODN in 2005) accumulated on average 47.1 cm of material. With back-calculated extrapolation to the time of the breach it was estimated that these areas have accreted 63.9cm of material. The development of drainage creeks has been observed to rapidly change the hydrodynamics of the site and suitability for vegetation development. Saltmarsh development has continued and vegetation has begun to colonise even the lowest areas of mudflat areas inside the site (Common Cord-grass *Spartina anglica*). By July 2008 vegetation covered 31% of the initially lower northern part of the site and 76% of the initially higher and part vegetated southern part of the site. Therefore, if the rate of accretion continues to be high, it is predicted that the majority of the site will become saltmarsh and that mudflat habitats will only persist in the areas close to the breaches. In July 2008, although relative abundance still differed, all saltmarsh species occurring outside the site also occurred inside the site and at equivalent elevations.

**Intertidal Invertebrates**

Benthic invertebrate communities continued to develop, although rates of change slowed, and in 2008 had achieved species richness comparable to the communities of the established mudflats outside the site, which remained relatively stable over time. However, there were still significant differences to the typical middle estuary community in terms of mean species richness, abundance and diversity. This is to be expected as benthic invertebrate communities have been observed to take longer than five years to develop elsewhere since rapidly accreting sediments are too fluidised for burrowing organisms to survive in. Inside the site the early colonising small bodied species present in high numbers (*Paranais litoralis*) were being replaced by less abundant larger bodied organisms (*Hediste diversicolor*). However, it is noted that the increase in saltmarsh and high elevations with low frequency of inundation are likely to reduce the supply of larvae required for colonisation. Terrestrial/freshwater organisms which dominated in 2004 are no longer a significant component of the community.

**Birds**

Development of the above benthic invertebrate community provides a valuable food source for waterbirds, and the bird assemblage present within the site in 2008 was considered broadly typical of a mid-estuary community. The mudflats of the northern part of the site supported the highest densities of foraging birds and the high water islets in the south of the site were important for roosting/loafing birds. Overall the inside of the site supported more foraging wildfowl and fewer waders than the areas outside the site and was functioning as an extension of the upper shore. Peak maxima of 174 Redshank *Tringa tetanus* and 365 Dunlin *Calidris alpina* were

recorded during the winter of 07 and 08. The site continues to be of international importance for Golden Plover *Pluvialis apricaria* in winter and Black-tailed Godwit *Limosa limosa* in spring and summer and also still supports a colony of Avocets *Recurvirostra avosetta*. However, after five years of intertidal habitat development, the overall density of the birds using the site was much lower than that at the sites lost; for which PHS is providing compensation.

**Other surveys**

The results of bird surveys undertaken by volunteers have broadly corresponded with the findings of the IECS bird surveys, and illustrate the changing usage of the site with early pioneer species such as Teal *Anas crecca* and Shelduck *Tadorna tadorna* numbers declining over time. Invertebrate fauna recorded also seem to have undergone some changes with time, however these species are particularly vulnerable to weather conditions and survey date. The replacement aquatic habitats built behind the new flood banks have been successful receptor sites for translocated water vole *Arvicola terrestris*, aquatic vegetation and aquatic invertebrates. Recovery from saline incursion during 2005 appears to be complete with few key taxa closely associated with brackish water still present in 2008.

**Conclusions**

The monitoring programme undertaken at PHS has proven to be a sound basis for assessing progress towards targets. Within five years the targets for habitat creation and usage by birds has been met, and benthic invertebrates are lagging slightly as expected at this stage. However, there is substantial evidence that the habitats and communities are continuing to change and that, if current rates of accretion continue, the end point for the realignment site is likely to represent a much higher proportion of saltmarsh to mudflat habitat than was initially planned. Strategic decisions are needed to plan for future management of the site and modifications to future plans at other sites in the Humber to ensure that the integrity of the European Sites is maintained in the long term. Recommendations include proposals for a further five years of monitoring at PHS, additional analyses to test hypotheses developed during the first five year reporting and the adoption of lessons learnt at this site into designs and monitoring programmes for managed realignment sites elsewhere.

**Plate A - Aerial view of Paull Holme Strays site following the embankment breaches (October 2003, Environment Agency)**

**Plate B - The site in the third year post-breach (January 2006, Environment Agency)**

# 1 INTRODUCTION

## 1.1 Overview and Geographical Setting

1.1.1 Throughout the early 1990s considerable work was conducted on behalf of the National Rivers Authority (predecessor to the Environment Agency) to assess tidal defence needs in the Humber Estuary. Whilst a long term flood risk management strategy was being developed as the Humber Estuary Shoreline Management Plan (HESMP), the investigations also showed that urgent flood defence improvements were required at a number of locations, including the Thorngumbald Clough to Little Humber section on the north bank of the estuary to the east of Hull. Subsequent investigations, consultations and design development led to the submission of a planning application in August 2000 for a scheme comprising managed realignment of the defence and including creation of a new retired embankment and breach of the existing bank. This was expected to result in the creation of approximately 80 ha of new intertidal habitat.

1.1.2 A number of mitigation, monitoring, management and enhancement measures were identified within the Environmental Statement (ES), which was published in August 2000 to accompany the planning application for the Thorngumbald (Paull Holme Strays) Urgent Works (UW) Scheme. An Environmental Action Plan (EAP) was compiled to provide details of how these requirements (including a number of planning conditions) would be addressed and implemented during the detailed design, construction and post construction phases of the project. An Environmental Steering Group (ESG) was set up to ensure the continued involvement of key consultees throughout the design, construction and operational phases of the scheme.

1.1.3 The scheme was completed in 2003 with the existing bank being breached and the site first flooded in early September 2003.

1.1.4 The Humber Estuary Flood Risk Management Strategy is an overarching strategy that proposes a suite of managed realignment schemes with complementary objectives for the estuary. It was launched in March 2008 having been approved by the Environment Agency's Board and Defra. One of the complementary objectives within the Strategy is to address 'coastal squeeze'. Coastal squeeze is the term given to the 'drowning out' of intertidal habitats that are unable to migrate inland as sea levels rise due to the presence of hard coastal defences. The Humber Estuary CHaMP estimates that in the absence of action nearly 600ha of intertidal habitat (saltmarsh and mudflat) will be lost between 2000 and 2050, due to forecasted sea level rise and the effects of coastal squeeze.

1.1.5 Paull Holme Strays (PHS) was the first of the planned schemes under the Humber Estuary Flood Risk Management Strategy to become operational. Another at Alkborough has since been constructed and was breached in September 2006, providing a further 170ha of new intertidal habitat. In combination these schemes seek to ensure that the integrity of the European Sites is maintained in the long term. The design and monitoring of further managed realignment schemes is being informed by the lessons learned and successes at PHS.

## 1.2 Purpose of This Report

1.2.1 Since the PHS site was breached on the 5th September 2003, it has been rapidly changing as a result of twice daily tidal inundations and changes in sediment distribution. To monitor such change, a five year programme of environmental monitoring at the PHS 'realignment site' was established (inside and outside the realignment area where appropriate) to meet the requirements of the planning conditions, EAP and, where possible, the wider aspirations of the ESG. This programme comprises the following:

- Development and undertaking of a monitoring scheme for the site (inside and outside of realignment area where appropriate);
- Incorporation of additional monitoring by volunteer groups and others when available;
- Collation of additional information not covered by specific monitoring contracts (e.g. tide and surge, meteorological information etc);
- Collation of all monitoring results on an annual basis and production of an annual summary report to be circulated widely.

1.2.2 This report is the fifth and last annual summary report of the five year programme of environmental monitoring carried out at the site between October 2003 and September 2008.

## 1.3 Use of Paull Holme Strays as 'Compensatory Habitat'

1.3.1 The PHS (Thorngumbald) UW1 scheme (Figure 1.1) is within and/or adjacent to the Humber Estuary Special Protection Area (SPA)/Ramsar site and candidate Special Area of Conservation (cSAC). The proposed works were deemed to have the potential for 'likely significant effect on the European Sites' and consequently an 'appropriate assessment' was carried out under the Conservation (Natural Habitats & c) Regulations 1994 (SI No. 2716) (the Habitats Regulations). The 'competent authority' (East Riding of Yorkshire Council) decided that the works had potential for an 'adverse effect on the integrity of the European Site'. It was demonstrated that the scheme should go ahead for reasons of 'overriding public interest' and that there were no less damaging alternatives available. In the longer term, the scheme has the

potential to provide nature conservation benefits through the creation of new intertidal habitat. As a consequence of this habitat creation the scheme also provided 'compensation' for habitat losses at urgent tidal defence works being carried out elsewhere in the estuary.

1.3.2 The requirement for formal 'compensation' under the Habitats Regulations for adverse effects on the European Site, at UW1 (Thorngumbald/PHS) and UW15-17 (Immingham on the south bank of the estuary, specifically SCM Jetty to East of Oldfleet drain), was formally agreed with Defra and a number of consultees. It was also agreed that the habitat created at UW1 would be used to address the direct losses associated with another Environment Agency scheme at Barton Haven. Although there is no requirement for formal 'compensation' at this location, the Environment Agency is providing 'replacement' habitat as part of its wider 'no net habitat loss' approach to the delivery of tidal defences in the Estuary. The details of this estuary wide approach are set out in the Humber Estuary Flood Risk Management Strategy, 2008. The Environment Agency is also the lead organisation meeting targets for saltmarsh habitat within the UK Biodiversity Action Plan.

## 1.4 Paull Holme Strays Environmental Action Plan

1.4.1 A formal Environmental Action Plan (EAP) was developed for the PHS project and was agreed with the Planning Authority and other key consultees as part of the planning permission for the scheme. The EAP described the habitat creation and other mitigation measures identified in the Environmental Statement, outlined the monitoring programme and identified targets for habitat creation and species usage.

1.4.2 Details of the environmental targets for the site are provided in Appendix A. In summary the quantitative targets set were:

- Habitat creation to compensate for direct scheme losses at UW1 (PHS) and at UW15 to 17 (Immingham) = 2.43ha (of which 1.53 ha should be mudflat and 0.9ha saltmarsh)
- Habitat creation to compensate for coastal squeeze losses at PHS and Immingham = 10.58ha (of which 5.58ha should be mudflat and 5ha saltmarsh)
- Habitat creation to compensate for direct scheme losses at Barton Haven = 0.03ha mudflat.

1.4.3 The qualitative targets set were:

### (a) Mudflat

The mudflat created must support an invertebrate assemblage of similar species, population abundance and biomass to reference sites in the middle estuary (see Appendix A).

**(b) Saltmarsh**

The developing saltmarsh habitat should support a range of species which are representative of the middle and lower saltmarsh communities in the area (see table in Appendix A). Upper saltmarsh should be retained on the remnant floodbank.

**(c) Birds**

- At least 30 foraging wintering waterbirds: Redshank (*Tringa totanus*), Dunlin (*Calidris alpina*), Shelduck (*Tadorna tadorna*) and Curlew (*Numenius arquata*) must be present; and
- At least 12 roosting wintering waterbirds: Golden Plover (*Pluvialis apricaria*) must be present.

These targets assume that bird populations in the Humber remain stable over the review period.

**Plate 1 - Bird roost at Paull Holme Strays (L. Mander, IECS, February 2008)**

1.4.4 Realignment of the Humber bank between Paull and Thorngumbald resulted in the loss of brackish lagoons (borrow pits) and soke dykes which supported a variety of aquatic macro-invertebrates including rare coastal invertebrates and water voles *Arvicola terrestris*. New aquatic habitats were provided in the form of extensive dykes and a pond behind the new embankments with

vegetation, invertebrates and water voles translocated to the new habitats in an attempt to re-establish communities.

# 2 MONITORING PROGRAMME AND METHODOLOGIES

## 2.1 Introduction

2.1.1 The following is a brief outline of the methodologies for the specific monitoring studies that were undertaken at PHS over the five year monitoring programme. Full reports for each monitoring programme in 2008 and additional data sets are appended to this report (Appendices B, C, D, E, F and G).

## 2.2 Accretion & Erosion Monitoring

2.2.1 The aims of the accretion and erosion monitoring programme were:

- To monitor the sediment accretion of fixed sites twice annually (Spring and Autumn), in order to establish the patterns of accretion and erosion within the PHS scheme and comparison with sites outside the scheme.
- To monitor annually the height of the 34 posts above a gas pipeline crossing the realignment site to ensure that they were not threatened by erosion and exposure.

2.2.2 Following the breach in September 2003, the change inside the realignment scheme was observed to be rapid. The Institute for Estuarine and Coastal Studies (IECS) undertook an interim study to assess the extent (magnitude) of changes between December 2003 and March 2004 (when the Centre for Ecology and Hydrology (CEH) took over). To ensure continuity, the methodology used was approved by all concerned and the results of this initial survey, which was described in full in the first Environmental Monitoring Report (Environment Agency, 2005), are part of the overall long term accretion/erosion monitoring programme.

2.2.3 From May 2004 to September 2007 the accretion and erosion monitoring was carried out by CEH and then by CoastLife (with the same personnel and methodology) in 2008. The methodology can be found in Appendix B (Brown, 2009). Monitoring was conducted at several sampling sites along a series of transects across the site to cover existing intertidal habitats seaward of the old embankment and ‘new’ intertidal habitats inside the site (see plan in Appendix B). Sediment accretion was measured using a combination of buried expanded metal accretion plates and pairs of canes set up to support a level bar (Appendix B). Back-extrapolation on these data were undertaken to calculate the total accretion since the breach in September 2003.

**Plate 2 - Accretion plates (SL Brown)**

## 2.3 Intertidal Vegetation

2.3.1 The aim of vegetation monitoring was to record the colonisation, establishment and spread of vegetation in permanent quadrats as the site developed into saltmarsh and mudflat, with additional monitoring outside the realignment on the natural saltmarsh for comparison.

2.3.2 The intertidal vegetation monitoring was carried out in July each year by the Centre for Ecology and Hydrology (CEH) in 2004 – 2007 and by CoastLife with the same personnel and methodology in 2008. The methodology can be found in Appendix B (Brown, 2009). Briefly, vegetation cover and composition were monitored at the same sampling stations used for the accretion and erosion monitoring. There were eight transects within the managed realignment area and two transects within an intertidal area southeast of the realignment site, with some additional sites on the narrow marsh in front of the realignment. Vegetation was surveyed at two scales:

- Large quadrats of 5m x 5m associated with each accretion monitoring transect, to give an overview of vegetation inside and outside the realignment site.
- Five 1m x 1m quadrats over each set of sedimentation plates or between each pair of level bars, to provide % cover of vascular plants, algae, litter and bare ground, an din which vegetation change could be related to the accretion and elevation measurements.

2.3.3 A transitional zone was also monitored. Five 2 x 2m quadrats were set up in 2004, but the markers for these quadrats had been removed by vandals by

2005. Instead, five new 5 x 5m quadrats were set up and assessed using the same methodology as the other quadrats within the site. The increased size of quadrats was considered to give a better cover across the transitional zone.

2.3.4 A considerable amount of vandalism to many of the measurement sites occurred in the first and second years of monitoring (2004 and 2005), where marker canes were broken or removed. However, all but two sites were relocated and re-instated.

2.3.5 When sites on the initially bare mudflat started to develop vegetation additional vegetation quadrats were set up to follow saltmarsh development.

## 2.4 Benthic Invertebrate Monitoring

2.4.1 The aim of the benthic invertebrate monitoring was to record benthic community structure and sediment properties of the newly accreting mudflats within PHS relative to an established mudflat community adjacent to the managed site.

2.4.2 This monitoring was undertaken by the Institute of Estuarine and Coastal Studies (IECS) of the University of Hull and the full methodology is included in Appendix C (Mazik *et al*., 2009). The approach used the same transects as accretion/erosion and vegetation monitoring. Annual sampling took place at fixed locations in the existing and 'new' intertidal habitats. Due to high levels of accretion, station 1A became elevated above the zone of frequent inundation and the sediment in this area remains dry for significant periods. Station 1A therefore replaced with stations 8A and 9A, situated close to the western breach, which were sampled for the first time in 2007.

2.4.3 A number of replicate core samples from each location were tested for invertebrate analysis and one for organic carbon and particle size analysis (if needed) at each location; samples were then analysed for species composition and abundance, wet weight biomass, mean lengths of large invertebrates, and organic content.

## 2.5 Avifauna Monitoring

2.5.1 Avifauna monitoring aimed to:

- Assess the level of impact on avifauna of the pre-breach construction programme
- To observe the species and abundance of species using the new habitat compared to a 'control' site
- To observe avifauna usage and behaviour on the new habitat.

2.5.2 Ornithological monitoring was undertaken by the Institute of Estuarine and Coastal Studies (IECS) of the University of Hull and the full methodology is reproduced in Appendix D (Mander *et al*., 2009). Pre–breach monitoring using a single count point methodology allowed good views of the fronting mudflats and the majority of the retreat area, whilst minimising the potential for counter disturbance. Following the breach, a two point count approach was used and care taken to minimise disturbance to the avifauna of the area. Counts were conducted over a half tide cycle, either high to low or low to high water. Observations of behaviour (and behaviour change, e.g. disturbance) were also recorded.

## 2.6 Volunteer and Other Surveys

2.6.1 A programme of additional monitoring was organised by the Environment Agency to gain information about the wider biodiversity of the site. This was mainly carried out by volunteers including the Hull Valley Wildlife Group and comprised monitoring of marginal vegetation in the new soke dyke and new pond, general walkover surveys for Odonata and Lepidoptera, mammals and additional bird monitoring of the whole site, complementing IECS studies. This monitoring was undertaken in specific sectors at the PHS site as indicated in Appendix F. Botanical and water vole monitoring were also conducted in the first and second years of monitoring and water vole survey was repeated in 2008.

2.6.2 A survey of aquatic macro-invertebrates in the new car park pool and soke dykes was undertaken by Martin Hammond (Hammond, 2008) to evaluate both effectiveness of translocation and the overall fauna. The results are included in Appendix E. Sampling of aquatic invertebrates was conducted annually in May at four sampling points in 2004-2008 (Figure 2.1).

**Plate 3 - Pond (Martin Hammond, 2005)**

2.6.3 Other data and monitoring included tide and surge data (Environment Agency) and rainfall data (Environment Agency). These data have been included in the Annual Report as Appendix G. A photographic record of the site was also maintained, contributed to by Environment Agency field visits and volunteer photos. These are provided in Appendix H.

# 3 SUMMARY OF MONITORING RESULTS

## 3.1 Introduction

3.1.1 Complementary monitoring methods were employed at Paull Holme Strays to measure the rates of accretion/erosion at the realignment site, vegetation coverage, bird use of the site and benthic diversity (Appendices B, C and D) so that results could be readily inter-related. Combined with the supplementary data collected by volunteers and hydrometric data, the results provide a holistic view of the development of saltmarsh and mudflat habitats following the breach.

3.1.2 The monitoring results may be usefully considered in light of this basic time line for development of the site:

- Pre September 2001 – Site largely in arable use, the land being bare between plantings typically of oilseed and cereals. There was also some rough grassland, hedgerows and some well-vegetated brackish water pools (old borrow pits) present.
- September 2001 to September 2003 – Site under various stages of construction with large areas of disturbed or bare ground, ephemeral pools (especially during winter flooding) with ex-arable areas reverting to rank vegetation.
- Post September 2003 – Breaches created and site subject to tidal inundation creating large areas of new open water (where new borrow pits were flooded) and encouraging development of mudflat and saltmarsh areas.
- March 2005 – 1st Annual Monitoring Report covering the period October 2003 to November 2004.
- March 2006 – 2nd Annual Monitoring Report covering April 2004 to October 2005.
- March 2007 – 3rd Annual Monitoring Report covering November 2005 to September 2006.
- March 2008 – 4th Annual Monitoring Report covering September 2006 to September 2007.
- March 2009 – 5th Annual Monitoring Report covering September covering September 2007 to September 2008.

## 3.2 Accretion and Erosion

3.2.1 This section summarises the results and analysis of accretion and erosion inside and outside the managed realignment in 2008, the fifth year of monitoring (Appendix B: Brown, 2009), with reference to the measured changes that have occurred since the CEH monitoring began in May 2004 and estimated changes since the tidal defence was breached in September 2003. Results for previous years are contained within the annual reports: Brown & Garbutt (2004), Brown *et al*. (2005), Brown & Brown (2006) and Brown & Brown (2007).

3.2.2 The process of accretion is fundamental to understanding the development and sustainability of intertidal habitats. Accretion continued at PHS during the five years since the sea defences were breached with the winter and summer differences in accretion rate observed in previous years still apparent; i.e. greater net accretion during the winter periods than during the summer, with a small drop in the surface level during summer at some sites caused by drying and compaction with erosion of cracked surfaces.

3.2.3 In all years there has been an inverse relationship between accretion rate and elevation on the vegetated saltmarsh both inside and outside the site (as expected). There was no such relationship on the mudflat outside the site but it was very strong for the mudflat inside the realignment, most likely due to more sheltered conditions inside the site (Figure 3.1). The fastest rates of accretion have been and still are in the northern part of the realignment site which was initially at a lower elevation than the southern part. The mean total accretion in the north between May 2004 and September 2008 was 32.7cm, ranging from 4.2cm at the highest site to 62.5cm at the lowest site. The higher elevation southern part of the site had a lower rate of accretion over the monitoring period, with mean total accretion between May 2004 and September 2008 of 5.61cm, ranging from 0.83-16.4cm. The estimated (including back extrapolation) mean total accretion since the time of the breach to September 2008 was 44.7cm (lowest site estimate at least 80cm) for the northern part and 6.65cm for the southern part.

3.2.4 Across the whole site the mean rates of accretion for elevation categories (based on elevations measured in 2005) between May 2004 and September 2008 were:

- 2.0-2.3 mODN class: 47.1 cm
- >2.3-2.6 mODN class: 30.3 cm
- >2.6-3.0 mODN class: 9.19cm, and
- >3.0-3.5 mODN class: 3.01 cm.

3.2.5 Estimated accretion from the time of the breach to September 2008 for each of these elevation groups was 63.9 cm, 42.3 cm, 11.7 cm and 3.47 cm, respectively.

3.2.6 However, net accretion rate has progressively decreased over time across the northern part of the realignment, but most markedly at the initially lowest sites (Figure 3.2). This was expected as a consequence of the increase in elevation and shorter duration of tidal inundation. For example mean annual accretion was 14.6 cm, 12.1 cm, 7.29 cm, 5.67 cm and 4.15 cm for 2003-4 to 2007-8 respectively in the northern part of the realignment. Across the whole site, the decrease in accretion over time was, as expected, most rapid in the lowest elevation category (measured in 2005 at 2.0-2.3 mODN), with no measurable change in the highest elevation category (in 2005 at >3mODN).

3.2.7 Comparisons between the inside site accretion and that on the habitats outside showed that mean accretion on mudflats inside the realignment was more than three times greater than that on mudflats outside the realignment. However, accretion on the vegetated higher elevation sites (above ~2.8 mODN) was comparable to rates at those elevations outside.

3.2.8 The development of drainage creeks across the mudflat has been seen to initiate rapid change to the hydrodynamics of the site. With creek development drainage between tides has increased and sediments have become drier and firmer, which has increased suitability for development of vegetation (Section 3.3). Particularly dramatic changes have been observed in a deep creek that developed through the southern breach. This has continued to cut back through the site, joining up with the field drain that crossed the site and deepening it considerably during 2007. In 2008 this has resulted in the shallow pool at the southern end of the site draining between tides. It may take several more years before hydrodynamic equilibrium is reached in this area.

**Plate 4 - Creek through southern breach eroding mudflat area (S.L. Brown, 2008)**

3.2.9 Monitoring of accretion around the gasline posts has shown build up of sediment each year and, therefore, no indication of any threat of exposure of the subterranean pipeslines. Mean accretion was comparable to that on the mudflats in this area and was 28.6 cm (range 12 – 43 cm) between October 2004 and September 2008.

**Plate 5 - Mudflat accretion and creek formation (S.L. Brown, 2008)**

## 3.3 Intertidal Vegetation

3.3.1 This section summarises the development of intertidal vegetation inside the realignment site during the fifth year of monitoring, with reference to the development of intertidal vegetation over the entire five year period since the sea defence was breached (reports are combined with those for accretion, see Section 3.2).

3.3.2 In quadrats, the vegetation cover in July 2008 ranged from 0% to 99% cover. Mean cover in the north of the site was 31% in 2008 (up from 2.9% in 2004) and large areas of the mudflat had accreted to an elevation suitable for the development of saltmarsh, with vegetation spreading out from the site margins and the drain edges (Figure 3.3). Common Cord-grass *Spartina anglica* began to colonise parts of the central mudflat after about 2005 and has been spreading to form larger patches of vegetation as individual patches expanded in size and joined together. In the south the elevation was sufficiently high for saltmarsh development from the start and mean cover in 2008 was 76% (up from 19.6% in 2004). There was a steady increase in vegetation cover except at some locations with poor drainage and at high elevation quadrats where a decline in pioneer species (Spear-leaved Orache *Atriplex prostrata* and Lesser Sea-spurrey *Spergularia marina*) has not yet been offset by an increase in typical perennial saltmarsh species.

3.3.3 The only species at low elevations (2-2.3 mODN in 2005) was Common Cord-grass and this only started colonising in 2007. Vegetation started colonising the >2.3-2.6 mODN elevation group earlier, in 2005. At high elevations the pattern has been for early colonising ground-spreading species such as Spear-leaved Orache and Lesser Sea-spurrey to be replaced by cover of typical saltmarsh species (Common Saltmarsh-grass *Puccinellia maritima*, Sea Aster *Aster tripolium* and Common Cord-grass). For these sites, cover increased most rapidly between 2005 and 2006 (Figure 3.4). Other species such as Sea-purslane *Atriplex portulacoides*, Sea Plantain *Plantago maritima* and Sea-milkwort *Glaux maritima* have been slow to come in but are now starting to spread. The highest elevation sites (>3.0-3.5 mODN) have had the greatest vegetation cover throughout the survey due to Common Couch *Elytrigia repens* being present at some locations before the breach. In the upper zones Sea Couch *Elytrigia atherica* and Red Fescue *Festuca rubra* are steadily increasing following a decline in the early colonisers of the bare ground. All 24 species found in the saltmarsh outside the site (all typical for the habitat) were found inside the site in 2007 and in quadrats in 2008.

3.3.4 The transition zone is very narrow and has become dominated by perennial grasses, in particular Common Couch, Creeping Bent *Agrostis stolonifera* and Sea Couch, which are forcing out any more interesting herbs. Management would be required to reduce the vigour of the grasses. However, in general there is little transition zone on the Humber because the natural succession is truncated by the sea wall, therefore there may be little seed source for more desirable and transitional zone indicator species.

3.3.5 All species inside are occurring in the elevation zones where they are typical outside and the same species are occurring inside as outside but there are still differences in the communities present due to differences in relative species abundance, i.e. the community types have not fully developed yet. Results suggest that development of vegetation to relative species abundance and community types that are equivalent to those outside at the same elevations may still take some years to achieve.

## 3.4 Benthic Invertebrates

3.4.1 This section summarises the results and data analysis for year five of benthic invertebrate monitoring inside and outside the managed realignment site. Reference is made to the changes in the benthic invertebrate populations over the entire five year monitoring period. The full report for benthic invertebrate monitoring in 2008 is found in Appendix C (Mazik *et al*., 2009). Results for previous years are contained within the annual reports Burdon *et al*. (2005), Leighton (2006), Mazik (2006), Mitchell *et al*. (2008).

3.4.2 The sediments in this area are typical of this region of the estuary composed of silts/clays and fine sands with moderate to high organic content. The sediments inside the site have been marginally finer and with higher organic content than those outside the site, which reflects the fact that this site is effectively a continuation of the upper shore, the site is more sheltered than outside areas, and vegetation was not removed from the site prior to breaching. Over the five year monitoring period, the size of particles has fluctuated both inside and outside the site, therefore the size of particles is considered to be unrelated to the realignment.

3.4.3 In 2008, 25 species of benthic invertebrate were recorded; 20 inside the site and 21 outside, therefore species richness inside is now comparable to that outside, which is a typical community of a middle estuarine area. Increases in species richness, total abundance, total biomass and diversity were greatest between 2005 and 2006 but continued to 2008. However the mean species richness, abundance and diversity were lower inside than outside, so differences in the communities are still significant (Figure 3.5). Although mean species richness is lower inside, biomass is more or less equal inside and outside because bigger species are found inside. This pattern of species is indicative of small, early colonising species, present in high numbers (in this case *Paranais litoralis*) being replaced by less abundant, larger bodied organisms (e.g. *Hediste diversicolor*). This suggests that the communities inside are not yet fully developed, although the rate of change inside the site has slowed since 2006.

3.4.4 Four terrestrial/freshwater species were found inside the realignment over the five year monitoring period but these are no longer a significant part of the community, in contrast to 2004 when these were dominant. The magnitude of change over time is illustrated by the calculation of 88% dissimilarity between the communities in 2004 and those in 2008 inside the site. Outside, the community has been stable. Dissimilarity between inside and outside has reduced from 78% in 2004 to 56% in 2008, and communities near the western breach were quite similar in 2008 to those found outside, being dominated by the polychaete *Hediste diversicolor*.

3.4.5 Community development appears to be related to elevation, tidal inundation and, to a lesser extent, accretion, with colonisation being greatest in areas of moderate accretion but being limited in areas of excessively high accretion. Rapidly accreting sediments are too fluidised for organisms that inhabit semi permanent burrows to survive. Conversely, sites at high elevation with low frequency of inundation do not have the larval supply required for colonisation.

## 3.5 Ornithology

3.5.1 This section summarises the results and data analysis for year five of avifauna monitoring inside and outside the managed realignment site. Reference is made to the changes in the status of bird communities and use of the site by birds over the entire five year monitoring period. Results are reported in quarterly summary reports and an annual report. The full report for avifauna monitoring in 2008 is found in Appendix D (Mander *et al*., 2009). Results for previous years are contained within the annual reports Mander & Cutts (2004), Mander *et al*. (2005), Mander *et al*. (2006), Mander & Cutts (2008a).

3.5.2 There continues to be a change in the wintering species using the site, this is to be expected with the continuing development and change of habitats in the realignment (Figure 3.6). However outside the winter period no change can be detected. This is likely to be due to rapid turnover of species during passage period times in the Humber which cannot sufficiently be recorded with single monthly counts.

3.5.3 Bird usage of the site is continuing to increase though numbers of early colonisers such as Teal *Anas crecca* and Mallard *Anas platyrhynchos* are now in decline. The highest densities of foraging waders were found on the mudflats in the north of the site, while the high-water islets in the south of the site are important for roosting/loafing birds. Most species prefer the large sectors for roosting. Permanent pools are used at high water by waders but in 2008 they were used less frequently by waders – possibly because they are draining more. Peak maxima of 174 Redshank and 365 Dunlin were recorded during the winter of 2007/2008. Overall, density of activity is lower than the expected for the potential carrying capacity of the site.

3.5.4 Areas inside the realignment have a different usage to areas outside, with more foraging wildfowl and less foraging waders (specialist feeders) inside the site than outside. The exceptions to this were that there were more Redshank, Grey Plover *Pluvialis squatarola* and Bar-tailed Godwit *Limosa lapponica* inside, probably because these species have a preference for the upper shore.

3.5.5 The site continues to be of international importance for Golden Plover in winter, and Black-tailed Godwit in spring and summer. Fewer Avocets *Recurvirostra avosetta* attempted to nest in 2008, following the unsuccessful nesting (flooded by high spring tides) in 2007. The saltmarsh is becoming more dense (sea aster) and is therefore becoming less suitable for this species and other breeding waders. However, Wigeon *Anas Penelope* may start using the site if red fescue continues to spread in the upper zones,

especially as they have been displaced elsewhere on the Humber by grey geese sp.

### 3.6 Volunteer and Other Survey Results

3.6.1 Volunteer bird surveys over the past five years have shown up to 20,800 birds using the site in winter (monthly maxima in December 2003, Figure 3.7) with 64 species in total being recorded. The most numerous species recorded by volunteers in each year over the five years of monitoring were all wading species including Golden Plover, Black-tailed Godwit, Lapwing *Vanellus vanellus*, Dunlin and Redshank, which is consistent with the main bird monitoring undertaken by IECS. Wildfowl represent 5 to 10% of birds using annual sum of monthly maximas recorded in years 1-3 but then decrease in relative numbers in years 4 and 5. This may partly be explained by the decline in numbers of Teal and Shelduck *Tadorna tadorna* (annual sum of monthly maximas decreasing from around 1500 in 2003-2004 to 200 to 400 in 2007-2008), the increasing relative importance of passerine birds in 2006-2007, almost entirely due to large flocks of Fieldfare *Turdus pilaris*, and the increased relative importance of waders in 2007-2008 when they accounted for over 90% of annual sum of monthly maximas. Note that in 2005-2006, bird numbers appeared reduced and the peak monthly maximum was just over 8,000 birds, occurring in January 2006, but this may be due to changes in survey coverage.

3.6.2 Other fauna observed in 2007-2008 included five species of Odonata (dragonflies and damselflies). The majority of these were Common Darters *Sympetrum striolatum* and Migrant Hawkers *Aeshna mixta* seen in September. This is a slight change from previous years when Common Blue Damselfly *Enallagma cyathigerum* was the most frequently observed species. Ten species of butterfly were observed in year 5, 2007 to 2008, the most numerous being Gatekeeper *Pyronia tithonus* and Small Skipper *Thymelicus sylvestris*, again this differs from trends in previous data but this is likely to be due to variable timing of observations and weather. Mammals recorded in year five were fox *Vulpes vulpes* (as in previous years) but also common seal *Phoca vitulina* and Red Deer *Cervus elaphus*, which had not previously been recorded. Other species that had been recorded in years 1-4 were roe deer *Capreolus capreolus*, brown hare *Lepus capensis*, bank vole *Clethrionomys glareolus* and stoat *Mustela erminea*. Water vole surveys have found evidence that the species has colonised along the whole freshwater habitat area behind the new flood defences.

3.6.3 The aquatic invertebrate surveys found that aquatic invertebrate numbers in the car park pond increased in 2008 to 14 key taxa of which only 3 were closely associated with brackish water, compared to dominance by a single species, *Gammarus zaddachi*, in 2006. As such a freshwater community has

superceded the nascent lagoonal invertebrate community observed in 2006 and 2007 which has declined. This change reflects the reduction in conductivity (salinity) from 27 mS/cm-1 in May 2006 to 2.72 mS/cm-1 in May 2008 following engineering works. A newly emerged damselfly recorded in 2008 indicated that the salinity was sufficiently low for such freshwater species to complete their lifecycle. The aquatic invertebrate assemblage in the car park dyke has reflected the assemblage of the connected car park pond in all years (Previous results are found in Hammond, 2005; 2006 and 2007).

3.6.4 The western soke dyke has consistently had the greatest aquatic invertebrate diversity, which is probably related to the more diverse vegetation there and only mildly brackish conditions since creation. The eastern soke dyke continues to have a more species-poor assemblage and less vegetation.

3.6.5 As with previous years there were several substantial rainfall events at Great Culvert during spring and summer 2008, occurring in June and early September 2008. There were several peaks of rainfall in April and throughout August 2008 at Winestead. In 2008 there were no unusually high tidal surges. The raw data for tidal and rainfall monitoring are presented in Appendix G. The tidal data in particular have been used in the analysis of floral and faunal changes at PHS, wherever possible.

# 4 EVALUATION AND DISCUSSION

## 4.1 Five Years of Intertidal Habitat Development

4.1.1 The project at Paull Holme Strays is the first of the 'strategic' managed realignments to be delivered by the Environment Agency in the Humber Estuary and contributes 80ha of intertidal habitat creation to the strategic requirement. Monitoring development of the habitats and communities supported by the managed realignment site is crucial to measuring the success of the PHS site itself in meeting the biodiversity targets set in the Environmental Action Plan (EAP). It is also important for developing a wider understanding of such habitat creation projects.

4.1.2 Five years since the breach the rate of physical and biological change on the site has peaked and begun to decrease. The study has clearly demonstrated the fundamental importance of the underlying process of sediment accretion to intertidal habitat and ecosystem development. This process drives succession towards mature saltmarsh habitat that compensates for sea level rise and is, therefore, a key factor controlling the rate of development of the communities these support.

4.1.3 At PHS the rate of accretion in the north of the realignment site has been greater than was expected from assumptions made during design. This is attributed to the finding of an unexpectedly strong inverse relationship between elevation and net accretion on the mudflat zone, probably due to the 'settling tank' effect of the relatively sheltered conditions inside the site combined with the high sediment loads in the Humber Estuary. After five years even the lowest elevation sites here are beginning to show initial signs of colonisation by plants and, therefore, if this pattern of warping-up continues it is likely that the majority of the mudflat habitat of the north of the site will succeed to saltmarsh. Consequently the mudflat habitats and the fauna they sustain will perhaps only persist in the most exposed areas directly opposite the breaches (no accretion measuring points were located here due to difficult access at the start of monitoring).

4.1.4 The habitats and communities present have not yet stabilised with inter-annual change still occurring and differences in community structure and species abundances still apparent compared with mature habitats outside the site, indicating that ecological functioning of the site is not yet fully developed. This is to be expected after only 5 years of habitat development and is typical of early successional communities in dynamic and naturally disturbed environments. Indeed at many sites accidently breached during storm events, the timescale to develop habitat equivalent to neighbouring saltmarsh

runs into decades (Burd, 1994), although initial conditions including elevation may have been very different in some cases.

## 4.2 Assessment of Progress against EAP Targets

4.2.1 Quantitative targets given in the EAP for extent of intertidal habitat creation to compensate for direct losses at UW1 (PHS) and UW15 to 17 (Immingham), to compensate for coastal squeeze at these sites and to compensate for direct losses at Barton Haven were in total 7.14 ha of mudflat habitat and 5.9 ha of saltmarsh habitat.

4.2.2 The PHS scheme has created approximately 80 ha of intertidal habitat. Both intertidal mudflat and saltmarsh have developed on the site and after five years the extent of each of these habitats is well in excess of the targets. However, the expected outcome in terms of the ratio of mudflat to saltmarsh habitat is proving to be different from that anticipated before the breach, since accretion on mudflats has been so rapid, resulting in warping-up to elevations that allow colonization of saltmarsh plants. Nevertheless, the site is varied with a wide range of elevations. Different vegetation communities are also developing successfully and increasing in density and diversity. As set out in the targets, the vegetation communities that have developed are representative of saltmarsh in the middle estuary in terms of species present in relation to elevation and the upper saltmarsh has been retained on the remnant flood bank.

4.2.3 The target for benthic invertebrates is for mudflats to support an assemblage of similar species, population abundance and biomass to the outside sites; although the EAP notes that targets for fauna in the new intertidal areas may take longer than 5 years to be met. The benthic communities that have developed in the mudflats to date have similar biomass to those outside but are still quite different in terms of mean species richness, species abundance and diversity measures. Therefore, as expected, progress has been made towards this target, but success is a function of time and is yet to be fully achieved. In addition, the rate of accretion and subsequent increasing extent of saltmarsh means that suitable habitat for benthic communities is becoming more restricted. Monitoring results suggest that where saltmarsh habitat has developed, the higher elevation, restrictions in tidal inundation and colonisation by saltmarsh plants mean that the benthic invertebrate communities will remain in an early stage of development with low species diversity, abundance and biomass.

4.2.4 The targets for birds were based on the bird populations of the Humber remaining stable over the review period. Targets are for at least 30 feeding wintering birds to be present, to include Redshank, Dunlin, Shelduck and Curlew and at least 12 roosting wintering waterbirds, to include Golden

Plover. These objectives have been met and exceeded in terms of species and abundance. Also the site has become a successful resource for wildfowl, although that was not a primary aim within the conservation objectives. However, it is noted that the targets were derived from an area of loss substantially smaller than the size of PHS, and density values and carrying capacity for many species at the PHS site continued to be lower than that encountered on the 'lost habitat'. This suggests that site function has not yet been compensated for which may be linked to the lagging development of benthic invertebrate prey.

## 4.3 Habitats Regulations Commitments

4.3.1 One of the major aims of the PHS managed realignment scheme was provision of compensation for habitat losses under commitments to the Habitats Regulations (European Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora), and thereby ensuring that the **integrity** of the European Sites is maintained in the **long term**.

4.3.2 Integrity of the mudflats and saltmarsh is dependent on sustainability and ecological functioning of the new habitats. The results of avifauna monitoring show that after five years the new habitats have very low density of bird use compared to the sites that were lost and adjacent intertidal habitats. This suggests that PHS does not yet fulfil its role as direct compensation, in terms of ecological functioning, for areas of loss elsewhere in the estuary and that, as expected, achieving ecological functioning is likely to be time dependent. However, even given sufficient time, the degree to which changes in foraging and roosting wader numbers reflect changes in carrying capacity rather than regional or national population trends is unclear and further analysis of a range of datasets is necessary to address this and attempt to establish causal factors and linkages. For example, there is considerable uncertainty as to whether the increased usage of the PHS site represented an influx of new birds to the area, or local movement of birds from an existing adjacent site (Saltend). Certainly there was a degree of correlation between increases in species numbers on PHS and reductions in populations at Saltend.

4.3.3 It is notable that numbers of waterbirds in the Humber are currently not habitat availability dependent, with external factors such as winter survival rates and success on breeding grounds being of greater importance. Therefore, targets relating to potential carrying capacity of new sites may not be suitable for ensuring maintenance of ecological integrity. In addition, the habitats created at PHS are not homogenous and comprise a mosaic of habitats which may be mutually exclusive for some foraging activities, e.g. c. 40% of the site is saltmarsh which is not exploited by foraging Redshank and Dunlin.

4.3.4 The commitment to maintain ecological integrity of the European Sites in the long term is also raised for consideration, since it is clear that habitats at PHS are still undergoing change with the succession from mudflat to saltmarsh and the long term success of the site is yet to be determined. Of particular importance is the fact that, with a plentiful supply of sediment into a sheltered area, current predictions are for the extent of mudflat habitat to gradually decrease and in the long term it is likely to become limited to the most exposed areas only, i.e. directly inside the breach locations. Under the Humber Estuary Flood Risk Management Strategy there will be a sequence of sites beginning succession from mudflat to saltmarsh over the next 50 years. It is suggested that in setting habitat creation targets for these sites the long term predictions for existing sites are born in mind, rather than the original targets for the sites.

4.3.5 It should be noted that saltmarsh is a limited habitat within the Humber Estuary due to coastal squeeze and truncated upper shore zones. Therefore, although more saltmarsh than was originally planned is likely to develop at PHS, this habitat contributes positively towards the value of the site for target birds by providing high tide refuges, breeding sites for waders and foraging habitat for wintering passerine birds. Developing saltmarsh also contributes favourably towards the targets for this habitat within the UK Biodiversity Action Plan, for which the Environment Agency is the lead organisation.

### 4.4 Sustainability and Management of the Site

4.4.1 The high rates of accretion recorded at PHS remain in excess of sea level rise in this area, therefore, the site is proving a positive contribution towards tackling coastal squeeze. However, as discussed above, the high rate of accretion also suggests that under current conditions mudflat is not a sustainable target habitat across much of the realignment site in the long term. Due to the time required for fully ecologically functioning mudflat to develop, only those sustainable areas will truly be contributing towards maintaining the integrity of this habitat in the Humber. Such high rates of accretion as recorded at PHS suggest that creation of sustainable mudflat in this location requires greater erosional energy within the realignment to balance sedimentation processes, i.e. design of larger breaches. This would have to be weighed against loss of existing cliffed upper saltmarsh fronting approximately half of the site. It is also possible that with greater sea wall removal, major re-contouring would be necessary to deal with the lower lying area at the back of the site.

4.4.2 In terms of sediment erosion, the channel that has developed through the south breach has continued to cut back through the site and now causes the permanent pools at the back of the site to drain. These pools have been of importance for wildfowl, which rapidly took up foraging and roosting on the

site after the breach and remains a key function of the site. However, there has been some reduction in numbers in the past year since the pools began to drain and there are likely to be impacts on other aspects of bird usage of the site. Such pools are not sustainable without an engineering solution such as installation of sills.

4.4.3 Other sustainability issues relate to individual species on the site, such as the colony of avocets. This breeding colony has been an important contribution of the PHS scheme to the bird assemblage of the Humber Estuary as a whole. Avocets are a new species on the Humber and have only been present for around 10 years. However, fewer avocets attempted to nest in 2008, following the unsuccessful nesting in 2007, due to inundation, and the increasing density of the saltmarsh vegetation at PHS is making the site less suitable for this species. Avocets are a pioneer species, therefore active management would be required to maintain appropriate conditions (Mander & Cutts, 2008b). A strategic decision is needed to assess whether management to raise the elevation of the islets in Sector I and vegetation management is worthwhile here or whether another site would be more suitable. In particular the sustainability of any management should be assessed.

4.4.4 If maintenance of the islets is agreed then it is suggested that a management plan for the Avocet breeding colony and other uses of the islets is drawn-up and implemented, with monitoring of the breeding colony undertaken to assess success and allow for subsequent 'tweaking' of conditions. If there is to be no management for this species, then the breeding success of avocet at this site would be strongly affected by the occurrence of very high spring tides during the breeding season, which occurs most years. Such management would also benefit populations of waders that use the islets to roost at high water (although vegetation management would also be necessary). If management is not undertaken then options to discourage them from nesting might be considered to prevent chicks drowning.

4.4.5 Anthropogenic disturbance is a significant pressure on the function of the intertidal area for waterfowl usage, being significantly bounded by public rights of way plus *ad hoc* unregulated disturbance across much of the intertidal area. This has considerable implications for breeding colonies on the site and should be addressed with management initiatives to reduce the daily impacts on the bird assemblage that effectively reduces the area of PHS available for bird activity. Options to manage disturbance should be identified in a study into the impacts of disturbance on foraging, roosting and breeding activities and investigated in terms of extent, duration and frequency of impacts. This could also inform management practices at other sites.

4.4.6 Sustainability of the new freshwater habitats has also been considered since saline incursion, as happened in 2005, will eliminate many freshwater invertebrates. Although the aim is to maintain freshwater habitats, brackish habitats are also of ecological value and therefore sustainability of fresh to brackish aquatic habitat, rather than freshwater habitat per se, is considered more likely and of equal value at this site.

## 4.5 Comparison with other Managed Realignments

4.5.1 Managed realignment schemes have been undertaken on different areas of the UK coast, with varieties of exposure e.g. open coastline, estuarine, and at sites with various tidal ranges and sediment loads. The drivers for these vary between cost effective solutions to problems of erosion to sea defence embankments and schemes to specifically provide compensation habitat for coastal squeeze or coastal defence or other works.

4.5.2 Often creation of saltmarsh has been found to be a greater challenge than creation of mudflat due to limited sediment supply and coastal erosion particularly in the southeast coast of Britain. Therefore, the particularly high rates of accretion at PHS make this an interesting site for comparison. For example Tollesbury realignment site on the Blackwater Estuary, Essex (Halcrow, 2008) experienced much slower saltmarsh habitat development than PHS. This 21 ha site was breached in 1995 and was initially at substantially lower elevation than the adjacent saltmarsh (Garbutt *et al*. in Reading *et al*. 2002 and 2008). By 2001 accretion rates at Tollesbury averaged 23mm per annum. This is an order of magnitude less than accretion rates observed over the first five years at PHS and is likely to be the reason for slower rates of saltmarsh development. In 2001 saltmarsh had only developed over 6 ha at Tollesbury and was dominated by Annual Glasswort *Salicornia europaea*, a pioneer species, and after 4 or 5 years the waterbird and invertebrate assemblages on this site were still evolving (Atkinson *et al*., 2004). Twelve years after the breach two saltmarsh plant communities had developed; *Puccinellia* saltmarsh SM13 and *Spartina* saltmarsh SM6 covering about 16ha. Mudflat dominated by mud snail, ragworm and Baltic tellin covered about 5ha (Reading *et al*., 2008).

4.5.3 To accelerate habitat development at Wallasey Wetland, Wallasey Island, southeast Essex (Halcrow, 2008), pollutant free mud was brought into the site to artificially raise the elevation prior to breach rather than relying on sediment accretion. It is expected that this site will reach its habitat and bird targets by only year five after the breach.

4.5.4 In contrast, to improve the likelihood of creating sustainable mudflat at Chowder Ness in the middle/Inner Humber (Halcrow, 2008) a long length of 570m of seawall was removed to increase connectivity with the wider estuary

and to increase energy levels inside the realignment. This compares to two breaches of 150m and 50m at PHS, which is five times larger in area. Initial topographic monitoring suggests an overall trend of accretion with an approximate average of 9cm across the site. This relatively high rate may be associated with errors in data collection (LIDAR), however it may also suggest that the high sediment loads of the Humber are strongly disposed to accretion rather than erosion, especially as this rate is comparable with that seen at PHS.

4.5.5 Another example of techniques aimed at mudflat creation in the Humber is at Welwick in the outer estuary. Here, wholesale removal of over 1.4km of the fronting seawall was undertaken, rather than the creation of breaches, complemented by re-profiling (elevation lowering), since warping-up in the past had raised the site to an elevation suitable for saltmarsh creation rather than mudflat habitat. In essence, the scheme was to un-do past anthropogenic changes. The fronting saltmarsh was retained. Removal of the whole seawall is not a widely undertaken exercise for reasons described in paragraph 4.5.2 and also for reasons of cost, but where suitable does offer a number of merits in the short to medium term such as lower tidal levels and decreased flood risks; reduced rates of coastal squeeze; reduced pressure on existing defences downstream of the site; increased space for estuary adjustments to future changes such as sea level rise; and greater ecological connectivity for import of juvenile species and propagules (Pontee *et al*., 2006).

4.5.6 Similarities have been drawn between PHS and Freiston Managed Realignment Scheme, in the Wash near Boston, Lincolnshire. For example, the Freiston site showed a similar, though less marked response of accretion with elevation when comparing sites at similar elevations inside and outside the site, i.e. locations inside the site showed slightly higher accretion than those outside at the low end of the elevation gradient and slightly lower accretion at the high end (Brown *et al.*, 2007). This can be explained by sediment being likely to drop out on entering the more sheltered realignment, leaving less material in suspension to be carried and subsequently deposited at higher elevations at the back of the site. Freiston also demonstrated similarities in creek development, with considerable erosion and major topographic changes associated with drainage system development including formation of massive creeks with side wall slumping and rapid headward extension.

4.5.7 The range of elevation at PHS makes the results here particularly interesting, since accretion, elevation change and subsequent development of saltmarsh could be studied in detail for a range of initial elevations within the same realignment. In contrast, at Freiston almost the entire site was at an initial

elevation suitable for saltmarsh development. This site was quicker to develop saltmarsh than PHS, which may also have been contributed to by Freiston being surrounded by more extensive saltmarsh than PHS, with potential for a larger source of propagules. Propagule availability can be an important factor in limiting plant abundance within marsh zones (Rand, 2000; Wolters *et al*., 2005). It has been estimated that the Freiston site may achieve an equivalent vegetation community to that outside after about 10 years post-breach (approximate estimate by S.L. Brown, in Brown *et al.*, 2007; Brown 2008).

4.5.8 Use of the Freiston realignment by fish showed that the new habitats were important nursery areas for juveniles, including commercial species (Brown *et al.*, 2007). Although not included in the monitoring programme, fish were sampled at PHS by IECS as part of the HARBASINS project. This showed that sand goby and flounder are the dominant fish along the Humber estuary, but that diagnostic species for middle/outer estuary sites including PHS were commercial marine species such as plaice, sole, whiting, sprat and seabass. Most of the fish caught in this study were small species or juveniles of species that rely on benthic food sources. This finding adds strength to the view of intertidal areas as important nursery grounds and essential habitats for estuarine and marine migrant species (Pérez-Dominguez, 2008).

## 4.6 Lessons Learnt

4.6.1 The design and monitoring of future managed realignment schemes in the Humber Estuary Flood Risk Management Strategy and elsewhere should be informed by the lessons learned and successes at PHS. As this is a relatively new management technique, guidance documents such as the CIRIA *Coastal and Estuarine Managed Realignment – Design Issues* handbook (Leggett *et al*., 2004) have been devised based on limited real examples, therefore, as more empirical evidence becomes available such guidance can become more informed and the likelihood of achieving targets increased. A number of lessons from the PHS site are documented below and relate to design of the realignment for maximum conservation benefit as well as design and implementation of the monitoring programme.

4.6.2 A key point emerging from evaluation of the PHS monitoring scheme has been that physical parameters are key to the rates of development and sustainability of different habitat types, and that accretion rates can be in excess of 0.5m over five years where elevation is sufficiently low and sediment load and shelter are sufficiently high.

4.6.3 In particular, the results at PHS demonstrate the importance of elevation in fauna and flora community development and that saltmarsh development rate is proportional to time to achieve appropriate elevation. Due to changing

elevation with processes of accretion, it is recommended that, where available, comparison sites outside the scheme are distributed over a range of elevations to allow valid analyses to be undertaken. Further to this, it is also recommended that monitoring point locations are selected based on topographic data for the site prior to breaching. Such topographic data is likely to be useful in predicting which areas of the site may trap water and be slow to drain. Initial elevation data together with local accretion rates would help to refine predictive models used to assess the likely saltmarsh to mudflat ratio outcome of realignment sites.

4.6.4 Design lessons are also apparent when the results of the monitoring are reviewed in context with other sites, since sustainability of mudflat habitats is unlikely in an estuary with high suspended loads like the Humber without providing a greater degree of exposure. Very high deposition (several mm of sediment) can occur on the north Humber saltmarsh surfaces on a single high spring tide (Brown, 1998) in conditions of high turbidity, but much of it may be re-suspended on the ebb tide and carried away. Therefore, if mudflat habitat is desired in such locations, it may be desirable to remove a greater length of the former embankment with compensation for further loss of fronting saltmarsh, which may be inevitable with degradation of the seawall in the long term. If a strategic decision is made to stick to the original targets for mudflat creation at PHS in the shorter term, then remedial breach modification action may be required.

4.6.5 The erosion and topographic changes observed both at this site and at Frieston during the process of achieving hydrodynamic equilibrium (creek development and associated erosion) may be unavoidable, especially as there are cost implications in site preparation, breach excavation etc. However, the findings from these two sites suggest that more research into such change could help in determining optimum breach width, number of breaches, site gradient and configuration and density of starter creek systems. An early development of an efficient drainage system seems to be critical for the success of saltmarsh creation as creeks supply sediment and nutrients, dissipate tidal energy, and drain the marsh during the ebb tide. Good drainage increases sediment stability and reduces water-logging which is detrimental to plant and benthic fauna colonization and survival, and creek configuration is critical for enhancement of the important nursery role of saltmarsh for juvenile fish. Poorly drained sites can also be subject to lower accretion rates since more fluid sediment is more vulnerable to erosion (Brown *et al*., 2007).

4.6.6 Monitoring of hydrodynamic changes may also help to inform possible designs to allow controlled warping directed at cost effective modification of unfavourable initial topography of a site. For example a phased approach to

warping and bank removal may rectify situations like the backward-sloping profiles at PHS, which may be an important long term sustainability issue when the fronting marsh is exposed to erosion after the remaining sea defence has eroded away.

4.6.7 Integration of monitoring and analysis for example of vegetation and accretion data has proved extremely successful in providing insights into species colonisation, establishment and succession of species on new areas exposed to tidal inundation. It is highly recommended that complementary monitoring is employed in all future monitoring programmes in order to increase the power of the data and to identify relationships and causal factors. However, the integration of analysis at PHS could be improved, since the annual reporting regime established at this site has not been amenable to full integrated analysis so that some hypothesised relationships e.g. between benthic fauna and accretion rate, have not been verified. This is largely related to contract programming and availability of funds, therefore, it is recommended that where possible arrangements for monitoring and analysis for the project lifecycle are in place prior to scheme implementation and that these are developed in light of circulation of all available data to all parties. This is particularly important to ensure that the rapid changes following breaching are captured, especially given that this scheme has demonstrated how important this factor is in explaining all other variables over the subsequent monitoring programme, and may also be used to refine outcome predictions.

## 4.7 Future Monitoring

4.7.1 The 2008 results show that all parameters measured within the intertidal habitats are still changing and/or have not yet become as diverse or of the same community structure as outside habitats. This provides a strong impetus for the continuation of monitoring at the site. At present we do not know how long it takes to create saltmarsh and mudflats with equivalent community structure to adjacent habitat, from good initial starting conditions. From a wider view, continued monitoring at a number of contrasting sites will enable estimates of progress against BAP targets to be calculated by proxy. In addition, there are few examples of monitoring of managed realignment sites over a long time scale (Halcrow, 2008). Therefore it is proposed that a further five year monitoring programme is undertaken, at the end of which, ten years of detailed managed realignment monitoring will have been recorded.

4.7.2 Due to the reduced rate of change, monitoring of accretion, vegetation and benthic invertebrate sampling is proposed to continue at the same level of detail, in order to retain scientific power, but at reduced frequency, i.e. twice

within a five year period. A number of sites which had not provided useful data would be removed from the samples to streamline data gathering effort.

4.7.3 The avifauna community continues to have inter-annual change, therefore, it is proposed that annual surveys continue; an alteration in survey frequency at this time would be of limited value. The existing monitoring protocol is considered to remain sufficient to meet the broad requirements of the programme, with monthly counts conducted at low, mid and high water. The analysis of the winter core data should allow for further trend analyses to be conducted with a likelihood of significance, whilst the passage data will continue to allow site function to be assessed.

4.7.4 The targets for birds were based on the bird populations of the Humber remaining stable over the review period. As such it would be useful to assess bird counts in relation to the overall bird populations on the estuary for different species. It is, therefore, suggested for future reporting that the trends in the abundance of key species using the PHS realignment site over the monitoring period should be addressed in the wider context of local (middle estuary), regional (Humber) and national trends for those species over the same timeframe. Indeed, it is suggested that additional analysis on regional trends be undertaken to cover a period prior to the commencement of the monitoring programme, in order to identify medium term population patterns for key species in the area. In addition to the standard waterfowl survey programme, it is also proposed that a single breeding bird survey be undertaken on an annual basis, in order to charcterise the assemblage on the site, including Avocet and passerines

4.7.5 Also, in order to address lessons learnt from the first five year period regarding integrated analysis of results, it is proposed that additional analysis is carried out to relate accretion and elevation data to benthic fauna data. This will test hypotheses and provide value results in terms of predicting and designing length of time required to establish a functioning intertidal ecosystem.

## 4.8 Conclusions and Recommendations

4.8.1 The key findings at Paull Holme Strays are:

1. Over a five year period approximately 80ha of saltmarsh and mudflat habitat have been created, and the monitoring programme implemented has proven to be a sound basis for observing the development of the site and assessing the progress towards achieving targets.

2. The site has achieved EAP targets for habitat creation with typical saltmarsh species present, and usage by waterbirds as specified to

compensate for lost habitats. However, despite clear progress towards developing a benthic invertebrate community, this aspect, as expected, is lagging in terms of meeting targets, and the density of birds using the site is much lower than was the case on the sites lost for which they are compensating.

3. Accretion and saltmarsh development is greater than originally expected and it is suggested that the site will become dominated by saltmarsh within a few years.

4. The key factors affecting the development of the site are the sediment load in the Humber estuary and the limited exposure of the site, which have had profound implications for rates and types of habitat creation. Resulting elevation has been demonstrated to be critical to rates and locations of vegetation development. Sustainability of mudflat habitats appears to be limited by the lack of exposure at this site, however this is a trade-off with erosion and losses of natural saltmarsh along the frontage of the remaining sea defence and cost implications.

5. Hydrodynamic changes, with development of drainage systems have also been demonstrated to be critical for vegetation and benthic invertebrate community development and impact strongly on bird usage.

6. Compensation for lost borrow pit and soke dyke habitats by translocation appears to have been successful with water vole, vegetation and freshwater invertebrate communities establishing.

7. The data sets generated during this five year study have been a powerful resource in developing understanding of processes and considerations in managed realignment habitat creation and contribute to current best practice.

4.8.2 Recommendations from this study are provided below (not in any particular order):

8. Monitoring should continue for another five years with the same methodology, however due to reduced rates of change the frequency of monitoring for accretion, vegetation and benthic invertebrates could be decreased.

9. Further studies should be undertaken into interrelationships between data sets e.g. relationships between benthic invertebrates and accretion, and benthic invertebrates and birds activity, and into the context of the avifauna population of the site in relation to regional and national trends.

10. Long term objectives for the site should be set in the light of predicted outcomes and commitments under the Habitats Regulations for the Humber Estuary in general (including review of the EAP). A number of management decisions will need to be made in relation to sustainability of the site and, where necessary, schemes to implement management need to be initiated.

11. Lessons learnt at this site (section 4.6 of this report) should be used to assist future planning and management of realignment sites in the Humber and elsewhere.

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**FIGURES**

Figure 1.1 General Plan of the Paull Holme Strays Site

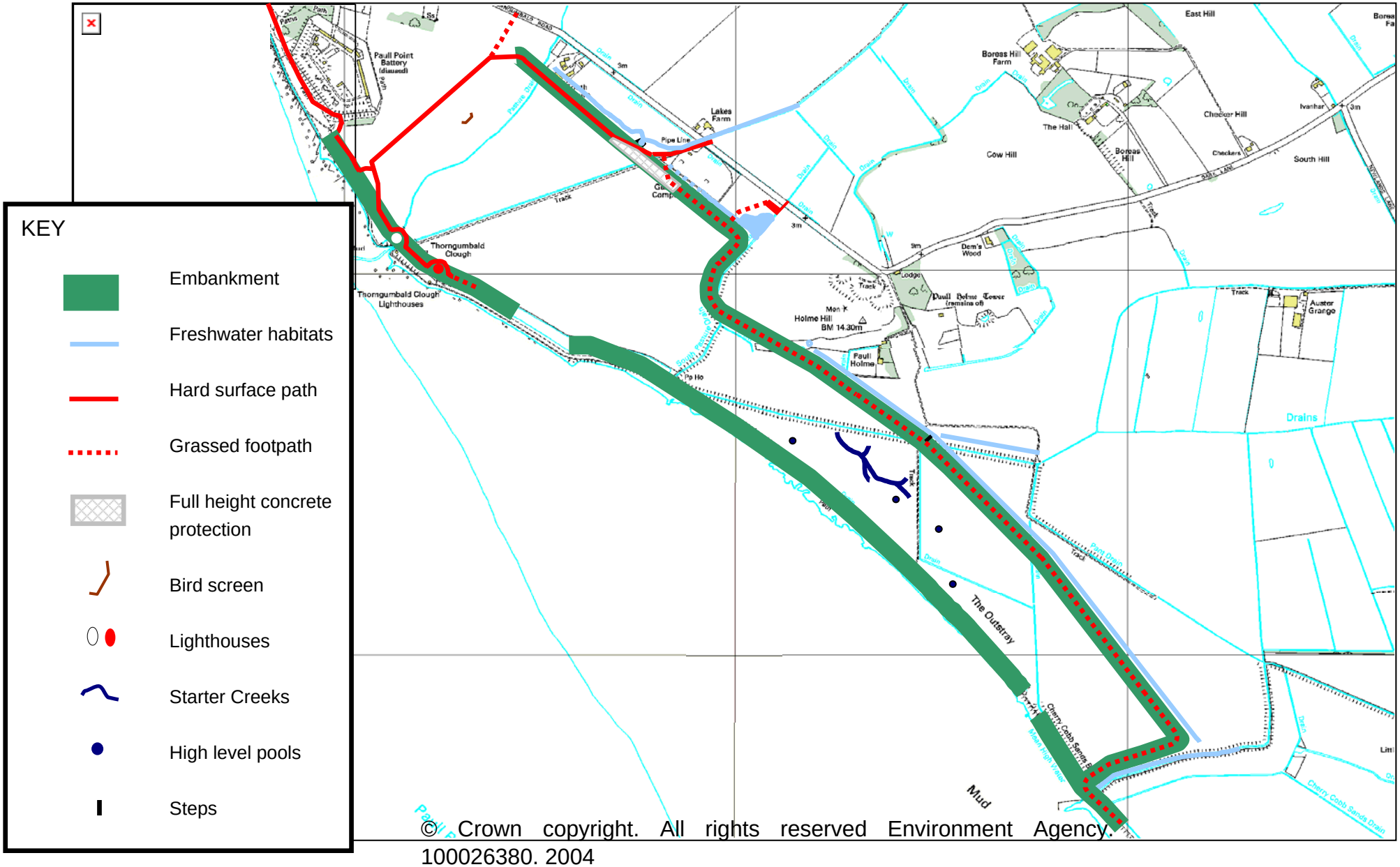


Figure 2.1 Aquatic Invertebrate and Water Vole Monitoring Locations.

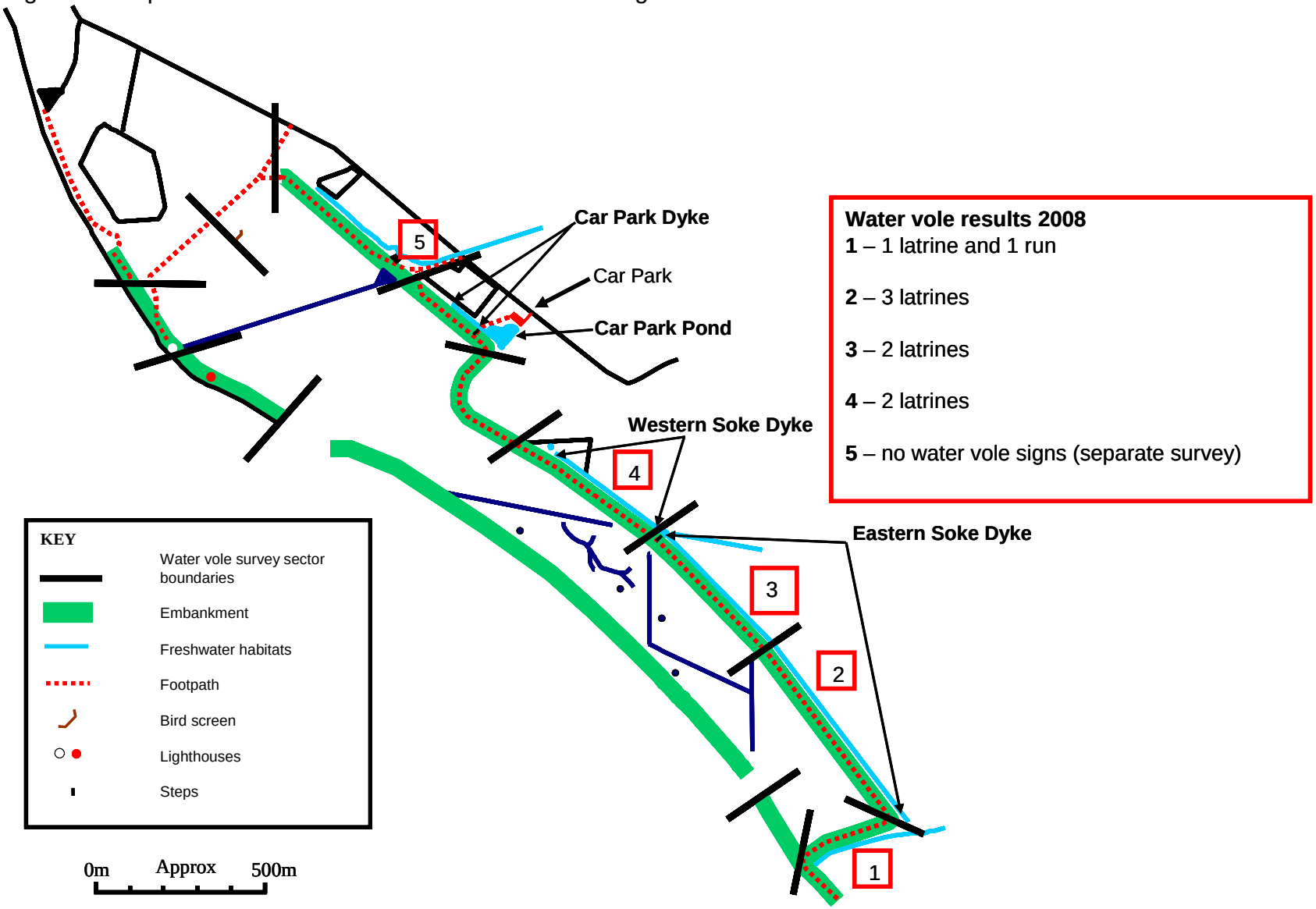


Figure 3.1: Total Accretion by Elevation Inside and Outside the site between May 2004 and September 2008. Adapted from Appendix B (Brown, 2009)

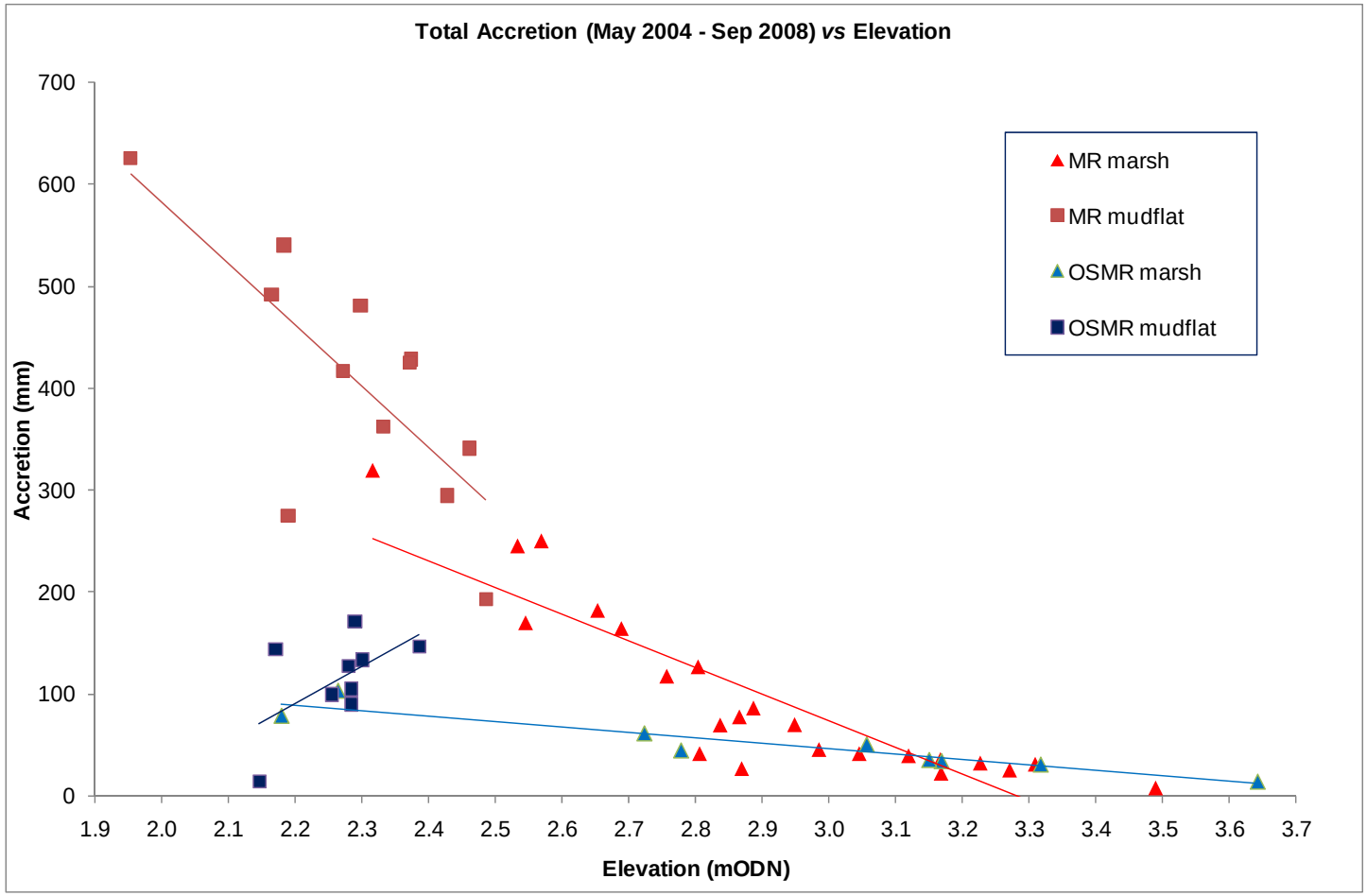


Figure 3.2: Mean Accretion by Elevation Category Inside the Realignment Since 2004. Adapted from Appendix B (Brown, 2009)

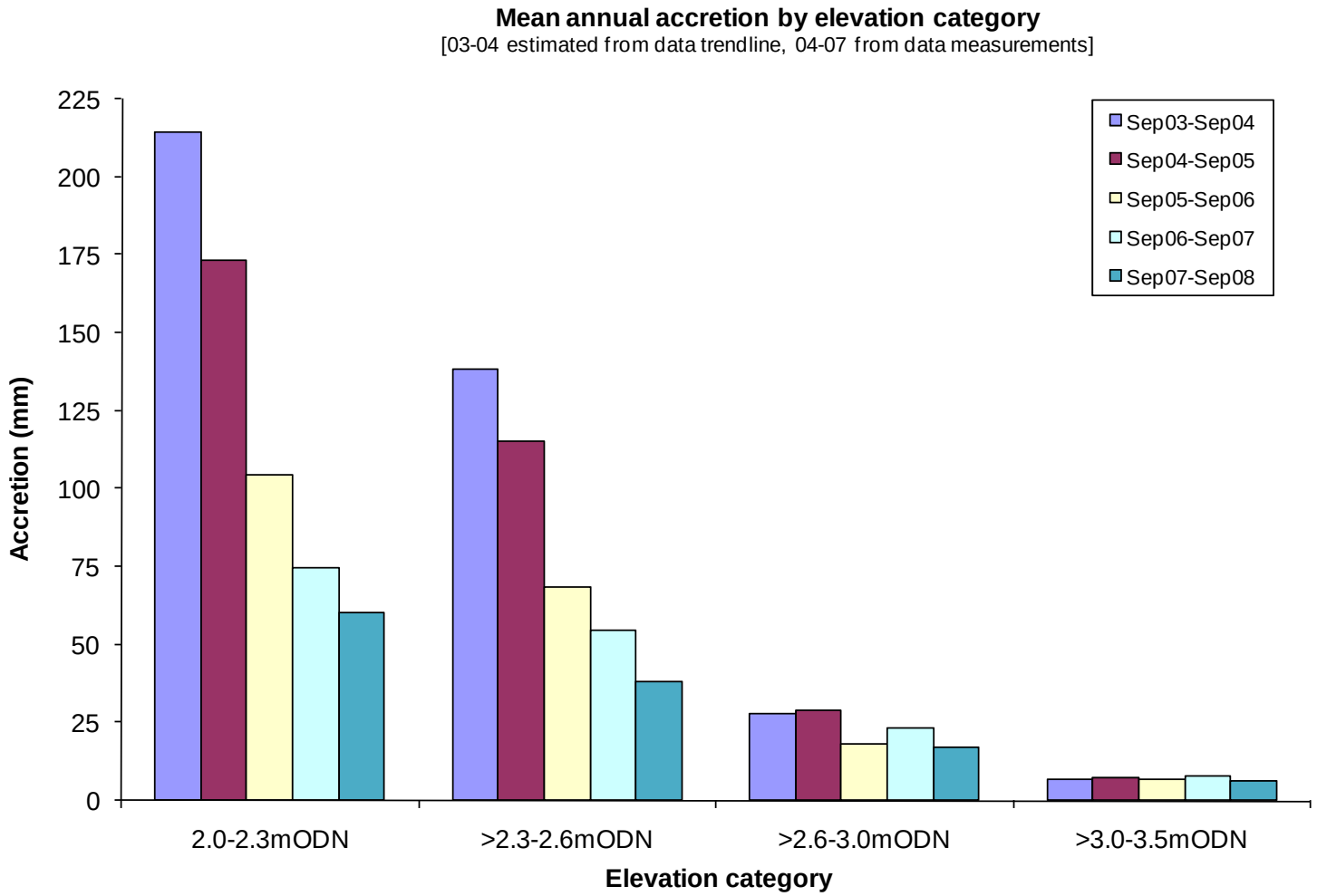


Figure 3.3: Mean Total % Vegetation Ground Cover in 25m$^2$ Quadrats by Sector. Adapted from Appendix B (Brown, 2009)

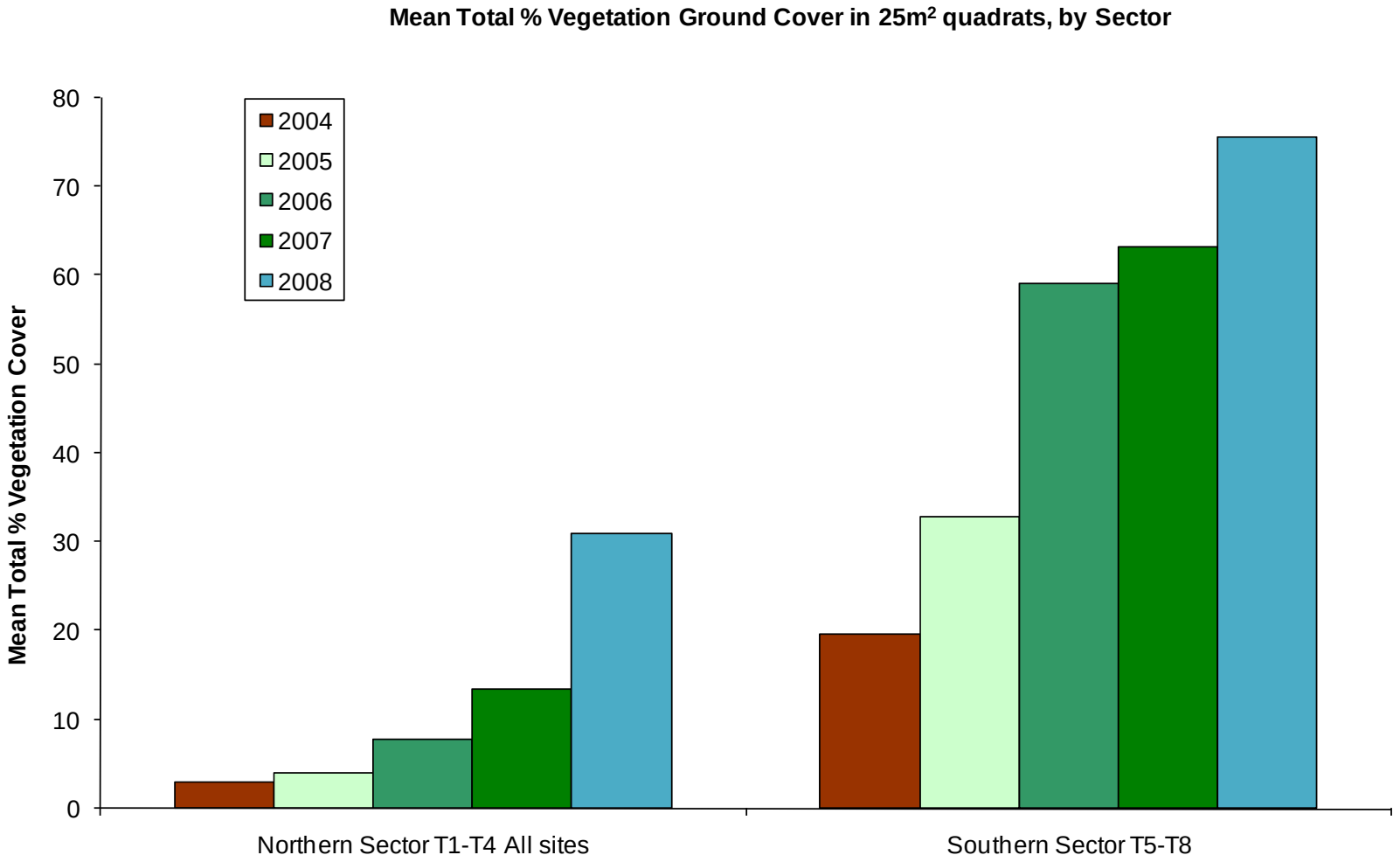


Figure 3.4 Mean Total % Vegetation Ground Cover in 25m$^2$ Quadrats by Elevation. Adapted from Appendix B (Brown, 2009)

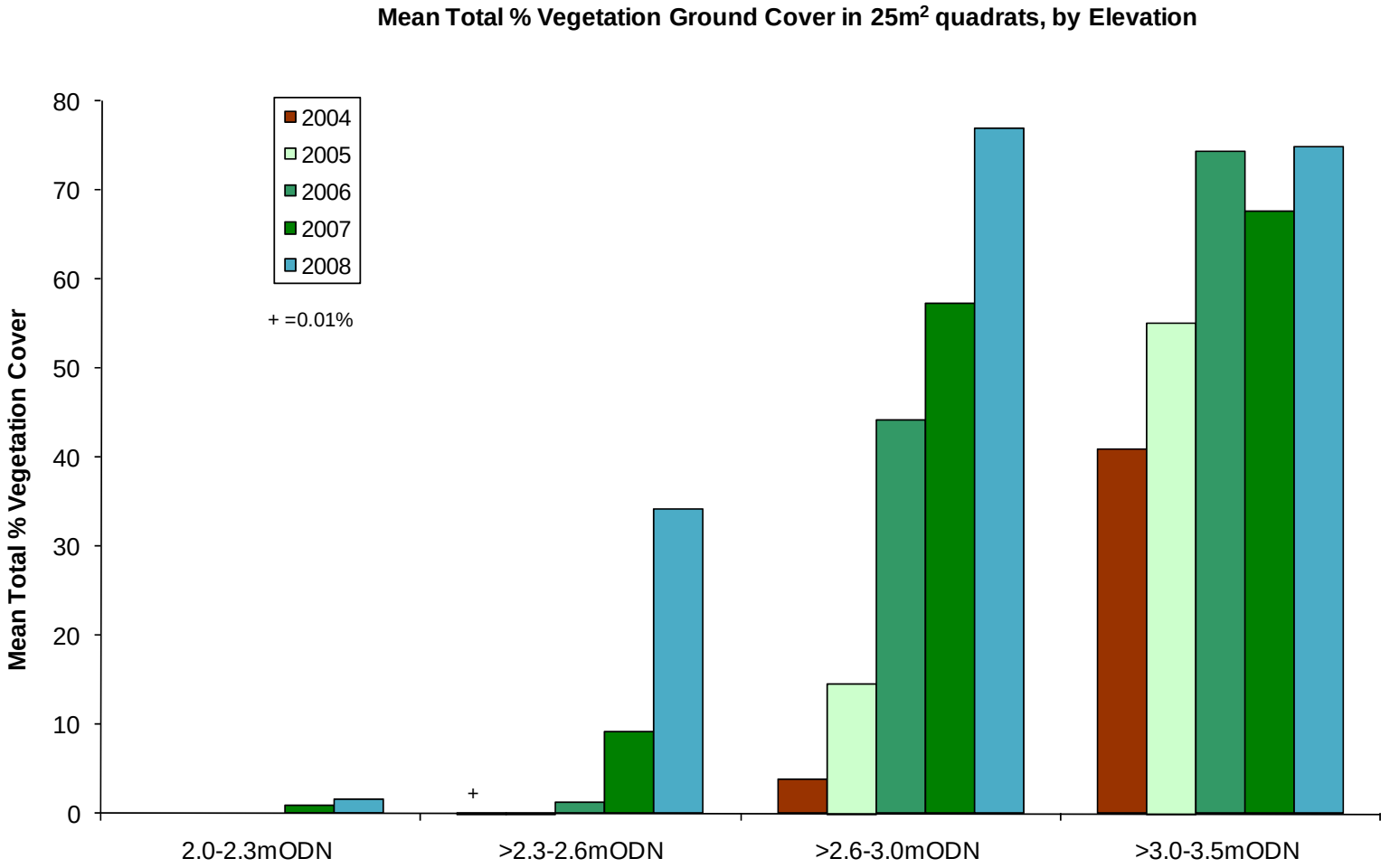


Figure 3.5. Temporal Changes in the Number of Species, Abundance, Biomass and Diversity (mean ±SD) of Benthic Invertebrates between 2004, 2007 and 2008 for Stations (Collectively) Inside and Outside the Realignment Site. Adapted from Appendix C (Mazik *et al*. 2008).

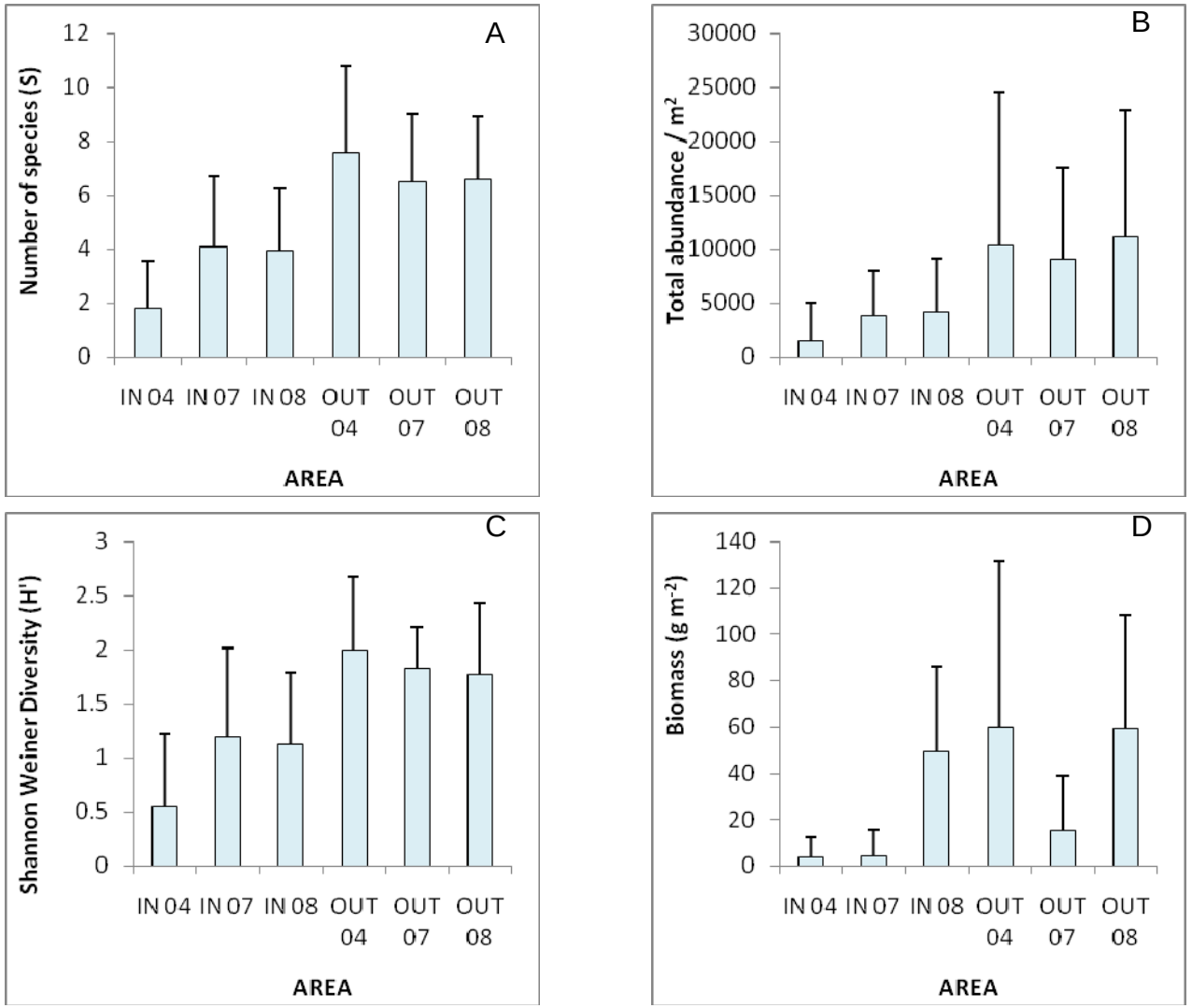
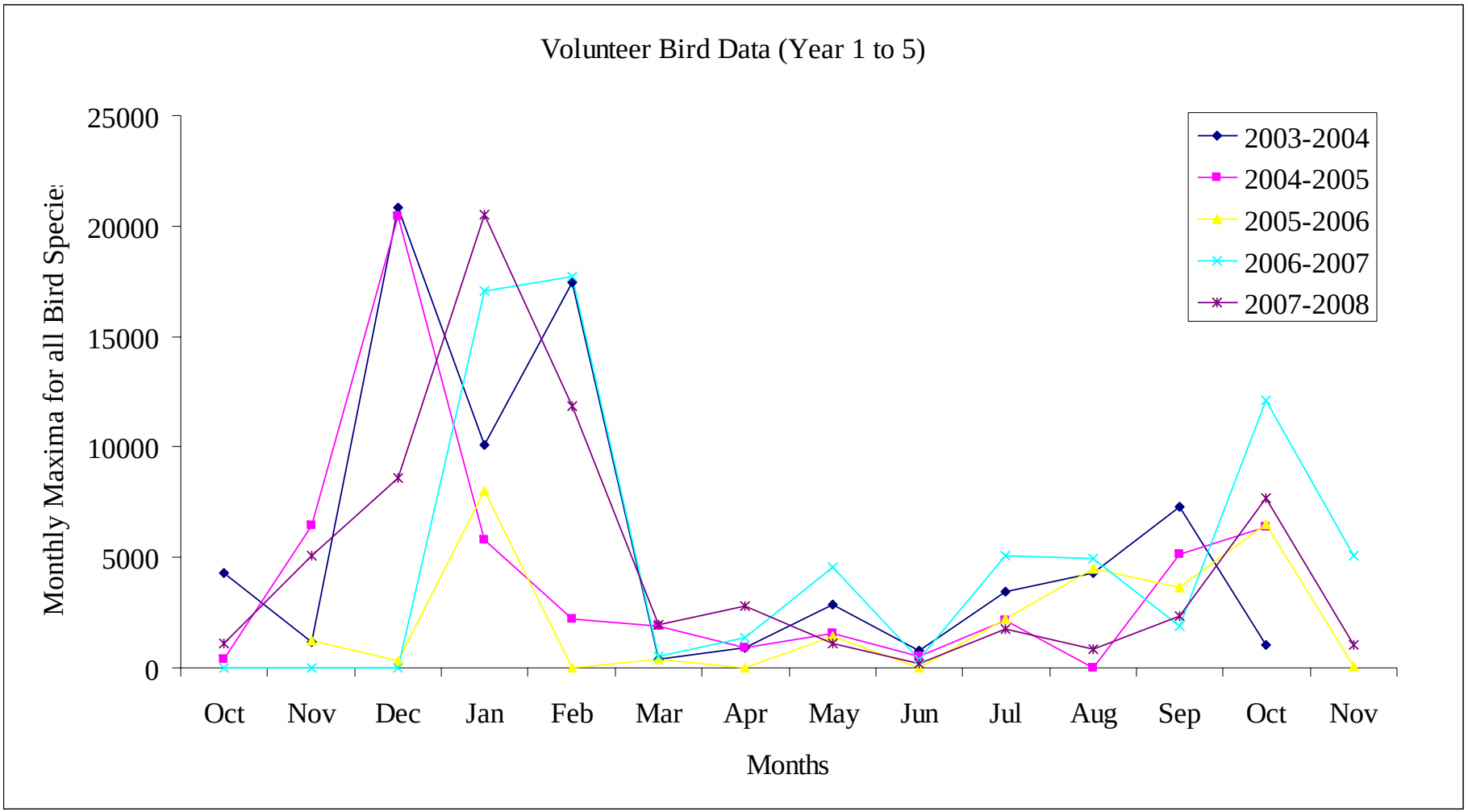


Figure 3.6 Key Bird Species Annual Mean and Five-Year Mean During Winter (November to March) At Paull Holme Strays. Adapted from Appendix D (Mander and Cutts 2009).

| | **Annual Mean Abundance** | | | | | **5 - year mean** | **Threshold of importance** | |
|---|---|---|---|---|---|---|---|---|
| | **03-04** | **04-05** | **05-06** | **06-07** | **07-08** | **03-08** | **International** | **National** |
| **Shelduck** | 30 | 169 | 173 | 84 | 148 | 120 | ***3,000*** | ***782*** |
| **Wigeon** | 2 | 87 | 82 | 85 | 110 | 73 | ***15,000*** | ***4,060*** |
| **Teal** | 198 | 331 | 124 | 153 | 396 | 240 | ***4,000*** | ***1,920*** |
| **Mallard** | 115 | 52 | 37 | 45 | 67 | 63 | ***20,000*** | ***3,520*** |
| **Oystercatcher** | 2 | 13 | 1 | 5 | 2 | 5 | ***10,200*** | ***3,200*** |
| **Avocet** | 0 | 0 | 1 | 11 | 1 | 3 | ***730*** | ***35*** |
| **Ringed Plover** | 0 | 3 | 1 | 0 | 1 | 1 | ***730*** | ***330*** |
| **Golden Plover** | **4,880** | **3,364** | **6,312** | **2,711** | **4,804** | **4,414** | ***9,300*** | ***2,500*** |
| **Grey Plover** | 1 | 200 | 28 | 11 | 85 | 65 | ***2,500*** | ***530*** |
| **Lapwing** | 3,750 | 690 | 407 | 550 | 2,645 | 1,610 | ***20,000*** | ***20,000*** |
| **Knot** | 37 | 32 | 13 | 0 | 27 | 22 | ***4,500*** | ***2,800*** |
| **Dunlin** | 65 | 54 | 277 | 252 | 528 | 235 | ***13,300*** | ***5,600*** |
| **Black-tailed Godwit** | 67 | **159** | 60 | 32 | 36 | 71 | ***470*** | ***150*** |
| **Bar-tailed Godwit** | 0 | 29 | 38 | 35 | 191 | 59 | ***1,200*** | ***620*** |
| **Curlew** | 3 | 63 | 39 | 79 | 99 | 57 | ***8,500*** | ***1,500*** |
| **Redshank** | 39 | 63 | 95 | 133 | 368 | 139 | ***2,800*** | ***1,200*** |

Figure 3.7 Monthly Maxima (Volunteer Data): All Bird Species across Five Survey Years.



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incident hotline
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floodline
0845 988 1188

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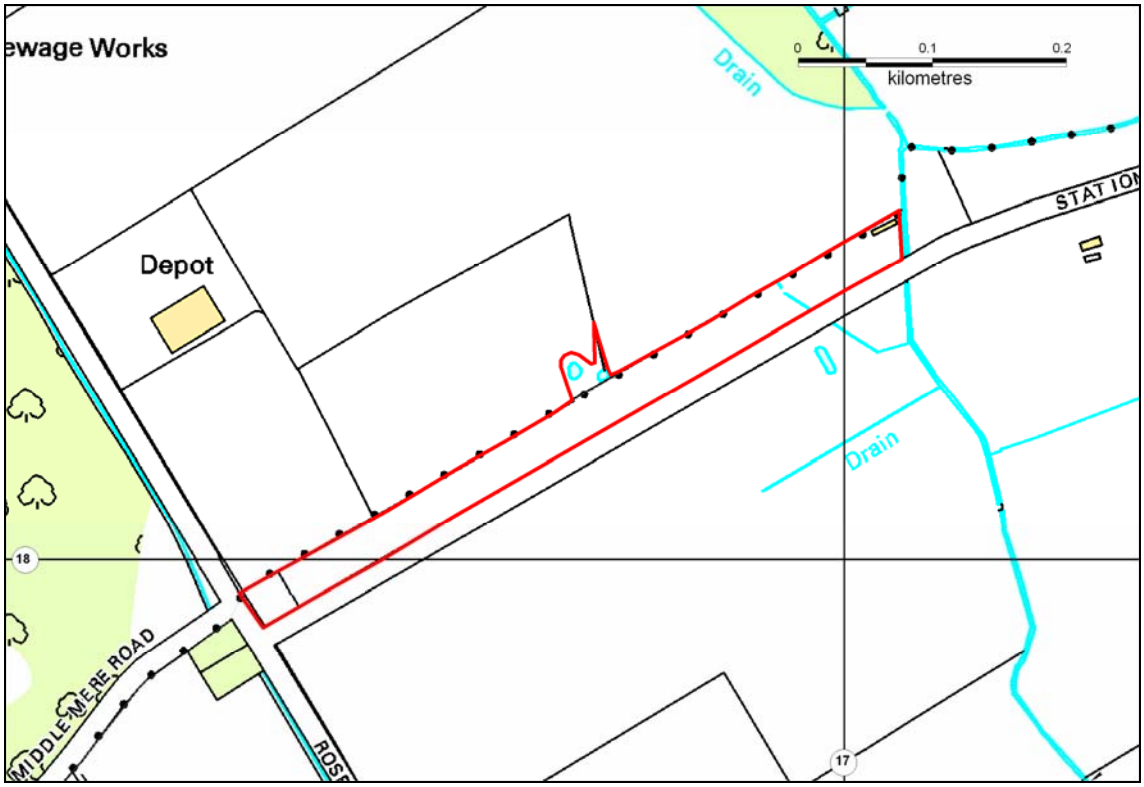
# Station Road Field






**Grid ref:** **TA168181** **Survey:** **5 July 2007**
**Area:** **1.7 ha** **Surveyor:** **J.Fraser**

**Main habitat:** **Neutral grassland, ruderal**
**Additional habitat:** **Scattered scrub, running water, species-poor hedgerows**
**Additional features:** **Varied sward height, seasonally wet/damp areas, lichens**

This narrow, straight-sided site measures approximately 550 m by 30 m, with the long axis aligned south-west to north-east. It is almost flat and is crossed by the 5 m contour. Adjacent land is road verge to the south-east and south-west, and farmland to the north-west and north-east.

Almost all the site is grassland, comprising from south-west to north-east: a small square area that is mostly old hardstanding; a long, thin horse pasture; and small area of horse pasture with some ungrazed land and old stables. The whole area is surrounded by hedges, and the three components are separated from each other by short hedges. Ditches occur beside some of the hedges.

During the visit it appeared that grassland was being grazed on rotation, so that fresh grass was available from time to time. Consequently, some land was very heavily grazed and poached, some was well grazed, some held trampled vegetation, and some had not been grazed in 2007. Botanical richness was most easy to evaluate where no recent grazing had taken place, and here the survey revealed a situation typical of horse grazing – very coarse and poor vegetation in some places and short herb-rich areas between.

The patches of short vegetation had presumably been hard grazed by horses in the past, possibly annually. Here there is an abundance of relatively few plant species such as ribwort plantain, cat's-ear, autumn hawkbit, creeping buttercup, selfheal, common bent and yellow oat-grass. Less commonly encountered are bird's-foot-trefoil, red bartsia, common centaury, agrimony, common sorrel, crested dog's-tail and sweet vernal-grass. The coarse vegetation

supports a large number of docks of four species – curled, broad-leaved, wood and clustered – as well as small amounts of common nettle and thistles. Other associated species include common vetch, cut-leaved crane's-bill, hogweed, cock's-foot, Yorkshire-fog and false oat-grass.

Wetland adds to the interest of the site, and is mostly restricted to boundary ditches and one internal ditch. Some of the plants present are fool's water-cress, pink water-speedwell, common fleabane, woody nightshade and hairy buttercup, the latter on damp, grazed land nearby. Boundary hedges are primarily of long un-managed hawthorn, but there is also a scatter of wych elm, elder, blackthorn, field maple and dog-rose.

The small area of hardstanding is being colonised by a good range of typical plants, including thyme-leaved sandwort, common cudweed, procumbent pearlwort, white stonecrop, small-flowered crane's-bill, black medick, red fescue, squirrel-tail fescue and fern-grass. Neutral grassland and scrub around the edge provide structural diversity.

The site supports a good range of common farmland birds and butterflies, for instance yellowhammer, meadow brown and ringlet. Two ponds are located within a patch of dense scrub approximately midway along and just outside the north-western boundary. One of these ponds held breeding great crested newts in 2006.

**Criterion passed: Mos1(NG1, CG1)**
**Recommended as a Local Wildlife Site: 9 December 2008**