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Flood and Coastal Defence R&D Programme

Managed Realignment Review

Project Report

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This document has been prepared for DEFRA and the Environment Agency to identify areas of concern in the delivery of managed realignment solutions for flood and coastal management. The results will be used to inform future guidance but this document should not be considered as a statement of guidance or recommendations for good practice.

DEFRA

Managed Realignment Review
Project Report

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1. Introduction

The Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency are seeking to identify the constraints and incentives to Managed Realignment of flood defences, both on rivers and on the coast. This Research Project has been conducted by a consortium comprising Halcrow, the Centre for Social and Economic Research on the Global Environment at the University of East Anglia and Cambridge University's Coastal Research Unit.

Managed realignment means the deliberate process of realigning river, estuary and/or coastal defences. This may take the form of retreating to higher ground, constructing a set-back line of defence, shortening the overall defence length to be maintained, reducing wall or embankment heights or widening a river flood plain. The purpose of managed realignment schemes might be to:

- Reduce defence costs by shortening the overall length of defences to be maintained;
- Increase the efficiency and long term sustainability of flood and coastal defences by recreating river, estuary or coastal habitats and using their flood and storm buffering capacity;
- Provide other environmental benefits through re-creation of natural habitats; or
- Provide replacement habitats in or adjacent to a European designated site to compensate for habitat loss as a result of reclamation or coastal squeeze.

Whilst Managed Realignment has been a topical issue for many years now, there have been few examples of the practice being implemented. There is an urgent need for a better understanding of issues associated with Managed Realignment, and how it could be better delivered through future flood defence planning. This research project sets out to answer the following six questions:

- Where has Managed Realignment been tried?
- What are the drivers (incentives) for Managed Realignment?
- What are the constraints (obstacles) to Managed Realignment?
- What can we learn from experience of Managed Realignment?
- What are the costs and benefits of Managed Realignment?
- How can we realise the benefits of Managed Realignment?

The research comprised a *review of experience*, both in England and Wales and overseas; conducting postal *questionnaires* and regional *workshops* to gather information and opinions; analysing in detail three *case studies*; and an examination of the implementation of present policy relating to *Shoreline*

Management Planning, *economic valuation*, *financial compensation*, *nature conservation* and *planning*. The results of this work are described in the Stage 1 Final Project Report, of which this is a summary.

2. *Where has Managed Realignment been tried?*

In England and Wales, a strategic approach is taken to flood and coastal defence for rivers and estuaries through the production of Shoreline Management Plans (SMPs), the first round of which is largely complete. A similar approach to rivers is being promoted through Catchment Flood Management Plans (CFMPs), which are still at an early stage of preparation.

Shoreline Management Plans divided the coast into about 1,100 management units. Managed Realignment was proposed in 39 units, of which eight have been or are being constructed and nine are in the process of planning or design, a 44% uptake (Figure 2.2). However, a further 16 coastal and estuarine Managed Realignment sites have been identified (five of them implemented and 11 in planning/design) which were not included in SMPs. This suggests that SMPs have been of limited effectiveness in bringing forward Managed Realignment, since only a small number of sites (about 3% of management units) were identified, of which almost half have been taken forward. Moreover, of the sites that have been or are being realigned, only half were included in SMPs. The sites where Managed Realignment has been considered or implemented are generally in low-lying areas, particularly estuaries such as the Humber, the Wash, Essex, the Solent and Bristol Channel, with few on the open coast, cliff frontages or the developed coast.

On rivers, the concept of Managed Realignment is less well developed. However, 30 schemes in planning, design or implementation have been identified that include realignment of flood banks or channel realignment for flood defence purposes. These are broadly geographically distributed (Figure 2.3). A number of schemes have sought to provide environmental enhancements as a primary or secondary objective.

Overseas, in the countries reviewed as part of this project, Managed Realignment has been implemented mainly as part of nature conservation or (re-)creation projects in estuarine locations in the US (e.g. Mississippi delta, San Francisco Bay area), the Netherlands (e.g. Fiesland, the Scheldt Estuary), and Germany (e.g. the Elbe river). As is the case in the UK, open coast sites are rare.

3. *What are the Drivers (Incentives) for Managed Realignment?*

Questionnaire respondents were asked for their personal views, rather than statements of organisational policy. There was general consensus amongst on the relative importance of drivers (Figure 3.4). Managed realignment is perceived first and foremost as a means of providing sustainable and effective flood and coastal defence, and respondents felt that it should be seen as part of a long term strategy to address sea level rise. The environmental benefits are also seen as

very important. For most stakeholders, apart from DEFRA respondents, reducing costs of flood and coastal defence was seen as an important consideration, though it is not the main driver for the implementation of Managed Realignment. Eight drivers for Managed Realignment have been ranked in descending order of importance, according to the mean scores from 81 questionnaire responses:

1. Providing sustainable and effective flood and coastal defence
2. Essential for a long term strategy of coping with sea level rise
3. Providing environmental benefits in terms of habitat creation
4. Habitats Regulations (means of compensating for inter-tidal habitats lost elsewhere through reclamation or coastal squeeze)
5. Reducing costs of flood and coastal defence
6. Controlled breach better than dealing with an accidental breach
7. DEFRA funding not available for holding the line
8. Low cost means of recreating natural habitats

Participants at regional workshops agreed that **providing sustainable flood and coastal defence** is the main driver. Environmental benefits were considered as important, but it was felt that, so far, Managed Realignment has been opportunistic and environmental benefits have not been maximised. The **Habitats Regulations** are seen as a major driver, requiring recreation of inter-tidal habitats to compensate for habitats lost to development or coastal squeeze, but also as a constraint (Section 4). DEFRA's high-level targets and the Biodiversity Action Plans have also introduced further habitat maintenance and creation objectives, which in some cases can be achieved through Managed Realignment.

A review of SMPs showed that **natural processes** were considered to be an overall driver in half of 19 Managed Realignment sites reviewed. In particular, Managed Realignment is seen as a way of dissipating wave energy in the inter-tidal zone and thus lowering flood and coastal defence costs. However, in some cases, this may be regarded as questionable in the absence of adequate information on the hydrodynamics, ecology, and geomorphology. There appears to be a lack of quantitative economic assessments on the actual defence cost reduction achieved. Natural process knowledge may not be adequate or in an appropriate format to come to a clear conclusion on the impacts of Managed Realignment. Our research also suggests that the lack of such information might enable operating authorities to put forward a particular rationale for Managed Realignment that fulfils a political or economic need, but may not be justified from the point of view of natural processes.

Overseas, Managed Realignment appears to be mainly driven by flood defence or habitat creation/restoration considerations. There are considerable national differences in the

administration and funding of coastal management schemes. Some of these, for example relating to the national significance (and hence public perception) of Managed Realignment, are likely to be due to factors such as different lengths of coastline relative to the countries' land area.

4. What are the Constraints (Obstacles) to Managed Realignment?

Major obstacles that were clearly identified by questionnaire respondents are the lack of financial compensation to land-owners, the need to provide compensatory habitats under the Habitats Regulations when terrestrial or freshwater sites are lost, and lack of public support (Figure 3.5). Eleven constraints to Managed Realignment have been ranked in descending order of importance, according to the mean scores from 81 questionnaire responses:

1. Insufficient financial compensation to land owners
2. Habitats Regulations
3. Potential loss of land with high property value
4. Lack of support from public opinion
5. Insufficient consultation
6. Potential high cost of Managed Realignment
7. Potential loss of terrestrial and freshwater habitats
8. Managed realignment is ineffective if carried out on a piecemeal basis
9. Lack of access to or information about suitable funding
10. Insufficient robustness of flood and coastal defence
11. Difficulty of recreating an environmentally diverse habitat

Many practitioners see lack of **financial compensation** (which in this context includes both land purchase and payment for the use of land) as the biggest obstacle to Managed Realignment. Under present legislation, landowners do not generally have any right to financial compensation where a decision is made to no longer defend their land. In the case of Managed Realignment, there are limited exceptions where land may be purchased:

- Where a new inter-tidal area forms part of a new defence, for example where the realigned land will become salt marsh which will attenuate wave energy and allow a reduced standard of defence to landward.
- Where realignment is implemented to create a more sustainable regime within an estuary or river, such as improving discharge capacity or reducing flood levels, it is reasonable to purchase the land. Exceptionally, areas allocated for fluvial flood storage may be acquired where it is deemed necessary to allow for full control.
- Where a realignment scheme is being constructed specifically to create compensatory habitat for the effects of another scheme, the new habitat creation would be an integral part of the requirements of the other scheme.

Although Managed Realignment can only be carried out by agreement, the operating authority can decide to implement the alternative of Non Intervention, which may lead to unmanaged failure of existing defences. However, in practice where Managed Realignment is not implemented, experience suggests that existing defences will often continue to be maintained.

Landowners can also obtain payment from agri-environmental schemes such as Countryside Stewardship. These represent a possible complementary source of funding for habitat creation such as salt marsh and reedbeds, effectively recognising environmental as well as flood defence benefits from Managed Realignment. However, existing schemes are not very attractive to landowners because of the ten-year time frame for payments, which contrasts with the long time scale of Managed Realignment benefits and the relative irreversibility of the change in land use. Benefits from these schemes may, however, be preferable to no payment and the unmanaged failure of the flood defence if an alternative policy of non-intervention were adopted.

Other issues explored at regional workshops included the role of the **Habitats Regulations** as a constraint where loss of terrestrial or freshwater sites is entailed. Where a plan or project (including Managed Realignment) may have an adverse effect on the integrity of a European site, it can only be implemented where "no alternatives" and "imperative reasons of over-riding public interest" are demonstrated. Whilst "over-riding public interest" is often straightforward to demonstrate in the case of flood defences protecting life and property, there are often a number of alternative ways of achieving this objective, particularly since the cost of alternatives is not an explicit factor in the Regulations. As Managed Realignment often involves changing habitat from freshwater to inter-tidal or grazing marsh to reedbed, schemes may be refused consent under the Regulations, even where compensatory habitat is proposed to replace that which is lost. In effect, the Regulations create a strong presumption that habitats be conserved in their present location. Coastal and riverine systems are naturally dynamic and the way in which the Regulations have been applied can make it difficult to implement many management interventions, even when (as with Managed Realignment) they are designed to work with natural processes.

Technical barriers and lack of scientific understanding can also be significant, in particularly in relation to lack of process information which may lead to Managed Realignment having unforeseen negative consequences elsewhere on the coast, in an estuary or along a river. It can be difficult to predict with certainty what type of habitat would emerge from a particular Managed Realignment scheme, for example, whether salt marsh will colonise a new inter-tidal site. This can be an issue in terms of predicted flood defence benefits and planning the provision of compensatory habitat.

Although reducing flood and coastal defence costs is a potential benefit of Managed Realignment, **additional costs** may also arise from factors such as **high land prices**, **delays** due to the planning process and the potential need for **research** into hydrodynamics. The demands of the planning process also create **additional flood risks** where scheme implementation to reduce flood risks is delayed.

The review of SMPs identified that Managed Realignment is often perceived as a long-term solution to flood and coastal defence problems rather than a short-term one. The reason for this may be that Managed Realignment continues to be a **politically less acceptable** coastal management option, particularly in the short term. It is easier for operating authorities to postpone implementation and/or argue that the benefits will become apparent only over time-scales beyond their term of office. In view of these considerations, the lack of long-term general and site-specific **coastal process information** in a form that facilitates objective decision-making appears to constitute a real and significant problem.

Although planning issues were not discussed in detail at workshops, experience suggests that central and local government **planning policies** for protecting agricultural land of Grade 1, 2 and 3a may be a constraint to implementing Managed Realignment, particularly where planning permission is required. In the planning process, protection of existing agricultural land and rural landscape generally has backing from statutory plans and guidance whereas proposals for Managed Realignment derived from SMPs, for example for reasons of coastal processes and sustainable shoreline management, may not carry the same weight.

Overseas, in the countries reviewed in this project, the key constraints to Managed Realignment are similar to those in the UK. Lack of political acceptability and technical knowledge featured in most of the responses obtained from individuals involved in Managed Realignment discussions. While financial compensation is also being discussed overseas, it was not mentioned as being a factor that is publicly addressed.

5. What can we learn from Experience of Managed Realignment?

Three case studies were examined during the project: Thorngumbald on the Humber Estuary, Brancaster on the north Norfolk Coast and Halvergate on the River Yare (Norfolk Broads). The first two are in the process of implementation, whereas Halvergate is at the planning/design stage. Experience overseas was also investigated. A number of general lessons emerged from these studies:

- The importance of getting the **community** involved and supporting the scheme at an early stage was underlined throughout the case studies, as it can help reduce delays, for example resulting from a Public Inquiry. The difficulty is in finding how best to "sell" the scheme to

local communities, as this will vary across the sites. Social and recreational benefits (including access), habitats and common rights to use them are the types of issues perceived as important. The objective should be to engage the community in a way that enables a real input to shaping the scheme but not to oppose a decision for Managed Realignment principle, once it has been taken. Steering groups and user fora proved to be an effective way to manage the consultation process at Brancaster and Thorngumbald. This point was reflected in the review of Managed Realignment in the case of Denmark, where it appears that the public attitude to nature conservation and recreation in the coastal zone is more favourable (emphasised also by the Danish planning regulations), making it perhaps easier to 'sell' such schemes to local communities.

- The Habitats Regulations and planning process are likely to cause significant **delays**, especially where European nature conservation sites are involved. Experience suggests that Managed Realignment schemes will almost always take longer than hold the line (or non-intervention) schemes, which can be an important issue in the context of urgent flood works. A realistic time scale needs to be allowed for at the outset.

- **Technical issues** about how best to help natural succession of habitats, model channels and the development of creeks, as well as obstacles such as the presence of heritage resources and how best to protect them, can be costly and time-consuming to resolve. This issue was also identified in the review of Managed Realignment in the Netherlands, where the awareness of technical limitations of such schemes was greatest. It appears that much could be gained from a better monitoring of intertidal environments (both natural sites and those resulting from human intervention) and from EU-wide collaboration / exchange of technical information.

- **Financial compensation to landowners** appears to have been a key factor in the success of the Thorngumbald and Brancaster schemes in reaching implementation. In both cases, the retreat area is being purchased by agreement with the landowners and DEFRA funding has been made available as the created salt marsh will form an integral part of the new flood defence. In addition, at Thorngumbald, the recreation of a large inter-tidal area to compensate for losses elsewhere in the estuary contributed to agreement to funding the land purchase expenses. The situation with financial compensation at Halvergate has yet to be finalised, but it was interesting that the operating authorities stated that there is more flexibility to disburse funds in this way as the public-private partnership has more discretion over expenditure to deliver the flood management service to be provided with DEFRA funding. The review of financial compensation issues overseas indicated that use is made in The Netherlands of a combination of national and EU funding resources.

- Some **innovative and creative approaches** were taken to deal with site-specific issues. Some of these, such as the creation of reedbeds in material borrow pits and assistance in kind towards building a new private counterwall to protect a golf course in Brancaster, can be transferred to other schemes.

Although many issues arising on rivers are similar to those on the coast, some lessons in terms of how river sites differ also emerged. For example, conversion to inter-tidal represents a permanent, major change in land use that may justify land acquisition. In a fluvial environment, where works such as reducing the standard of an existing defence significantly increase susceptibility to flooding, financial compensation for occasional flooding (for example through Countryside Stewardship) may be more realistic.

6. *What are the Costs and Benefits of Managed Realignment?*

There are potentially significant net benefits from Managed Realignment. Some, but not all, of these are accounted for in economic terms using DEFRA's current project appraisal methods.

The main economic benefits are **reduced defence costs**, due to both shorter defences and the role of inter-tidal habitats in wave energy reduction. Standard project appraisals aim to account for these benefits but currently existing scientific information on wave energy dissipation over inter-tidal surfaces is not fully utilised in predicting how much lower defences realigned inland could be for different water depths. However, inter-tidal habitats also provide other important products and services that, even though they are often not marketed, have significant economic social value. There have been few valuation studies specific to Managed Realignment. One study of wetland values showed that the function with highest value is likely to be **flood control**, followed by **water generation** (surface and groundwater recharge, which might not be significant in the context of Managed Realignment), **water quality improvement**, and finally **biodiversity support**.

Compared to Holding the Line, the situations where Managed Realignment is likely to have the higher net benefits include:

- areas with low value agricultural land;
- sites where the topography allows shorter defences inland or no additional defences where retreat is to higher ground; and
- sites where the topography is such that only minor or no engineering works are necessary to ensure natural succession to the desired type of ecosystem.

Experience shows that the costs of engineering works are likely to be minor compared to land opportunity costs. In some cases, Managed Realignment leads both to the loss of freshwater or brackish habitats and to the creation of salt marshes or mudflats. It is difficult to generalise as to which type of habitat has the higher value, though in some cases one type of habitat may clearly be providing more valuable goods or services. In the case of the Brancaster realignment scheme, for example, the local population did not want to lose resources provided by the existing habitats used under common rights and this was a factor in developing a scheme that protects a significant proportion of existing habitats. An economic valuation of subtle changes, such as recreational use and visual amenity by the general public, would be difficult. However, when Managed Realignment involves the loss of a designated nature conservation site, the costs and benefits of both this change and the replacement site should be included in the analysis. The net result might be positive, resulting in increased benefits, or negative, in which case it represents additional costs to the scheme.

There is still considerable uncertainty regarding benefits and costs of Managed Realignment. Results from case studies show that costs can be higher than expected, as it is difficult to predict the success of habitat recreation, what further works might be necessary to improve or accelerate habitat succession, and what the cost of maintenance will be. There can also be costly delays in the process of Managed Realignment due to planning complexities that were not foreseen. The benefits of managed versus unmanaged realignment are not always clear. There is no consensus amongst ecologists about whether managed retreat sites lead to higher quality habitats than unmanaged ones. Furthermore, the potential costs of unmanaged realignment are likely to depend on risk communication and accompanying safety measures.

There is a perception that the benefits of the strategic approach offered by SMPs have not always been realised in bringing forward Managed Realignment schemes. Evidence for this may be found in the number of Managed Realignment proposals that have been developed independently of SMPs and the number of Managed Realignment schemes proposed in SMPs that have not been progressed towards implementation.

It is worth noting that with climate change and sea level rise, holding the line options are likely to become increasingly costly. Managed Realignment schemes are likely to become increasingly preferable on economic grounds, both along the coast and rivers, as it becomes possible to evaluate sea-defence cost savings more accurately based on scientific information.

7. How can we realise the Benefits of Managed Realignment?

Managed Realignment is an appropriate response to coastal defence in some locations, particularly where it can deliver benefits to the sustainability and economics of flood defence and/or habitat creation. It is unlikely to be suitable for developed urban areas or in very extensive agricultural

areas, where the economic and social gains associated with the assets protected will generally justify the resources required to defend them for the foreseeable future. However, some set back may be required in such areas to achieve necessary flow capacities in rivers or acceptable levels of security at the coast.

There is no simple way of carrying out Managed Realignment and experience to date suggests that such schemes are always likely to be more complex and time consuming than holding the line. However, it also seems that they are becoming increasingly costly and taking longer to implement. To some extent this is common to experience of all kinds of major projects in the planning process. However, participants to workshops were broadly unanimous in stating that the current situation is not satisfactory. If Managed Realignment is to be undertaken on a larger scale and become a central feature of coastal and fluvial flood defence strategy, the current approach has to be streamlined.

It was notable from the questionnaire consultation that the stated views of respondents within DEFRA tend to diverge from those of other stakeholders on several issues. Whilst these were the personal views of individuals, this does suggest that successful shifts in policy towards the implementation of cost-effective and environmentally beneficial realignment schemes may require targeting of policy with regard to the views expressed by most stakeholders. In addition, public awareness campaigns such as those recently started in The Netherlands may be needed to increase the political acceptability of Managed Realignment as a policy option. The following issues have been identified as representing significant barriers to Managed Realignment that should be addressed.

The desirability of increased provision of **financial compensation** to individual stakeholders such as landowners who are adversely affected by Managed Realignment is a strong theme identified in this research. Amendments to policy would address the present perception that the public benefits of Managed Realignment (for example better flood defence, habitat creation and lower maintenance costs) may be achieved at the cost of private loss (for example of agricultural land). One reason why the communities at Thorngumbald and Brancaster were broadly supportive of the realignment schemes is that the landowners directly affected were perceived to have been dealt with fairly, in that their land had been acquired by agreement. Financial compensation may comprise either acquisition of land or payments for specific use (or loss of use) of land, without title being transferred.

The Countryside Stewardship scheme offers an example of a possible way forward, where payments to landowners are linked to delivery of societal benefits. Closer integration between the rural development and the flood and coastal defence functions of DEFRA, in terms of its administration, planning, delivery and funding would be beneficial, including seeking additional

funds from complementary sources. Lengthening the period of management agreements would recognise the long-term nature of land use changes induced by Managed Realignment, together with review of the levels of payment for the relevant inter-tidal and wetland options to more fully reflect the loss in value of land brought in to inter-tidal use.

In addition, we recommend adopting a wider range of circumstances in which land acquisition is recognised as appropriate when implementing Managed Realignment. This would essentially be an extension of the existing DEFRA policy, which recognises that land can be acquired for specific beneficial uses, but does not currently recognise all the potential benefits that can arise or their associated economic value. In The Netherlands, a combination of EU, national government, provincial and non-governmental funds have been used to acquire managed realignment areas for habitat creation.

Whilst the existence of potential objections to wider financial compensation is recognised, it could be very difficult to bring forward significant numbers of Managed Realignment schemes to implementation in the absence of more general provisions for such compensation. Operating authorities often have to choose between Managed Realignment and a (politically driven) option to hold the line, even where the latter would be less economic. Rather than being perceived as a cost to the public purse, such targeted compensation could be regarded as a way of unlocking wider benefits in the public interest.

The **Habitats Regulations** could act as less of a constraint to Managed Realignment if a more flexible interpretation were adopted to their application. In particular, there is an argument for recognising that works "directly connected with or necessary to the management of the site" includes measures to achieve long-term sustainable management of the coast (i.e. working with natural processes), provided that the overall mosaic of habitat types is maintained. This would allow Managed Realignment schemes that change habitat (e.g. from grazing marsh to salt marsh on the coast or grazing marsh to reedbed on rivers) to go ahead without the need to demonstrate "no alternatives" and "imperative reason of over-riding public interest", provided the changed habitat were re-established in an adjacent locality. Given that concerns may be raised that habitat creation may not be successful or that the recreated habitats might not deliver similar benefits within a short time period, there is a case for taking a proactive approach to habitat creation (see below). A less onerous interpretation of what constitutes "adverse effect on site integrity" would recognise that coastal habitats are naturally dynamic, and a degree of change (whether natural or man-made) should be acceptable within their framework for management. Linked to this is the idea that site boundaries should be drawn in such a way that habitats can be allowed to migrate (or be re-created) in accordance with the dynamic nature of the coastal environment. From comments received during this research, it is understood that English Nature is opposed to such changes in the application of the Regulations. However, there is a widespread perception amongst many stakeholders that the present application creates significant difficulties in

delivering environmentally beneficial schemes, which this Review considers should be addressed. It would be interesting to further investigate how the Habitats Directive has been interpreted in other European Countries in relation to these issues and Managed Realignment schemes in particular.

There are close links between political, social, economic and technical issues on the one hand and the availability and use of **natural processes knowledge** on the other. These links are important as they may either prevent existing natural process knowledge being used fully (e.g. where it contradicts a powerful political aim) or limit the extent to which a case could be put forward for/against Managed Realignment (e.g. if there is a lack of natural process knowledge). As well as collecting more long-term process data, there is a need for better integration of natural process knowledge into Managed Realignment scheme planning and for process issues (e.g. degrees of wave attenuation over salt marsh) to be quantified. This is key to ensuring the physical sustainability of a scheme, which is a prerequisite before assessing economic and social sustainability. It is recommended that decision support mechanisms be developed to assist operating authorities by:

- Identifying a prioritised set of physical parameters and data required for the assessment of the physical sustainability of Managed Realignment schemes over a series of time horizons.

- Reviewing of existing scientific information on the ecological, geomorphological, and hydrodynamic functioning of inter-tidal and, in particular, Managed Realignment areas, including assessments of variability.

- Developing methodologies for converting existing scientific knowledge into qualitative and, most importantly, quantitative assessments of (a) the possible future evolution (and thus the sustainability) of Managed Realignment schemes and (b) uncertainty associated with such predictions.

- Assessing the natural sea-defence value of existing or potential future inter-tidal areas.

Appropriate **consultation and public participation** are important in developing any scheme. Involving stakeholders is not easy. It is time consuming, intensive in management time and can lead to outcomes that are not in the best interests of strategic flood management. Managed Realignment is a complex issue, which needs to be explained, and expectations need to be managed. Constructive ways to inform and involve the local communities both at an early stage of the scheme, and for monitoring purposes need to be explored, such as steering groups and local fora that were set up at Brancaster and Thorngumbald.

The **planning process** is complex and often causes long delays, both in terms of technical details and obtaining consents. Many of the issues seem to be due to the relatively novel nature of Managed Realignment. Experience from these early cases could be documented to provide useful information for future cases and accelerate the process. Improved links are needed between non-statutory plans (SMPs and CFMPs) and statutory plans, so that adopted coastal management policies can be implemented without undue delay. Particular problems arise where recommendations for Managed Realignment may be contrary to other Local Plan policies such as protecting agricultural land, in which instances a persuasive case will need to be made by SMPs and CFMPs for their recommendations. In addition, overseas experience shows that a longer-term view may be needed with regard to planning in order to prevent new development in areas that may, in future, be needed to accommodate Managed Realignment strategies.

Reducing the **political sensitivity** of Managed Realignment would contribute to enabling more balanced consideration with other coastal defence options and therefore better integration into the strategic planning process. Mechanisms for this could include public education about benefits of Managed Realignment in situations where it is appropriate and providing financial compensation to landowners, so as to reduce the perception that such benefits are achieved at the expense of private loss.

Environmental benefits and costs should be included explicitly in economic appraisals of schemes and be taken into account by the scheme prioritisation system, while taking care that there is no overlap between the economic and environmental criteria. Current advice in the Flood and Coastal Defence Project Appraisal Guidance is to use habitat replacement costs as a proxy for the minimum value of habitat loss. However, these are likely to be a significant underestimate, as the total economic value of an ecosystem is likely to be higher than the costs of recreating it. A more thorough review of the relative importance of services provided by inter-tidal habitats would provide insights into which services should be valued in priority order. New valuation studies should be designed to allow generic valuations (benefit transfer) to avoid the need for further costly studies in the future.

Anticipatory habitat creation, whereby areas of habitat are created ahead of displacement or loss, could alleviate some of the difficulties encountered relating to habitat creation. This includes a number of issues raised during consultation, such as the complexity of the planning system and delays associated with the Habitats Directive, the uncertainties about what type of habitat the schemes would provide and the increase in transaction costs. "Land banking" is practised in the United States and has been widely advocated as a better alternative to site by site mitigation under the wetland federal law. However, the approach has been criticised by some studies as leading to continued loss of habitats and it is not clear to what extent it would address the specific requirements of the Habitats Regulations. A number of specific issues regarding the practical

implementation of anticipatory habitat creation in the UK and how it can be controlled to meet strategic objectives need to be investigated in detail.

There is a need to better understand **risks and uncertainty** associated with Managed Realignment, particularly when compared to "traditional" Hold the Line schemes. Uncertainties include the lack of ability to predict physical processes, anticipation of longer periods required to obtain consents and licences and estimating long-term maintenance costs or other similar factors. Quantifying these would assist decision-makers, who are usually risk-averse, in bringing forward more schemes.

Our review of **overseas experience** suggests that there are useful lessons to be learnt from practice in other countries, particularly the southern North Sea countries of Netherlands, Denmark and Germany. An in-depth review of any literature published by the government, the media, and scientists in these respective countries would be valuable, together with (semi-) structured interviews with members of the central, regional, and local government authorities that deal with coastal defence funding, planning, and implementation and nature conservation organisations. Key issues on which to focus include how financial compensation is handled and funded and how constraints arising from political acceptability are addressed in these countries.

To achieve the full benefits of Managed Realignment in situations where it is appropriate, there needs to be a **strategic approach**, integrating traditional benefit-cost measures with wider environmental, nature conservation and socio-economic consequences. This will only be achieved through full and open discussion of Managed Realignment on an equal basis with other options, which would be facilitated by implementing a number of the recommendations above. These include measures to reduce the political sensitivity of Managed Realignment, improved public education and community participation. The new DEFRA priority scoring system, which includes elements for economics, people and environment, represents a move towards recognising the inter-dependence of these issues.

1 Introduction

The Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency are seeking to identify the constraints and incentives to Managed Realignment of flood defences, both on rivers and on the coast.

Managed Realignment means the deliberate process of realigning river, estuary and/or coastal defences. This may take the form of retreating to higher ground, constructing a set-back line of defence, shortening the overall defence length to be maintained, reducing wall or embankment heights or widening a river flood plain. The purpose of managed realignment schemes might be to:

- Reduce defence costs by shortening the overall length of defences to be maintained;

- Increase the efficiency and long term sustainability of flood and coastal defences by recreating river, estuary or coastal habitats and using their flood and storm buffering capacity;

- Provide other environmental benefits through re-creation of natural habitats; or

- Provide replacement intertidal or wetland habitats in or adjacent to a European designated site to compensate for habitat loss as a result of implementing a plan or project or coastal squeeze against hard defences.

Whilst Managed Realignment has been a topical issue for many years now, there have been few examples of the practice being implemented. There is an urgent need for a better understanding of issues associated with Managed Realignment, and how it could be better delivered through future flood defence planning.

The overall project as originally defined comprises two Phases, defined as follows:

Phase 1 : ***Review (this Report)***
Examination of issues and recommendations for further work and/or guidance based on current knowledge, experience and research. This Review describes the results of Phase 1.

Phase 2 : ***Implementation***

Depending on the results of Phase 1, any further fieldwork or study and/or development of detailed guidance or new methodologies necessary for full implementation.

A contract for Phase 1 of the research project was awarded in September 2001 to a project team comprising Halcrow, CSERGE (Centre for Social and Economic Research on the Global Environment) at the University of East Anglia and CCRU (Cambridge Coastal Research Unit). The purpose of the Phase 1 Review was to:

- Identify the drivers for Managed Realignment (i.e. the circumstances where Managed Realignment is appropriate);
- Identify the reasons why Managed Realignment has not been taken up widely as a strategic option (cultural, political, technical, economic or policy);
- Identify the constraints for a variety of stakeholders;
- Consolidate the lessons for implementation learnt from the few examples of Managed Realignment implemented in the UK;
- Identify the nature of benefits to flood defence that can be achieved through management of the process in coastal, estuarine and fluvial situations;
- Make recommendations for further work and/or guidance (basis for Phase 2 if required).

The Review itself was divided into three Stages, comprising:

Stage One

(a) Identification and review of sites considered for Managed Realignment (Section 2);

(b) A postal questionnaire to identify and analyse stakeholders' views on drivers and constraints affecting Managed Realignment in England and Wales (Section 3);

(c) Consultation with practitioners in a number of other countries to examine experience in Managed Realignment overseas (Section 4).

Stage Two

(a) Conducting three regional workshops to explore themes and issues identified from written consultation (questionnaires) with a range of stakeholders who have been involved in Managed Realignment (Section 5);

(b) Conducting three case studies of Managed Realignment schemes that are in the planning or implementation stage, to look at site-specific constraints and drivers (Section 6);

(c) Reviewing the role of Shoreline Management Plans in identifying sites for and implementing Managed Realignment (Section 7);

(d) Reviewing the role of existing DEFRA guidelines in achieving Managed Realignment (section 8); and

(e) Reviewing current policy and legislation on economic valuation (section 9), compensation (Section 10), nature conservation (Section 11) and planning (Section 12) issues.

Stage Three

Stage Three comprised the development of recommendations, which are described in Section 13. These include proposed policy issues and recommendations for work to be undertaken in Phase 2.

The Stage One and Stage Two work was originally reported in interim reports published in February (Halcrow, 2002a) and May (Halcrow, 2002b) respectively. This final Phase 1 Project Report includes all the material originally published in the interim reports, which has been updated in the light of new information received, comments and further analysis. A non-technical summary of the Phase 1 findings has been produced as a separate report.

The core team who undertook the Review comprised Robert Harvey (Halcrow, Project Manager), Laurence Banyard (Halcrow), Laure Ledoux (CSERGE), Sarah Cornell (CSERGE) and Iris Moller (CCRU). The team would like to express its thanks to members of the project Steering Group for their advice and assistance with the project: David Richardson (DEFRA), Terry Oakes (WS Atkins), Jonathan McCue (WS Atkins), Kathryn Pygott (WS Atkins), Sue Rees (English Nature), Peter Bye (Environment Agency), Steve McFarland (Canterbury City Council) and Brian Empson (Environment Agency).

2 Implementation of Managed Realignment in England and Wales

2.1 Sources of Information

Information has been obtained from:

(a) Shoreline Management Plans, which cover coasts and estuaries

These are discussed further in Section 2.2.

(b) Coastal Strategies and Scheme Designs

These are discussed further in Section 2.2.

(c) Responses to the General Questionnaire on Managed Realignment

Respondents to the general questionnaire described in Section 3 mentioned 46 potential Managed Realignment sites, but no details of the sites were given. Limited research has been undertaken to establish, as far as possible, a more precise location of each of the sites and to classify them into fluvial rivers or coasts and estuaries.

(d) River Restoration Centre (RRC)

The RRC maintains a database and was engaged as a subconsultant to provide details of ten fluvial schemes.

(e) Detailed Questionnaire on River and Estuary Sites

Because of the paucity of information from published sources on rivers and estuaries, a more detailed questionnaire was prepared and details were obtained from Environment Agency regions by post, e-mail and telephone. The following responses were received from the regions of the Agency:

- Anglian Region three completed questionnaires
- Midlands Region one completed questionnaire
- North East Region one completed questionnaire
- North West Region four completed questionnaires
- South West Region seven completed questionnaires

No completed questionnaires were received from Southern Region, though two sites were advised where on-line storage had been created as part of flood alleviation measures. No completed questionnaires were received from Thames Region or from Wales.

(f) *Information from practitioners obtained at Workshops held in January 2002*

(g) *Sites described on the Environment Agency website*

For the purposes of classifying the information obtained, it was necessary to distinguish between coasts and rivers. It was decided to treat estuarine (tidal) sites together with coastal sites (Section 2.2), because many SMPs cover both types of site. For the purposes of this review, only fluvial sites are treated as rivers (Section 2.3).

2.2 Coasts and Estuaries

2.2.1 General

The primary source of information on the coast protection policy of coastal authorities in England and Wales is the Shoreline Management Plan (SMP). The first generation of SMPs was produced in accordance with guidance contained in "Shoreline Management Plans – A Guide for Coastal Defence Authorities" (MAFF, 1995). This guidance defined four generic options for coastal defence policy, namely:

- Do Nothing (Non Intervention)
- Hold the Existing Defence Line by maintaining or changing the standard of protection
- Advance the Existing Defence Line
- Retreat the Existing Defence Line

Although included by some SMPs under "Retreat the Existing Line" policy, *Managed Realignment*, meaning an active process of redefining where the line of the coast should be and taking steps to make it happen, was not an explicit option in the guidance under which the existing SMPs were produced. Following a review of the first SMPs (MAFF, 2000) to prepare for the second round of SMPs (expected to start preparation in 2002) the guidance has been revised to define the following categories (DEFRA, 2001a):

- Hold the Line
- Managed Realignment
- Advance the Line
- Limited Intervention
- No Active Intervention

In particular, the revised guidance makes a clear distinction between active retreat (i.e. *Managed Realignment*) and passive retreat (termed *Limited Intervention* or *No Active Intervention*).

Typical scenarios whereby Managed Realignment might be selected as the preferred policy for coastal defence are outlined in the consultation paper "Managed Realignment: Land Purchase, Compensation and Payment for Beneficial Land Use" (DEFRA, 2001b) as follows:

- retreat to higher ground;
- realignment of defence to reduce length maintained;
- realignment to improve performance;
- set back in mitigation for encroachment by flood or coastal defence work elsewhere;
- realignment of coastal cliff frontages; and
- requirements under Habitats Regulations.

These scenarios combine different types (physical forms) and purposes of Managed Realignment. The different types may be condensed to:

- retreat of flood defences - breaching of existing defences to allow flooding up to higher ground or a new defence line; and
- realignment of coastal cliff frontages - remove existing defences to allow cliff erosion up to a new defence line.

2.2.2 *Approach to Data Gathering*

The relevant volumes of the SMPs were collated and a schedule of the documents produced (Appendix A). The SMPs reviewed comprised:

- all open coastal frontages in England, plus Kent Estuaries and Humber Estuary; and
- all coastal frontages in Wales, except that for Anglesey, which was not completed or available at the time of the Phase 1 Report (the St Govans

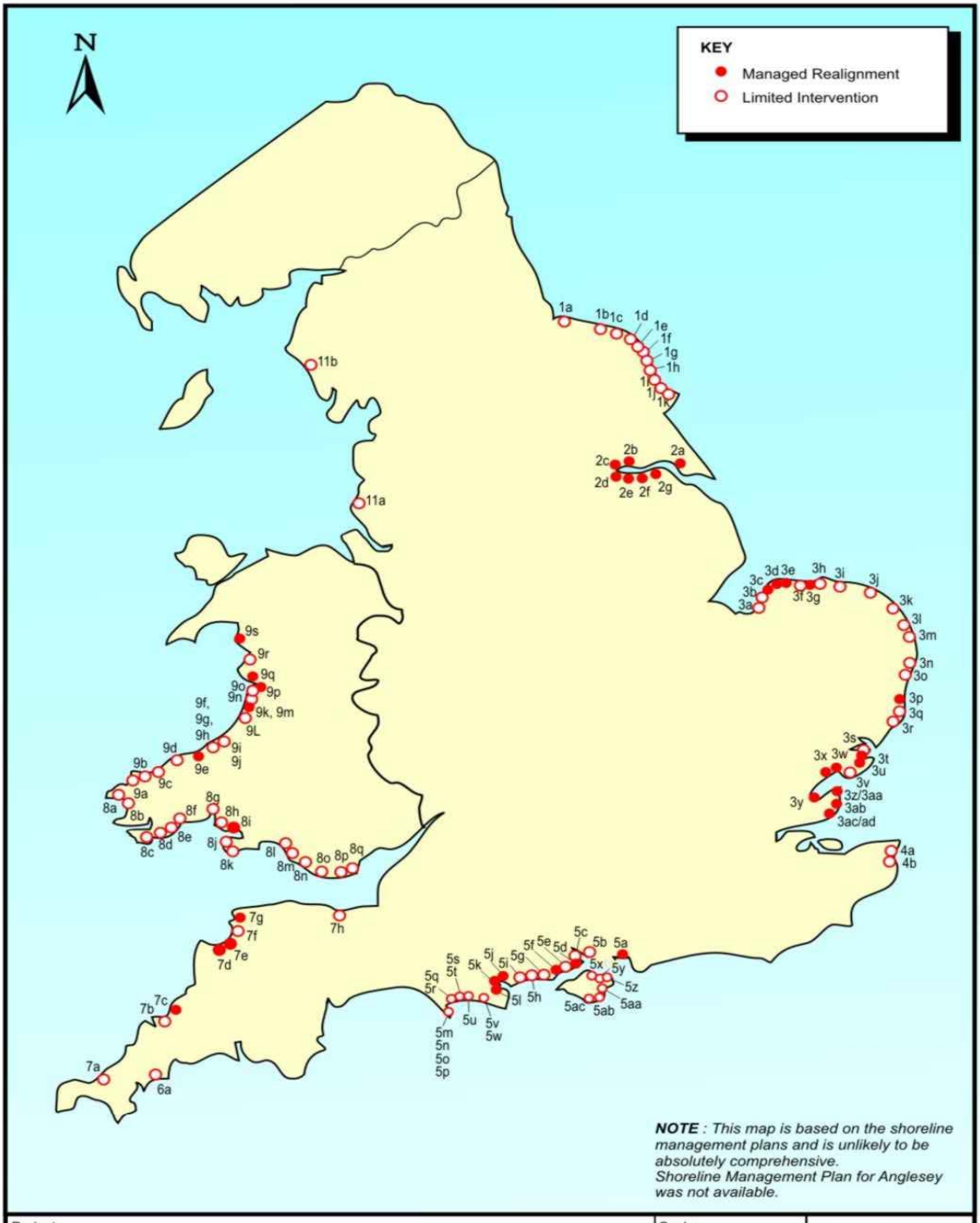
Head to Teifi Estuary SMP was reviewed, though it is still in draft and has not yet been adopted).

In addition to information in SMPs, a number of Managed Realignment sites was identified by consultees or from Halcrow's knowledge of coastal strategies and these have been included in the schedule of sites. In some cases, consultees identified more than one Managed Realignment scheme within a single management unit (e.g. Northey Island, Tollesbury and Orplands all fall within the Blackwater Estuary management unit). In order to ensure consistency with other sections of coast, these have been treated as a single Managed Realignment site, but the inclusion of more than one named scheme in the unit was recorded.

Since the existing SMPs were produced in accordance with the 1995 guidance, a policy of Retreat does not necessarily mean Managed Realignment. In many cases the policy of Retreat was adopted where the management of the coastline was, for example, limited to cliff monitoring. Under current guidance, these sites would be classified as Limited Intervention or No Active Intervention. Hence, the Retreat frontages were then investigated further to establish whether the type of retreat that had been envisaged would be re-classified under the 2001 guidance as Managed Realignment.

Of the 127 sites listed in the SMPs where Retreat had been adopted as the policy, our analysis indicates that 39 represent Managed Realignment and 88 represent Limited Intervention. A map of the Retreat sites, classified into Managed Realignment and Limited Intervention, is provided in Figure 2.1, each site being identified with an initial number for the coastal cell and a letter. Table 2.1 lists the sites and provides a key to the map. Sites classified as Managed Realignment were followed up to ascertain whether they have progressed either to the planning stage or to construction/completion. Figure 2.2 shows the Managed Realignment sites, indicating those fall into these categories.

A further 17 coastal and estuarine Retreat sites not included in SMPs were identified through consultation and questionnaires, of which 16 were classified as Managed Realignment and the status of one is unclear (a small number of Limited Intervention sites identified from consultation responses were not included in the database). These sites are identified on Figure 2.2, identified with a capital letter.



***NOTE** : This map is based on the shoreline management plans and is unlikely to be absolutely comprehensive. Shoreline Management Plan for Anglesey was not available.*

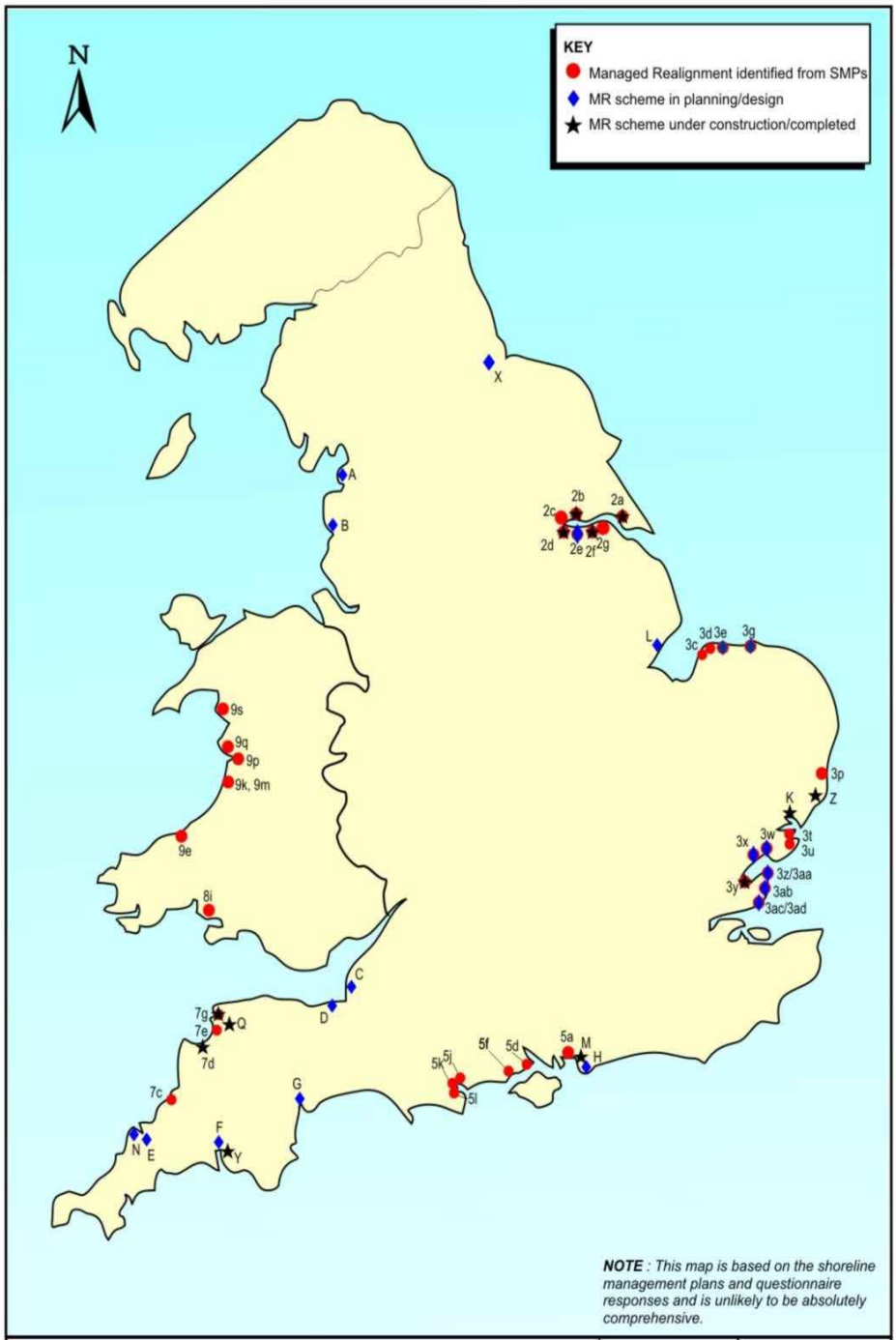
Project: **MANAGED REALIGNMENT RESEARCH**	Scale: Not to Scale	Halcrow
Figure Title: **COASTAL MANAGED RETREAT SITES IN SMPs SHOWING CLASSIFICATION AS MANAGED REALIGNMENT AND LIMITED INTERVENTION**		Figure 2.1

GRAPHIC UNIT/CEFAAI11/LB/04.01.02

Coastal and Estuarine Managed ealignment Sites (Key to Figure 2.2)

Code	Site / Management Unit
X	Greatham Creek, Tees Estuary
2a	Spurn Head to Paull (includes Thorngumbald, Sunk Island & Kilnsea)
2b	North Ferriby to Trent Falls (includes Crabley to Brough)
2c	Trent Falls to Boothferry Bridge (North Side)
2d	Trent Falls to Boothferry Bridge (South Side) (includes Goole Hall & Swinefleet to Reedness)
2e	Trent Falls to Keadby Bridge (includes Alkborough)
2f	Whitton to South Ferriby Cliff (includes Wintering-ham Ings & Winterhingham to Ferriby Sluice)
2g	South Ferriby Cliff to North Killingholme (includes Chowder Ness)
L	Freiston Shore, Lincolnshire
3c	Thornham to Hunstanton Golf Course
3d	Beach access road to Thornham
3e	Brancaster Staithe to Beach access road
3g	Kelling Quag to Cley Coastguards (includes Salthouse)
3p	Walberswick to Dunwich village
Z	River Ore, Orfordness
K	Trimley Marsh, Felixstowe
3t	Little Oakley to Dover Court
3u	Hamford Water
3w + 3x	The Colne
3y	The Blackwater (includes Northey Island, Tollesbury, Orplands and Abbots Hall)
3z + 3aa	The Dengie Peninsula
3ab	The Roach and the Crouch
3ac	Havengore to Foulness
3ad	Maplin Sands
H	Selsey Bill
M	Chichester Harbour (includes Thornham Bay, Thorney Island and Hayling Island)

Code	Site / Management Unit
5a	Inn on the Beach to Langstone Harbour
5d	Fawley Oil Refinery to Hythe Sailing Club
5f	Satchell Marshes to Badnam Creek
5j	Lytchett Bay
5k	Hydes Quay to Holton Point
5l	Hydes Quay
G	Exe Estuary
Y	Saltram, Plym Estuary
F	River Tamar – National Trust
N	River Camel, Cornwall
E	Camel Estuary (Padstow)
7c	Crackington Haven
7d	Pebble Ridge (includes Northam Burrows)
7e	Skern Saltmarsh
Q	River Torridge (includes Knapp House, Westleigh, Pillmouth Farm, Amey Kiln and Watsdown Farm)
7g	Home Farm Marsh to Fremlington Pill, Taw Estuary (includes Isley Marsh)
D	Lilstock, Bristol Channel
C	Bridgwater Bay – Parrett Estuary
8i	The Nose to Burry Port
9e	Tresaith
9k	Clarach
9m	Ynyslas
9p	Aberdyfi Golf Course
9q	Penllyn
9s	Morfa Aberech
B	Hesketh Outer Marsh, Ribble Estuary
A	Lune Estuary, Morecombe Bay



Project	Scale	
MANAGED REALIGNMENT RESEARCH	Not to Scale	Halcrow
Figure Title: COASTAL MANAGED REALIGNMENT SITES SHOWING CURRENT IMPLEMENTATION STATUS		Figure 2.2

GRAPHIC UNIT/CEFAAI13b/RH/13.06.02

Table 2.1 List of Coastal Managed Realignment and Limited Intervention Sites (Key to Figure 2.1)

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
X	Greatham Creek, Tees Estuary	E	Workshop consultation (English Nature)	Managed Realignment	Proposal stage only
1a	Huntcliffe Cottages to Jackdaw Crag	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1b	Port Mulgrave	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1c	Whitby	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1d	Scarborough / Wheatcroft	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1e	Cayton Bay	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1f	Filey Brigg	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1g	Filey Bay	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1h	Amtree Park	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1i	Hunmanby Gap	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1j	Reighton Sands	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
1k	North Landing	C	Huntcliffe to Flamborough Head SMP	Limited Intervention	-
2a	Spurn Head to Paull (includes Thorngumbald, Sunk Island & Kilnsea)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP Thorngumbald under construction
2b	North Ferriby to Trent Falls (includes Crabley to Brough)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP Crabley to Brough completed
2c	Trent Falls to Boothferry Bridge (North Side)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP
2d	Trent Falls to Boothferry Bridge (South Side) (includes Goole Hall & Swinefleet to Reedness)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP Goole Hall completed

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
2e	Trent Falls to Keadby Bridge (includes Alkborough)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP Alkborough in planning/design
2f	Whitton to South Ferriby Cliff (includes Winteringham Ings & Winterhingham to Ferriby Sluice)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP Winteringham Ings & Winteringham to Ferriby Sluice all completed
2g	South Ferriby Cliff to North Killingholme (includes Chowder Ness)	E	Humber Estuary SMP	Managed Realignment	not stated in SMP
L	Freiston Shore, Lincolnshire	E	Questionnaire Response (English Nature)	Managed Realignment	Short term
3a	Hunstanton Cliffs	C	North Norfolk SMP	Limited Intervention	-
3b	Hunstanton Golf Course	C	North Norfolk SMP	Limited Intervention	-
3c	Thornham to Hunstanton Golf Course	C	North Norfolk SMP	Managed Realignment	Long term
3d	Beach access road to Thornham	C	North Norfolk SMP	Managed Realignment	Long term
3e	Brancaster Staithe to Beach access road	C	North Norfolk SMP	Managed Realignment	Short Term. In construction
3f	Cley Coastguards to Stiffkey Marshes	C	North Norfolk SMP	Limited Intervention	-
3g	Kelling Quag to Cley Coastguards (includes Salthouse)	C	North Norfolk SMP	Managed Realignment	Short Term. In planning
3h	Sheringham to Kelling Quag	C	North Norfolk SMP	Limited Intervention	-
3i	Beeston Regis Hills to Cromer, Bernard Road	C	Sheringham to Lowestoft SMP	Limited Intervention	-
3j	Trimingham, Beacon Hill to Mundesley, Seaview Road	C	Sheringham to Lowestoft SMP	Limited Intervention	-
3k	Walcott, Ostend Cottages to Happisburgh, Caravan park	C	Sheringham to Lowestoft SMP	Limited Intervention	-

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
3l	Gorleston, Links Road to Hopton, Cliff Cottages	C	Sheringham to Lowestoft SMP	Limited Intervention	-
3m	Hopton Playing Field to Corton Caravan Site	C	Sheringham to Lowestoft SMP	Limited Intervention	-
3n	Pakefield Cliffs to The Red House, Kessingland	C	Lowestoft to Harwich SMP	Limited Intervention	-
3o	Benacre Pumping Station to Easton Marshes, Southwold	C	Lowestoft to Harwich SMP	Limited Intervention	-
3p	Walberswick to Dunwich village	C	Lowestoft to Harwich SMP	Managed Realignment	-
3q	Dunwich village to Dunwich Heath	C	Lowestoft to Harwich SMP	Limited Intervention	-
3r	Dunwich Heath to North Sizewell	C	Lowestoft to Harwich SMP	Limited Intervention	-
Z	River Ore, Orfordness	E	Site visit (National Trust)	Managed Realignment	Completed
K	Trimley Marsh, Felixstowe	E	Questionnaire Response (Harwich Haven Authority)	Managed Realignment	Completed
3s	Carless Refinery to Lawford	E	Essex SMP	Limited Intervention	-
3t	Little Oakley to Dover Court	E	Essex SMP	Managed Realignment	Long term
3u	Hamford Water	E	Essex SMP	Managed Realignment	Long term
3v	The Naze	C	Essex SMP	Limited Intervention	-
3w + 3x	The Colne	E	Essex SMP	Managed Realignment	Long term
3y	The Blackwater (includes Northey Island, Tollesbury, Orplands and Abbots Hall)	E	Essex SMP	Managed Realignment	Long term. Northey Island, Tollesbury and Orplands implemented
3z + 3aa	The Dengie Peninsula	C	Essex SMP	Managed Realignment	Long term
3ab	The Roach and the Crouch	E	Essex SMP	Managed Realignment	Long term
3ac	Havengore to Foulness	E	Essex SMP	Managed Realignment	Long term

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
3ad	Maplin Sands	E	Essex SMP	Managed Realignment	Long term
4a	Palm Bay to White Ness	C	Isle of Grain to Dover Harbour SMP	Limited Intervention	-
4b	White Ness to North Foreland	C	Isle of Grain to Dover Harbour SMP	Limited Intervention	-
J	Seaford Bay, East Sussex	C	Questionnaire Response	Unclassified	Long term
H	Selsey Bill	C	Questionnaire Responses (Environment Agency)	Managed Realignment	Long term
M	Chichester Harbour (includes Thornham Bay, Thorney Island and Hayling Island)	E	Questionnaire Responses (Marine Conservation Society)	Managed Realignment	
5a	Inn on the Beach to Langstone Harbour	C	East Solent SMP Volume 2	Managed Realignment	Not immediate
5b	Fort Gilkicker to Browndown Ranges	C	East Solent SMP Volume 2	Limited Intervention	-
5c	Elmers Court Country Club to Pitts Deep	E	Western Solent & Southampton Water SMP	Limited Intervention	-
5d	Fawley Oil Refinery to Hythe Sailing Club	E	Western Solent & Southampton Water SMP	Managed Realignment	-
5e	Cliff House to Ensign Industrial Park	C	Western Solent & Southampton Water SMP	Limited Intervention	-
5f	Satchell Marshes to Badnam Creek	C	Western Solent & Southampton Water SMP	Managed Realignment	Long term
5g	Chewton Bunny to Barton on Sea	C	Hurst Spit to Durlston Head SMP	Limited Intervention	-
5h	Hengistbury Long Groyne to Tip of Mudeford Sandbank	C	Hurst Spit to Durlston Head SMP	Limited Intervention	-
5i	Warren Hill to Hengistbury Long Groyne	C	Hurst Spit to Durlston Head SMP	Limited Intervention	-
5j	Lytchett Bay	E	Hurst Spit to Durlston Head SMP	Managed Realignment	
5k	Hydes Quay to Holton Point	E	Hurst Spit to Durlston Head SMP	Managed Realignment	
5l	Hydes Quay	E	Hurst Spit to Durlston Head SMP	Managed Realignment	

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
5m	Church Ope Cove	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5n	Grove Point Rifle Ranges (Disused)	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5o	Rifle Ranges (Disused) to Portland Breakwater	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5p	Fleet Opening (North) to North Breakwater	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5q	Overcombe to Bowleaze Cove (West)	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5r	Bowleaze Coast (West) and Bowleaze Cove (East)	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5s	Osmington Bay Holiday Centre	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5t	Goggin's Barrow to Osmington Mills (East)	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5u	Lulworth Cove (West) to Lulworth Cove (East)	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5v	Kimmeridge Bay (West) to White House	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5w	White House to Clavel Tower	C	Durlston Head to Portland Bill SMP	Limited Intervention	-
5x	West Woodside to Chapelcorner Copse	C	Isle of Wight Coast SMP	Limited Intervention	-
5y	Fishbourne to Pelhamfields	C	Isle of Wight Coast SMP	Limited Intervention	-
5z	Horestone Point to St Helens Tower	C	Isle of Wight Coast SMP	Limited Intervention	-
5aa	Horse Ledge to Monks Bay	C	Isle of Wight Coast SMP	Limited Intervention	-
5ab	Steephill Cove to East of Binnel Bay	C	Isle of Wight Coast SMP	Limited Intervention	-
5ac	East Binnel Bay to Puckaster Point	C	Isle of Wight Coast SMP	Limited Intervention	-
5ad	Cowes Harbour	E	Isle of Wight Coast SMP	Limited Intervention	-

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
G	Exe Estuary	E	Questionnaire Response (Devon County Council)	Managed Realignment	
Y	Saltram, Plym Estuary	E	Questionnaire Response (Environment Agency)	Managed Realignment	Implemented in 1995
F	River Tamar – National Trust	E	Questionnaire Response	Managed Realignment	
6a	Pentewan Harbour to Caravan Park	C	Rame Head to Lizard Point SMP	Limited Intervention	-
N	River Camel, Cornwall	E	Questionnaire Responses (Devon County Council)	Managed Realignment	
E	Camel Estuary (Padstow)	E	Questionnaire Response (Devon County Council)	Managed Realignment	
7a	Phillack Towans (nr Hayle Towans)	C	Land's End to Hartland Point SMP	Limited Intervention	-
7b	Pentonwarra Headland (Trevone)	C	Land's End to Hartland Point SMP	Limited Intervention	-
7c	Crackington Haven		Land's End to Hartland Point SMP	Managed Realignment	
7d	Pebble Ridge (includes Northam Burrows)	C	Bridgwater Bay to Bideford Bay SMP	Managed Realignment	Controlled rollback of shingle ridge implemented since 1984
7e	Skern Saltmarsh	E	Bridgwater Bay to Bideford Bay SMP	Managed Realignment	-
7f	West of Appledore	E	Bridgwater Bay to Bideford Bay SMP	Limited Intervention	
Q	River Torridge (includes Knapp House, Westleigh, Pillmouth Farm, Amey Kiln and Watsdown Farm)	E	Questionnaire Response (Environment Agency)	Managed Realignment	Embankments and walls breached to higher ground or abandoned, 1990-2000
7g	Home Farm Marsh to Fremlington Pill, Taw Estuary (includes Isley Marsh)	E	Bridgwater Bay to Bideford Bay SMP	Managed Realignment	Breach abandoned at Isley Marsh in 1980
D	Lilstock, Bristol Channel	C	Questionnaire Response (Environment Agency)	Managed Realignment	

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
C	Bridgwater Bay – Parrett Estuary	E	Questionnaire Response (Environment Agency)	Managed Realignment	
7h	Porlock Bay	C	Bridgwater Bay to Bideford Bay SMP	Limited Intervention	-
8a	Whitesands Bay	C	St Govans Head to Teifi Estuary	Limited Intervention	
8b	Solva to Porth Clais	C	St Govans Head to Teifi Estuary	Limited Intervention	
8c	Freshwater East	C	Worms Head to St Govans Head SMP	Limited Intervention	-
8d	Manorbier Bay	C	Worms Head to St Govans Head SMP	Limited Intervention	
8e	Lydstep Haven	C	Worms Head to St Govans Head SMP	Limited Intervention	-
8f	South Beach, Tenby	C	Worms Head to St Govans Head SMP	Limited Intervention	
8g	Carmarthen Holiday Park	C	Worms Head to St Govans Head SMP	Limited Intervention	-
8h	Pembrey Sands	C	Worms Head to St Govans Head SMP	Limited Intervention	-
8i	The Nose to Burry Port	E	Worms Head to St Govans Head SMP	Managed Realignment	Long Term
8j	Cwm Ivy Marsh to Burry Holms	C	Worms Head to St Govans Head SMP	Limited Intervention	-
8k	Llangenneth Burrows to Worm's Head	C	Worms Head to St Govans Head SMP	Limited Intervention	-
8l	Afon Cynffig to Sker Point	C	Lavernock Point to Worms Head SMP	Limited Intervention	-
8m	Newton to Ogmore River	C	Lavernock Point to Worms Head SMP	Limited Intervention	-
8n	Dunraven Bay to Trwyn y Witch	C	Lavernock Point to Worms Head SMP	Limited Intervention	-
8o	Cwm Col Huw to Limpert Bay	C	Lavernock Point to Worms Head SMP	Limited Intervention	-
8p	West Side Sully to Swanbridge West	C	Lavernock Point to Worms Head SMP	Limited Intervention	-
8q	Ball Rock To Lavernock Point	C	Lavernock Point to Worms Head SMP	Limited Intervention	-
9a	Abereiddi Bay	C	St Govans Head to Teifi Estuary	Limited Intervention	

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
9b	Pwllgwaelod	C	St Govans Head to Teifi Estuary	Limited Intervention	
9c	Newport Sands	C	St Govans Head to Teifi Estuary	Limited Intervention	
9d	Poppit Sands	C	St Govans Head to Teifi Estuary	Limited Intervention	
9e	Tresaith	C	Central Cardigan Bay SMP	Managed Realignment	Long term
9f	Traeth Gwyn	C	Central Cardigan Bay SMP	Limited Intervention	-
9g	The Bay	C	Central Cardigan Bay SMP	Limited Intervention	-
9h	Aberarth	C	Central Cardigan Bay SMP	Limited Intervention	-
9i	Morfa Mawr	C	Central Cardigan Bay SMP	Limited Intervention	-
9j	Llanrhystud Bay	C	Central Cardigan Bay SMP	Limited Intervention	-
9k	Clarach	C	Central Cardigan Bay SMP	Managed Realignment	Not immediate
9l	Borth Cliffs	C	Central Cardigan Bay SMP	Limited Intervention	-
9m	Ynyslas	C	Central Cardigan Bay SMP	Managed Realignment	
9n	Ynyslas Dunes	C	Central Cardigan Bay SMP	Limited Intervention	-
9o	Twyni Bach	C	Central Cardigan Bay SMP	Limited Intervention	-
9p	Aberdyfi Golf Course	C	North Cardigan Bay SMP	Managed Realignment	
9q	Penllyn	C	North Cardigan Bay SMP	Managed Realignment	
9r	Llwyngwril	C	North Cardigan Bay SMP	Limited Intervention	
9s	Morfa Aberech	C	North Cardigan Bay SMP	Managed Realignment	
11a	Dale Slack Gutter to Formby Coastguard station	C	Formby Point to Rossall Point SMP	Limited Intervention	Long term
B	Hesketh Outer Marsh, Ribble Estuary	C	Questionnaire Response (Environment Agency)	Managed Realignment	

Number	Site / Management Unit	Estuary or Coast	Source of Information	Type of Retreat	Timescale (Managed Realignment only)
A	Lune Estuary, Morecombe Bay	C	Questionnaire Response (Environment Agency)	Managed Realignment	
11b	Eskmeal Dunes	C	St Bees Head to Earnse Point SMP	Limited Intervention	-

Further details of seven estuarine realignment sites were obtained from Environment Agency staff by postal or telephone questionnaires, and these are summarised in Table 2.2. Details of three implemented and one planned Managed Realignment schemes in the Blackwater Estuary in Essex are documented in the Essex Coastal Habitat Management Plan (Posford Haskoning, 2002). Information about some of these estuarine Managed Realignment sites that are of particular interest is summarised below.

(a) Alkborough

As part of the Humber Estuary Shoreline Management Plan, an area of more than 400 hectares at Alkborough is being considered for Managed Realignment. The area lies at the base of the limestone escarpment at the junction of the River Trent with the River Humber and is currently defended by nearly six kilometres of flood embankments. As it may not be cost effective to maintain these embankments in the future, consideration is being given to the creation of new inter-tidal habitat by the abandonment and possible breaching of the embankments. This would provide a significant environmental enhancement in the estuary and provide compensatory habitat for the loss of inter-tidal habitat by "coastal squeeze".

(b) Thorngumbald

Also in the Humber Estuary at Thorngumbald, just to the east of Kingston-upon-Hull, construction work has just started to realign approximately 2.5 kilometres of the flood defences by up to 500 metres landward of the existing line. The existing defences are deficient both in terms of their stability and the standard of protection that they provide. The realignment allows for new higher standard defences to be constructed further inland while delivering environmental enhancements by creating approximately 70 hectares of inter-tidal habitat. This habitat will compensate for other Agency construction works in the estuary where realignment is unavailable and encroachment seaward of the existing defence footprint is proposed. One of the main obstacles at Thorngumbald has been the acquisition of the necessary land. Although in the ownership of only two landowners, negotiations were protracted. Land values far in excess of agricultural market prices have been negotiated, justified in part by the fact that material for the new defences is to be obtained from borrow areas within the land purchased.

(c) *Cotehele*

It is proposed to breach the flood defences of the River Tamar in three places to provide more space for the river. As a result approximately 15 hectares of the National Trust's Cotehele Estate on the Devon/Cornwall border will be flooded. The purposes of the project are to reduce the risk of flooding to property as a result of climate change and to create wetland habitat. The area affected was reclaimed from the Tamar 150 years ago for agriculture. It is hoped that within about 20 years an extensive reed bed will have developed supporting diverse flora and fauna. This proposal is currently the subject of a planning application by the National Trust to the local authority, the outcome of which is expected to be known in September 2002.

(d) *Northey Island*

Northey Island is a small (0.8ha) site within the Blackwater Estuary owned by the National Trust, which was initially reclaimed in the 19th century. The site is anomalous in that it is high in the tidal frame and that under a superficial layer (0.2-0.5m in depth) of inter-tidal sediment lies a London Clay base. Restoration of the site was achieved in 1992 using a bank retreat technique and the material moved from the embankment to the borrow dyke on the landward side. Subsequent vegetation colonisation by halophytes was rapid with an almost complete *Salicornia* cover in the first year. Accretion rates were initially high in summer but with erosion in winter giving a low net value, however as perennial species began to colonise the net annual accretion increased.

(e) *Orplands*

A 45ha site on the south bank of the Blackwater was restored to inter-tidal habitat in 1994 using two breaches in the original flood embankment. The site has some similarities with Northey in that it lies high in the tidal frame and Holocene sediment lap onto the underlying London Clay forming the bounding higher ground. Orplands differs from the other Blackwater schemes in that no secondary defences were necessary. This means that a full vegetation succession from lower to upper salt marsh to terrestrial vegetation has developed here. This is a relatively rare scenario in Essex since most of the salt marshes are backed by sea wall which, as stated previously, limit their natural transition to terrestrial vegetation. As with Northey Island, Orplands has been a highly successful restoration scheme with rapid vegetation colonisation and accretion over its surface. Funding

was provided under the former Habitat Scheme operated by MAFF (Section 10.2).

(f) Tollesbury

Tollesbury is a 21 ha site located at the head of Tollesbury creek, a tributary of the Blackwater estuary. The site was restored in 1995 using a single breach in the existing embankment. The site is complex in that its northern half is low in the tidal frame and indeed below that necessary for the establishment of salt marsh, while the southern half is high in the tidal frame, running up to high ground. Despite the higher ground boundary, it was necessary to provide a secondary defence for the site to prevent any inundation of adjacent agricultural land. The higher margins of the site were rapidly colonised by annual *Salicornia* species but the lower areas have not yet colonised after 7 years of tidal influence. Nevertheless, monitoring data does show that considerable accretion is taking place within the lower areas and, as surface levels rise, colonisation by salt marsh vegetation is predicted.

(g) Abbotts Hall

A 20 ha site at Abbott's Hall in the Blackwater was restored to inter-tidal in 1996 with funding from the former Habitat Scheme operated by MAFF (Section 10.2). A further proposed scheme will involve five separate breaches of varying sizes to the seawall currently protecting agricultural land at Abbotts Hall Farm. The remaining lengths of seawall will be left in place. The scheme has been designed to ensure that approximately 115 ha of the low-lying land behind the seawall are flooded, in respect of which it is understood that Countryside Stewardship funding will be paid. As the land undulates slightly, there will be high land between each of the individual breach locations. The proposed scheme is predicted to create of a variety of habitats, including salt marsh, saline lagoons, and inter-tidal mud. It is anticipated that annual vegetation will be fully established on the site within two years and perennial vegetation within five years.

In June 2002, as this Review was nearing completion, the Environment Agency issued a consultation document (Environment Agency 2002) identifying a total of 12 sites being considered for Managed Realignment in the Humber Estuary, totalling 2,208 ha in area. Several of these are additional to those identified in the Shoreline Management Plan, but apart from those identified in Table 2.1, they have yet to enter the stage of detailed planning or design.

Table 2.2 **Summary of Responses Received to Detailed Questionnaire on Managed Realignment in England & Wales - Estuaries**

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
Alkborough Managed Retreat	River Trent and Humber Estuary	North Lincolnshire	Feasibility stage, construction planned for 2004	5,800	400	Earth embankment	Site identified in strategy, habitat creation	Abandon-ment and possible breaching	John Pygott, Environment Agency, North East Region
Thorngumbald	Humber Estuary	East Yorkshire	Construction commenced in 2001 and is ongoing	2,500	70	Earth embankment	Improve flood defence, compensatory habitat for other flood defence works	Realigned earth embankment	Keith Slaney, Environment Agency North, East Region
Brue Pill Tidal Banks	Weston Bay	Somerset	Implemented in early 1990s	-	-	Earth banks	Creation of habitat	-	Nick Stevens, Environment Agency, South West Region
Bridgwater to Combwich	River Parrett	Somerset	Feasibility Study	10,000	-	Earth embankment	Flood defence	Set back to a straighter or short line	David Pilkington, Environment Agency, South West Region

Powerham Bank	River Exe	Devon	Pre-feasibility Study	5,000	-	Earth embankment	Flood defence	Use railway embankment as setback defence	Carol Drummond, Environment Agency, South West Region
Cotehele Managed Retreat	River Tamar	Cornwall	Implementation planned to commence in June 2002	1,000	15	Earth embankment	Habitat creation	Flood to higher land and new embankment	Brian Muelaner, National Trust, Cornwall
Saltram Marsh	River Plym	Devon	Implemented in 1995	-	-	Earth banks	Wetland habitat creation	Spillway in bank	M Oram, Environment Agency, South West Region

2.2.3 *Discussion*

The review of sites identified in the SMPs indicates that there is a number of factors that may be influencing the selection of Managed Realignment as an option:

(a) *The coastal planning process*

The number of Managed Realignment sites appears to be relatively small compared to the total number of management units around the coast of England and Wales, which is approximately 1,100 (since not all of the SMPs define management units in exactly the same way, it is difficult to state the exact figure). Based on numbers of management units, the policy of Managed Realignment has only been adopted in SMPs along approximately 3% of coastline of England and Wales. Of the 39 sites identified in SMPs, eight (21%) are known to be under construction or completed, at least in part, and a further nine (23%) are known to be in the process of planning or design. This indicates a 44% uptake of the option once it has been adopted at SMP stage (though some of the implemented schemes were already in progress before the SMPs were written). It appears that major factors influencing the wider implementation of Managed Realignment are the small number of sites identified and adopted at SMP stage, as well as constraints on implementation once it has been adopted.

16 Managed Realignment sites were identified that are not included in SMPs, of which five (31%) are known to have been implemented and the remaining 11 are still in the planning/design process. Since five out of 13 implemented schemes and 11 out of 20 schemes in planning/design were not included in SMPs, this does raise the question as to whether SMPs have proved highly effective in identifying sites for Managed Realignment. One reason for this may be that some sites in planning/design are driven by the requirements of the Habitats Regulations, the implications of which were not fully addressed in many of the first generation SMPs.

The Environment Agency's consultation document on Managed Realignment on the Humber (Environment Agency 2002) represents an innovative approach to identifying potential sites and particularly in encouraging public participation in the process. The issues of political sensitivity and potential "land blight" encountered in promoting Managed Realignment in some other locations have been addressed by the Agency's

stated intention to purchase land required for Managed Realignment, an issue that is discussed further in Section 10.

(b) Topography

Most of the Managed Realignment sites are expected to involve artificial flooding for the purpose of retreating the defence to higher ground or a new defence line, rather than retreat of cliff frontage (which generally tends to be Limited Intervention). It would follow that Managed Realignment (as defined by DEFRA guidance) tends to be more applicable to low-lying land than to cliff frontages.

(c) Geography

The sites for which Managed Realignment has been considered are clustered around a number of locations, namely the Humber Estuary, the Wash, Essex Estuaries, The Solent, Bristol Channel and Cardigan Bay. This distribution is believed to reflect the fact that, as noted above, Managed Realignment as a policy option tends to be most appropriate on flat low lying land, and especially in estuaries sheltered from the more severe coastal conditions experienced on the open coast.

Conversely, there are fewer identified potential Managed Realignment sites within Coastal Cells 1 (St Abb's Head to Flamborough Head), 4 (Thames to Selsey Bill), 6 (Portland Bill to Land's End) and 10 (Bardsey Sound to Great Orme). This is thought to reflect the physical nature of the coastline in Cells 1, 6 and 10 and the intensely urbanised nature of the coastline in the case of Cell 4. The latter illustrates that human land use, and the resulting political considerations, is an important determinant of whether Managed Realignment is adopted as a policy.

The distribution of schemes in planning and design is even more concentrated:

- Of the 13 management units where schemes have been implemented, four are in the Humber Estuary, two in Suffolk estuaries, one in the Blackwater Estuary (where there are four individual schemes), one in Chichester Harbour, one in the Plym Estuary and two in the Taw/Torridge Estuary. Only two, Brancaster in Norfolk and Northam Burrows west of Appledore in Devon, are on the open coast.

- Of the nine schemes identified through SMPs that are in planning/design, one is in the Humber Estuary, one in North Norfolk and the other seven are in Essex. Three are on the open coast and six are in estuaries.

2.3 Rivers

2.3.1 General

The concept of Managed Realignment is not as well developed in the case of rivers as it is for coasts. For the purpose of this review, we have taken it to include any of the following:

- deliberate setting back of flood embankments to widen the flood plain;
- creation of on-line flood storage; and
- realigning a channel into a new course.

The role of these approaches to flood management in rivers and some of the issues arising were recently described by ICE (2001), as part of an independent review of the approaches to managing fluvial flood risk in the 21st century. This report notes:

- There is a desire to direct agricultural and forestry policies, practices and grant regimes towards flood risk alleviation and the restoring the role of undeveloped flood plains into flood storage and reducing peak flows downstream. It has been suggested that flood storage areas could be identified as a land use within local plans. Note, however, that there is a limited amount of flood plain storage available on agricultural land.
- Urban watercourses tend to be a neglected resource, are unattractive and inefficient conveyor of floods. Improvements to their environmental status (i.e. reintroduction of natural features in the channel) whilst improving flood conveyance should be sought. This may require space and mean the loss of gardens and even demolition of properties.
- The most sustainable solutions are those that address the issue of run-off at source i.e. storage. The long term sustainable option is to let rivers have space in urban areas and to encourage the development of an urban river corridor

that can accommodate increased flood capacity in sympathy with the urban use of the land.

- Conveyance and flood storage options should be considered for fluvial flooding problems.

Two basic options for dealing with excess flows in rivers exist:

(a) Temporary storage, including storage on farmland and regulated flood storage reservoirs (on-line or off-line storage), which also give potential for environmental enhancements. Storage options generally mimic nature and where practical are preferred. Options should start from the source of the run-off.

(b) Flow passed downstream. River restoration to a more natural state can slow down flows of water through the river reach. Extreme cases could involve clearing of houses and infrastructure to provide flood storage and conveyance. This has been practised in Japan and USA.

2.3.2 *Approach to Data Gathering*

A Catchment Flood Management Plan (CFMP) is to be developed by the Environment Agency and DEFRA for each river catchment in England and Wales. Following the preparation of a draft set of guidelines for the plans, pilot studies were commissioned for five rivers, namely:

- River Parrett in Somerset
- River Medway in Kent
- The Yorkshire Derwent
- River Irwell in Lancashire
- Upper River Severn

The five locations were chosen to provide a representative sample of river catchments within England and Wales, ranging from the small urbanised catchment of the River Irwell to the extensive rural catchment of the Upper River Severn. Once the pilot CFMP studies have been completed, the plan guidelines will be finalised and CFMPs will then be developed for all river catchments in

England and Wales. It is possible that some scoping exercises and data gathering may be undertaken before the pilot studies and guidelines are finalised.

A scoping exercise and data gathering were initially undertaken for each pilot study but the development of the CFMPs themselves has been delayed. The work done to date is not advanced sufficiently to provide input to the current study on managed realignment.

Consequently, there is at present no equivalent to Shoreline Management Plans which sets out high level policies on flood defence and land use in river catchments. In the absence of such a resource, it was agreed with the Steering Group that a comprehensive approach is not realistic and that we would seek information on as many schemes as possible from contacts in the Environment Agency through questionnaires and telephone interviews. Details of further schemes were obtained from the River Restoration Centre (RRC), which maintains a database of proposed and implemented fluvial projects, including several that entail managed realignment.

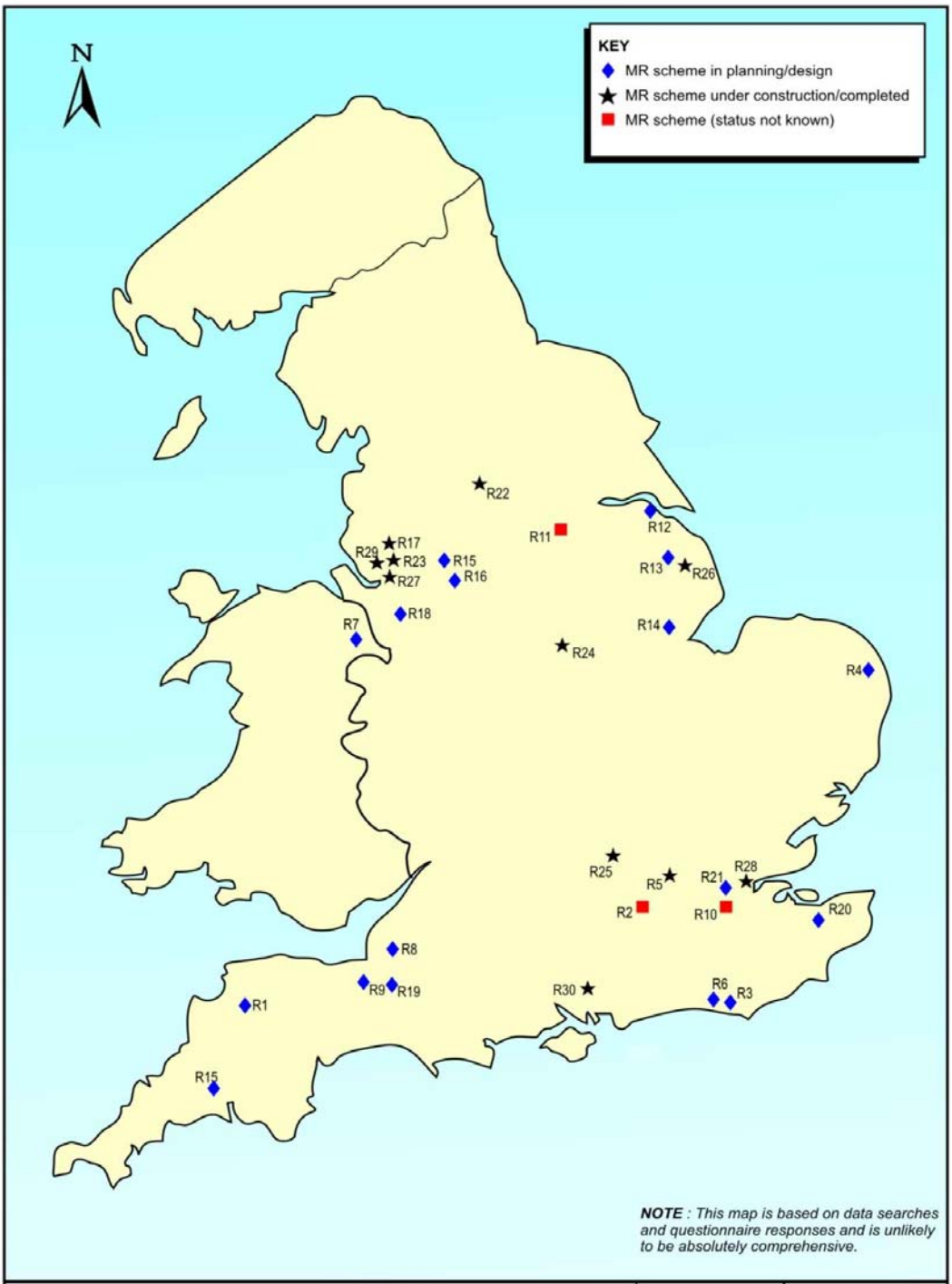
In advance of CFMPs, a number of Preliminary Strategic Reviews have been prepared for river catchments in the North East Region of the Environment Agency and those for the Upper Aire, Lower Aire Catchment, Lower Don Sub-catchment and the Upper Don Strategy were obtained and reviewed. These identified that potential flood defence solutions to these areas could include `managed realignment` works. However, until more detailed studies are carried out, insufficient information exists at this time to identify particular reaches where this is proposed. No other preliminary strategic reviews were identified in other regions of the Environment Agency.

2.3.3 *Managed Realignment Sites mentioned in Responses to the General Questionnaire*

A summary of the fluvial Managed Realignment sites identified from responses to the general questionnaire (Section 3) is presented in Table 2.3. The locations of these sites are shown in Figure 2.3, identified with an initial R plus a number. The map codes them according to whether they are at the planning stage or in implementation.

Table 2.3
List of River Managed Realignment Sites (Key to Figure 2.3)

Number	Site	River	County	Detailed Questionnaire Completed?	Source of Information	Type of Retreat	Timescale
R1	Cole	River Brue	Somerset	No	-	-	-
R2	Cove Brook	Cove Brook	Surrey	No	-	-	-
R3	Cuckmere Haven	River Cuckmere	Sussex	No (Planned)	-	-	-
R4	Havergate Island	River Yare, Waveney	Norfolk	No	-	-	-
R5	Jubilee River	River Thames	Berkshire	No	Environment Agency website	Flood relief channel	Implemented
R6	River Ouse	River Ouse	Sussex	No	-	-	-
R7	Ruthin Town	River Clywedog	Denbighshire	No	-	-	-
R8	River Yeo	River Yeo	Somerset	No	-	-	-
R9	River Parrett	River Parrett	Somerset	Yes	Questionnaire Response (Environment Agency)	Embankment realignment	Proposed long term
R10	Ravenbourne		London	No	-	-	-
R11	River Idle		Nottingham-shire	No	-	-	-



Project	Scale	
MANAGED REALIGNMENT RESEARCH	Not to Scale	Halcrow
Figure Title: RIVER MANAGED REALIGNMENT SITES SHOWING CURRENT IMPLEMENTATION STATUS		Figure 2.3

GRAPHIC UNIT/CEFAAI13a/RH/13.06.02

Number	Site	River	County	Detailed Questionnaire Completed?	Source of Information	Type of Retreat	Timescale
R12	Brigg Flood Alleviation	River Ancholme	N. Lincolnshire	Yes	Questionnaire Response (Environment Agency)	Embankment realignment	Proposed long term
R13	River Bain Flood Alleviation	River Bain	Lincolnshire	Yes	Questionnaire Response (Environment Agency)	Flood storage	Proposed long term
R14	Lower Witham Flood Alleviation	River Witham	Lincolnshire	Yes	Questionnaire Response (Environment Agency)	Flood storage	Proposed short term
R15	River Etherow Flood Alleviation Scheme	River Etherow	Manchester	Yes	Questionnaire Response (Environment Agency)	-	Implemented
R16	River Irwell Flood Control	River Irwell	Manchester	Yes	Questionnaire Response (Environment Agency)	Flood storage	Currently being implemented
R17	River Roch Flood Alleviation	River Roch	Lancashire	Yes	Questionnaire Response (Environment Agency)	-	Implemented

Number	Site	River	County	Detailed Questionnaire Completed?	Source of Information	Type of Retreat	Timescale
R18	Sankey Brook Improvements	Sankey Brook	Cheshire	Yes	Questionnaire Response (Environment Agency)	Realign embankments	Proposed long term
R19	Parrett Catchment Project	Rivers Parrett, Brew and Axe	Somerset	Yes	Questionnaire Response (Environment Agency)	-	Proposed long term
R20	Leigh Barrier	River Medway	Kent	Yes	Questionnaire Response (Environment Agency)	-	-
R21	River Quaggy Flood Alleviation	River Quaggy	London	Yes	RRC database	Channel realignment and flood storage	Proposed short term
R22	Mytholmroyd Flood Alleviation	Upper Calder	West Yorkshire	Yes	RRC database	Channel realignment	Implemented
R23	Atherton Lake Brook	Atherton Lake Brook	Lancashire	Yes	RRC database	Flood storage	Implemented
R24	River Erewash – Long Eaton	River Erewash	Derbyshire	Yes	RRC database	Channel realignment	Implemented
R25	Bear Brook	Bear Brook	Buckingham-shire	Yes	RRC database	Channel realignment	Implemented

Number	Site	River	County	Detailed Questionnaire Completed?	Source of Information	Type of Retreat	Timescale
R26	Great and Long Eau	Great and Long Eau	Lincolnshire	Yes	RRC database	Embankment realignment	Implemented
R27	Padgate Brook – Phase B, Farrell Street	Padgate Brook	Cheshire	Yes	RRC database	Embankment realignment	Implemented
R28	Spring Brook at Downham – Shaftesbury Park	Spring Brook	London	Yes	RRC database	Channel realignment	Implemented
R29	River Alt – B/Phase 2	River Alt	Merseyside	Yes	RRC database	Channel realignment	Implemented
R30	Hermitage Stream Restoration Project	Hermitage Stream	Hampshire	Yes	RRC database	Channel realignment	Implemented

2.3.4 *Responses to the Detailed Questionnaire*

Further details on 20 river schemes were obtained through the more detailed questionnaire and follow up. These, together with another scheme of which details were obtained from the Environment Agency website, are summarised in Table 2.4 and discussed in the following subsections.

2.3.5 *Overview of the Responses*

Analysis of the 20 completed questionnaires relating to fluvial sites indicates the following:

- Construction has been completed at eleven of the projects;
- Construction is underway at one site;
- One site is at pre-feasibility study stage with a further three sites at feasibility study stage and one at detailed design;
- A strategy is currently being developed for one site and negotiations with landowners are currently being undertaken for one site.

Table 2.4
Summary of Responses Received to Detailed Questionnaire on Managed Realignment on Rivers in England and Wales – Fluvial Sites

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
Brigg Flood Alleviation	River Ancholme	North Lincolnshire	Feasibility Report due early 2001	-	-	Canalised flood banks	Re-create floodplain	Lower flood banks	Chris Allwork, Environment Agency, Anglian Region
River Bain Flood Alleviation	River Bain	Lincolnshire	Feasibility Report due February 2002	2,000	-	Flood banks	Flood alleviation	On-line and off-line flood storage	John Oldfield, Environment Agency, Anglian Region
Lower Witham Flood Alleviation	River Witham	Lincolnshire	Negotiations with landowners	-	-	Canalised embankments	Flood protection and environmental enhancement	On-line flood storage	Janette Hunter, Environment Agency, Anglian Region
River Etherow Flood Alleviation Scheme	River Etherow	Manchester	Implemented in 1999	50	20	None	Provide water feature	-	Kieran Morris, Environment Agency, North West Region

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
River Irwell Flood Control Scheme	River Irwell	Manchester	Construction commenced in 1995 and is ongoing	1,000	30	Formal embankments and hard defences	Flood storage	-	Daniel Bown, Environment Agency, North West Region
River Roch Flood Alleviation Scheme	River Roch	Lancashire	Implemented in 2001	300	0.6	None	Environmental benefit	Earth fill	Andrew Holden, Environment Agency, North West Region
Sankey Brook Improvements Strategy	Sankey Brook	Cheshire	Pre-feasibility stage	1,500	21	Earth embankment	Allow natural channel mobility	Relined or non defence	Keith Roddy, Environment Agency, North West Region
Bridgwater to Langport	River Parrett	Somerset	Feasibility Study	20,000	-	Earth banks	Flood defence	Set back to a straighter or short line	David Pilkington, Environment Agency, South West Region
Parrett Catchment Project	Rivers Parrett, Brew and Axe	Somerset	Strategy, 5-6 years from specific proposals	-	-	-	Flood defence	Not yet defined	Ken Tatum, Environment Agency, South West Region

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
Leigh Barrier	River Medway	Kent	-	-	-	-	-	-	Richard Francis, Environment Agency, Southern Region
River Quaggy Flood Alleviation	River Quaggy	London	Detailed design stage (planning permission being sought)	450	'8 football pitches'	Channelised/ culverted	Create more natural flood storage area	Creation of new valley floor, low flow stream and off-line storage	Trevor Odell, Environment Agency, Thames Region (Source of information from RRC database)
Mytholmroyd Flood Alleviation	Upper Calder	West Yorkshire	Implemented 2000	500	-	Floodbanks	New habitat creation	Channel remodelling within existing floodbanks	Vicki Hirst, Environment Agency, North East Region (Source of information from RRC database)

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
Atherton Lake Brook	Atherton Lake Brook	Lancashire	Implemented 1994	1000	14	Pumped discharge	Flood alleviation	Flood storage	Pam Nolan, Environment Agency, North West Region (Source of information from RRC database)
River Erewash – Long Eaton	River Erewash	Derbyshire	Implemented 1996	700	-	Straightened channel bounded by floodbanks	Flood protection	Reconnect former meanders, rehabilitate floodplain pools	Valerie Holt, Environment Agency, Midlands Region (Source of information from RRC database)
Bear Brook	Bear Brook	Buckingham-shire	Implemented 1994	1000	8	Floodbanks (previously straightened)	Flood protection	Construction of floodbank and realignment of brook	Alistair Driver, Environment Agency, Thames Region (Source of information from RRC database)
Great and Long Eau	Great and Long	Lincolnshire	Implemented	2500	28	Floodbanks	Unsustainable	Realign one	Phil Smith,

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
	Eau		1996				flood protection	floodbank by up to 500m	Environment Agency, Anglian Region (Source of information from RRC database)
Padgate Brook – Phase B	Padgate Brook	Cheshire	Implemented 1997	1000	-	Floodbanks	Opening up of the Brook corridor	Set back existing floodbanks	Pam Nolan, Environment Agency, North West Region (Source of information from RRC database)
Spring Brook at Downham – Shaftesbury Park	Spring Brook	London	Implemented 2000	300	-	Concrete channel	Habitat improvement	Remove concrete channel and realign watercourse	Trevor Odell, Environment Agency, Thames Region (Source of information from RRC database)

Project	River	County	Current Stage of Project	Length of Defence (m)	Area within Realignment (ha)	Existing Defence Type	Reason for Realignment	Method of Realignment	Contact Details
River Alt – B/Phase 2	River Alt	Merseyside	Implemented 1996	600	2.5	Channelised river	Rehabilitation of river – improve water quality and landscape	Reinstate meanders and alter alignment of watercourse	Neil Guthrie, Environment Agency, North West Region, (Source of information from RRC database)
Hermitage Stream Restoration Project	Hermitage Stream	Hampshire	Implemented 2000	1500	-	Channelised and culverted	Improve the river environment	Removal of concrete, creation of two-stage channel	Lawrence Talks, Environment Agency, Southern Region (Source of information from RRC database)
Jubilee River	River Thames	Berkshire	Completed 2002	11.6 km	n/a	Floodbanks	Flood relief channel to carry 220 m^3/s	Excavation and landscaping of alternative channel	Environment Agency website

2.3.6 *Anglian Region*

The three potential Managed Realignment sites identified in the Anglian Region of the Environment Agency are all being considered primarily for flood alleviation purposes:

(a) In order to increase the standard of flood protection for the town of Brigg in North Lincolnshire, the re-creation of floodplain upstream of the town is being considered by the lowering of the canalised flood banks of the River Ancholme. This occurred informally in 1981 when flooding in Brigg was averted because the River Ancholme burst its banks upstream of the town, flooding several thousand hectares of agricultural land.

(b) An options development study carried out into the provision of flood alleviation for the town of Horncastle in Lincolnshire concluded that there were several sites in both the River Bain and the River Waring valleys upstream of the town which were suitable for flood storage. Currently investigations and consultations are underway to determine from the identified sites specific areas for flood storage.

(c) The strategy for the River Witham between Lincoln and Boston is a programme of flood bank strengthening works together with an increase in the standard of flood protection afforded by the creation of flood storage areas. The bank strengthening works have commenced and investigations are underway to determine potential flood storage areas, either by the recreation of flood plain or by the construction of on-line storage.

In each case, environmental enhancement is seen as a secondary objective, either by the recreation of a more "natural" flow regime or by river restoration. The main difficulty is seen as negotiations with the landowners of potential flood plain re-creation or flood storage sites. Experience suggests that there may be a need to maintain confidentiality where it is not proposed to purchase the affected land in order to avoid "land blight", whereby landowners are unable to use or deal with their land once proposals become public.

A fourth site along the Great and Long Eau was implemented in 1996 and involved the removal of approximately 2,000m of one of the existing floodbanks and replacing it with a new embankment set back by up to 500m, providing

425,000m^3 of flood storage. As with the three potential managed retreat schemes above, environmental enhancement was a secondary objective to the works.

2.3.7 *South-West Region*

Of the responses received from South West Region, two relate to fluvial sections of the River Parrett in Somerset (a third relating to a tidal section was included in Table 2.2) where landward realignment of the flood defences is being considered to straighten or shorten lines.

2.3.8 *North-East Region*

One site was identified within the North East Region, Mytholmroyd Flood Alleviation Scheme, where the primary objective of the scheme was to provide new habitat for wildlife whilst still ensuring sufficient flood defences. Extensive channel remodelling within the confines of the existing floodbanks enabled the creation of a diverse habitat and improved aesthetic and amenity value to the area.

2.3.9 *North-West Region*

Of the seven sites identified in the North West Region, four involve the realignment of flood defences to provide environmental enhancements as well as meeting flood defence requirements. In particular, a 20 hectare water feature was provided as part of the River Etherow Flood Alleviation Scheme. As part of the River Irwell Flood Control Scheme, it is proposed to realign one kilometre of flood defence in order to provide approximately 30 hectares of flood storage. The Improvement Strategy for Sankey Brook is to restore 1.5 kilometres of river, thereby allowing natural channel mobility. Padgate Brook and the River Alt schemes both involved the recreation of former meanders and the decommissioning of the highly canalised sections of watercourse.

2.3.10 *Midlands Region*

The scheme along the River Erewash involved the re-creation of ponds and river meanders as part of a flood defence improvement scheme.

2.3.11 *Southern Region*

One Managed Realignment scheme within the Southern Region along Hermitage Stream was identified from the RRC database. This was undertaken in order to restore the stream to a more natural river environment whilst still maintaining the existing standard of flood protection to the area.

2.3.12 *Thames Region*

Of the four schemes within the Thames Region, three have been implemented and the fourth is at detailed design stage.

Eight hectares of wetland were created as part of a flood storage scheme along Bear Brook while also enabling environmental enhancements and river asymmetry from the previously straightened channel. Spring Brook was also partly restored to improve the local habitat and amenity value of the watercourse. The Jubilee River is a very large flood alleviation scheme for the River Thames, which has incorporated extensive landscaping and habitat creation measures.

The River Quaggy scheme is currently at detailed design stage, to provide natural flood protection by creating flood storage. The main delay to the scheme has been the need for public consultation and the detailed development of the scheme.

2.3.13 *Discussion*

From the information obtained during the consultation process, there is a number of factors that may be influencing managed realignment as an option in fluvial systems:

(a) Drivers

Of the projects identified in the responses received to the Detailed Questionnaire, the primary reason for realignment given in 57% of the cases was to provide flood protection or alleviation. This has been or is to be provided by a variety of means ranging from the re-creation of a flood plan to set back of river banks and the construction of on-line storage. For the remaining projects, the primary reason was environmental enhancement, ranging from the reinstatement of meanders to the creation of a water feature.

(b) Constraints

Although not specifically defined in the responses, the main constraint to realignment appeared to be the time for implementation of such a scheme compared to that involving an improvement online option, due to the likelihood of prolonged consultations/negotiations. In addition, there were concerns as to the method by which the necessary land was to be purchased and the possibility of "land blight" following the identification of land which may be subject to future river or flood defence realignment. The perception of "losing land" to rivers was also mentioned.

3 Drivers and Constraints to Managed Realignment in England and Wales

3.1 *Approach*

The first stage in identifying obstacles and incentives to Managed Realignment was to send a questionnaire to a representative sample of stakeholders concerned by Managed Realignment. The objectives of the questionnaire were to:

- Collect information on potential constraints and drivers to Managed Realignment and their level of importance for a variety of stakeholders;

- Categorise stakeholders (e.g. level of interest and influence) and allow more in-depth analysis of the results (e.g. experience in Managed Realignment, perceptions of decision-making process etc.).

The questionnaire focussed on examining obstacles and incentives to Managed Realignment at a national and generic level. It also collected preliminary information for organising regional workshops, which have built on the themes raised by respondents.

The questionnaire (Appendix B) comprised four parts. Part A explored the position of the respondent and his or her institution, their level of interest in Managed Realignment and their level of influence, in order to allow categorisation of stakeholders. Part B focused on the theme of constraints and drivers *per se*. Constraints and drivers were classified in several distinct categories (technical/environmental, economic, policy and legislation, and political and cultural), and respondents were asked to indicate the level of importance of each factor, with space provided for comments. Part C asked respondents for details of their experience of Managed Realignment. Section D was concerned with the follow-up to the questionnaire, and respondents' interests in the regional workshops (Section 5).

The questionnaire was sent with a covering letter explaining the context of the study, as well as a list of people to whom the questionnaire had been sent, also included in Appendix B. Recipients included stakeholders at a variety of geographical scales and from a wide range of backgrounds, including central and regional governments, local authorities, associations of landowners and users, non-governmental organisations (NGOs), conservation organisations, coastal groups, regional and local flood defence

committees, port authorities, project managers and conservation officers. Respondents were asked to give their personal views, not a statement of their organisational policy.

180 questionnaires were sent in the first mailing. Targeted stakeholders were then followed up through phone calls, faxes and emails. A further five questionnaires were sent to additional consultees on the basis of recommendations from the first questionnaires returned. 81 questionnaires were returned by the end of the study, representing a return rate of 45%, which is well above the average for a postal questionnaire. A list of those who responded is given in Appendix C.

3.2 Results

3.2.1 Categories of stakeholders and their interests in Managed Realignment

The first section of the questionnaire dealt with stakeholder categorisation. Stakeholders were targeted at a generic (i.e. non-local, non-site-specific) level. In practice, of course, engagement is taking place at many different levels, in some cases even within an organisation. The targeted recipients included representatives of operational interests (organisations providing technical, legal or policy inputs or funding for schemes); statutory consultees who may not be directly affected but who inform the decision-making process; and stakeholders who are directly affected by the decision-making process. The respondents were therefore coded according to a broad functional classification based initially on the three levels of involvement in flood and coastal management:

- *Government* and operating agencies;
- *Statutory consultees*; and
- *Key stakeholders* who are directly impacted by flood or coastal defence decisions.

Because of the scale differences in the scope of the target organisations, the recipients of the questionnaire were also coded according to their organisation's geographical scope:

- *Local*, such as individual port authorities or local councils;
- *Regional*, made up, for example, of Environmental Agency regional managers and regional flood defence committees; and
- *National* organisations, including government agencies, conservation bodies, and advisory groups.

The qualitative comments in Section A were coded, and the key-word codings together with the numerical score responses from Section B have been used to identify the optimal clustering of organisations. These data, together with the preliminary classifications, were subjected to cluster analysis, which resulted in eight distinct categories of stakeholders (Table 3.1).

Table 3.1
Questionnaire Returns in each Stakeholder Category

Category	Questionnaires sent	Questionnaires returned	Return rate
DEFRA	7	3	43%
Environment Agency	23	15	65%
Conservation Bodies *English Heritage, English Nature, RSPB, WWF*	37	18	49%
Local Decision Makers *Local Government, Coastal Defence Groups*	25	12	48%
Landowners *NFU, CLA, Port Authorities, Defence Estates*	11	7	64%
Flood Defence Committees, Drainage Authorities	20	9	45%
Coastal Fora, Estuary & Project Officers	42	12	29%
Professional Advisory Groups	10	5	50%

Coastal Fora and the Estuary and Project Officers were initially categorised separately, as were the Flood Defence Committees and the Drainage Authorities. In both cases, their responses were closely clustered, and it was prudent to combine the data sets to ensure that the categories contained comparable numbers of responses.

These distinctions among the stakeholder responses are useful in that they allowed us to:

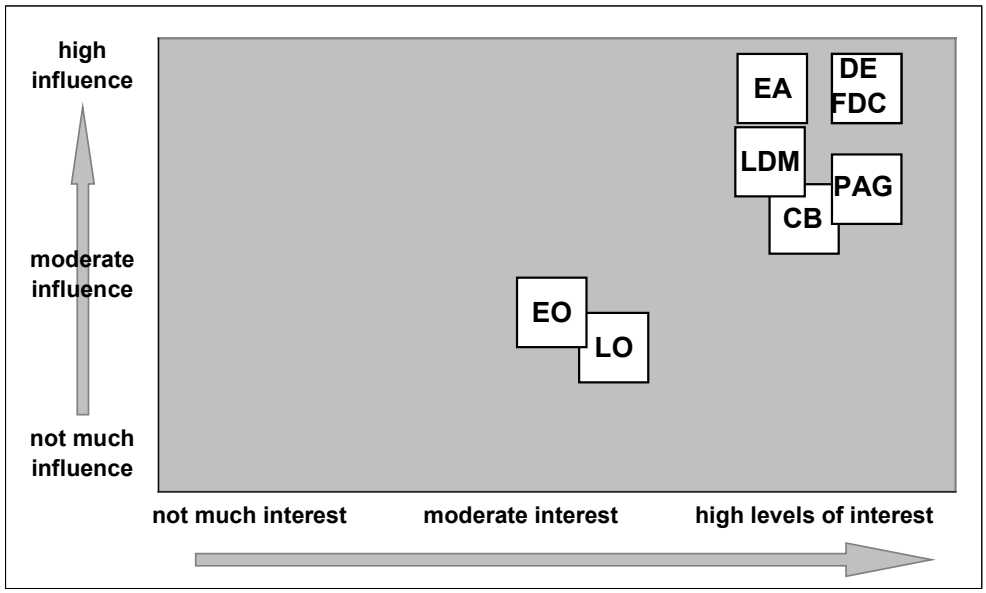
(a) address the differences of perception of the issues surrounding Managed Realignment in terms of the scale of influence of the respondents;

(b) explore the nature of some of the interactions between organisations; and

(c) ensure as representative a mix as possible of participants in the regional workshops (Section 5).

The responses were fairly evenly distributed amongst the categories (Table 3.1), with the exception of the coastal fora and project officers and DEFRA respondents. There were no responses from the regional Government Offices. Those stakeholders with an operational interest in flood management were particularly well represented (the Environment Agency response was 65%).

Figure 3.1 Stakeholder influence/interest matrix



Key:

CB	Conservation Bodies
DE	DEFRA
EA	Environment Agency
EO	Estuary Officers & Coastal Fora
LDM	Local decision makers (including local authorities)
LO	Landowners
PAG	Professional Advisory Groups
FDC	Flood Defence Committees and Drainage Authorities

Stakeholder mapping techniques were used to assess the levels of influence in the flood and coastal defence decision-making process, and also the degree to which respondents have a direct interest in flood and coastal management. This analysis was based on the responses of the questionnaire

recipients. This approach is useful in that it allows debate and decision-making to be targeted in a focused manner. The broad categorisation shows that the organisations representing key stakeholders who are directly affected by flood and coastal defence decisions feel they have at least a moderate influence in the process.

Organisations were asked *how* they had this level of influence. The responses are summarised in Table 3.2. Respondents were not required to give a single reason, so the total number of times the issues were mentioned is not the number of questionnaire responses. Table 3.3 shows how different categories of respondents viewed their involvement in flood and coastal management.

Table 3.2
Nature of stakeholder influence over flood and coastal defence decisions

Participation (as consultees)	40
Information provision	34
Execution of schemes	20
Flood defence planning and decision-making	18
Policy and SMP Development	11
Ensuring compliance with legislation	10
Funding	9

Table 3.3
Categories of stakeholders and their influence in flood and coastal management

	CG	EA	CB	LDM	LO	FDC	EO	PAG
Participation (+ users)		✓	✓	✓	✓	✓	✓	✓
Information		✓	✓	✓	✓		✓	✓
Execution of schemes		✓	✓	✓		✓	✓	
Flood defence planning and decision-making		✓	✓	✓		✓	✓	
Policy and SMP Development	✓	✓	✓	✓	✓	✓		✓
Compliance with legislation		✓	✓					
Funding		✓	✓			✓		

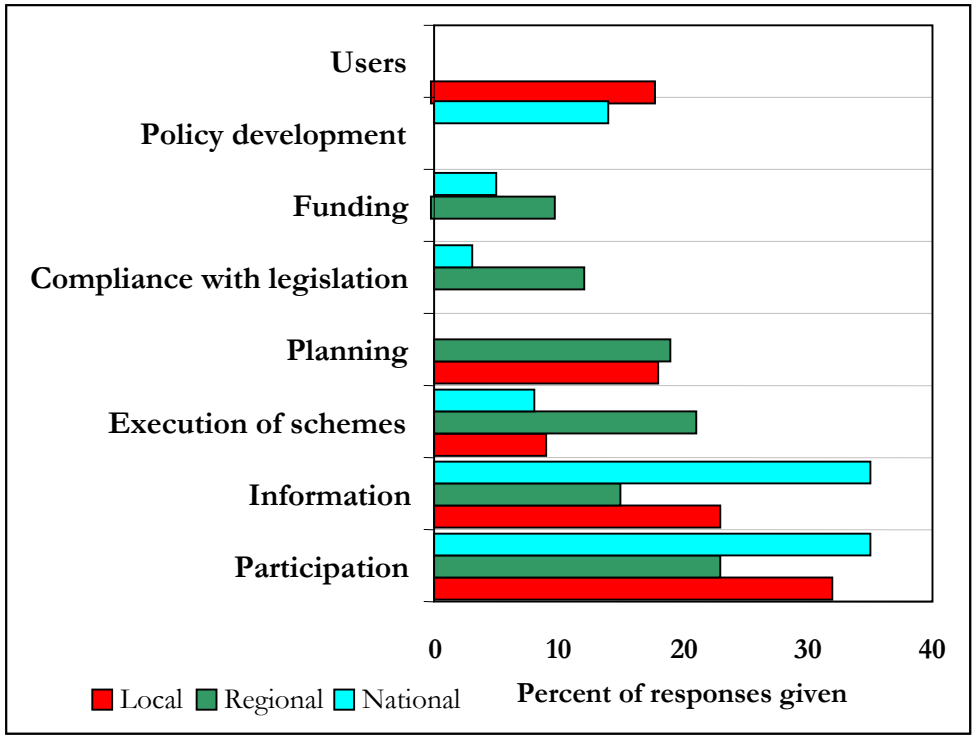
Respondents were asked about the circumstances under which they would see a positive case for the implementation of Managed Realignment. Motivations given for Managed Realignment are summarised in Table 3.4.

Table 3.4
Motivations given for Managed Realignment

Cost effectiveness	33
Sustainability	28
Integrated Coastal Zone Management	18
Environmental benefit	16
Habitat creation	12
Compensatory habitat/mitigation	12
Coastal squeeze	9
Regulations	9

Questionnaire recipients were asked what was the nature of their (or their organisation's) specific interests in the process of implementing Managed Realignment. Their responses were classed into eight themes. Many people expressed specific interests in more than one aspect of the process, and all of these have been collated. Figure 3.2 shows the percentages of the total number of interest statements made, classed according to geographical scope of the respondents' organisations. Engaging well at the regional level is clearly critical in terms of successfully planning and executing flood and coastal defence options.

Figure 3.2
Specific interests in Managed Realignment classed by geographical scope

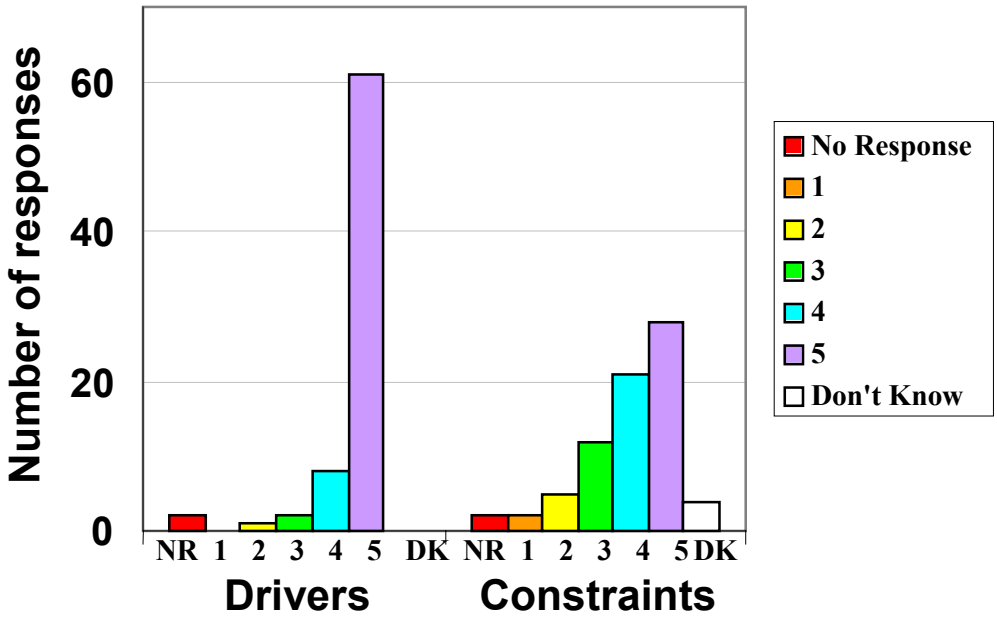


3.2.2 *Summary statistics on obstacles and incentives*

The second section of the questionnaire solicited the respondents' views on drivers and constraints to Managed Realignment. It is notable in the data that score responses are more closely clustered in the assessment of the importance of drivers, while the scores for the importance of the constraints to Managed Realignment are systematically more variable, within and amongst respondent categories.

What is also clear from the overview analysis is that the consultees appear to be much more unanimous about the importance of specific drivers than they are about the constraints. Responses tend strongly to be more closely clustered in the assessment of the importance of each driver, while the scores for the importance of the constraints to Managed Realignment are more variable. As an illustration of the differences in distribution of the responses, Figure 3.3 shows the number of responses in each category for the most highly ranked driver (provision of sustainable flood defence) and the most highly ranked constraint (financial compensation to landowners). In the first case, 80% of respondents gave a score of 5, whilst in the second, just 35% of respondents returned a score of 5, although the scores >3 accounted for 80% in total. In this part of the questionnaire, a score of 5 indicated "very important" and a score of 1 was "not important".

Figure 3.3 Distribution of responses for one driver and constraint



Because of this difference in the distribution of responses, two measures are given in the summary statistics below for the ranking of drivers and constraints. First, the issues are ranked according to the number (and percentage) of responses where an issue was identified as "very important". The mean score for each of the responses has also been calculated, and is shown in Tables 3.5 and 3.6, where values close to 1 are "not important", and a score of 5 is "very important". For

Figure 3.4 Drivers for Managed Realignment Identified by Consultees

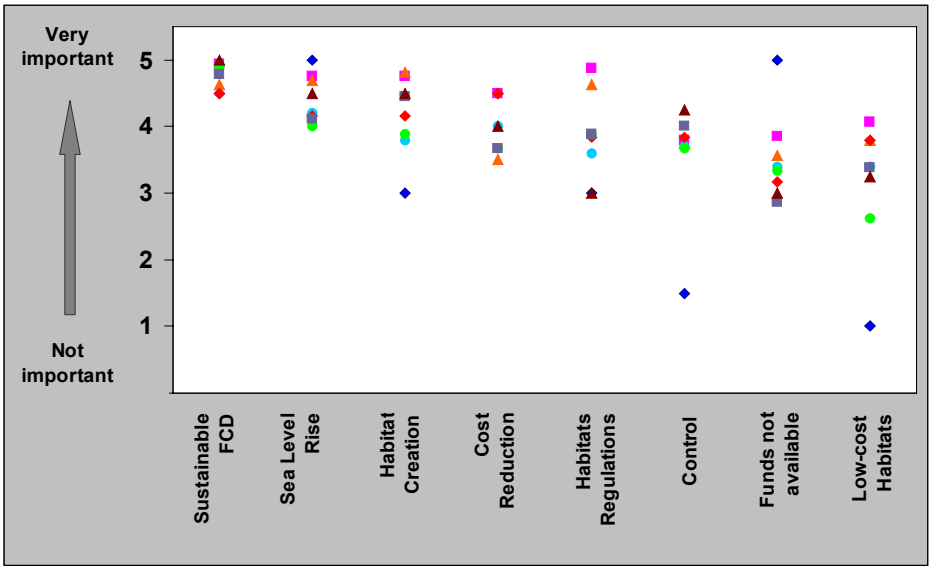
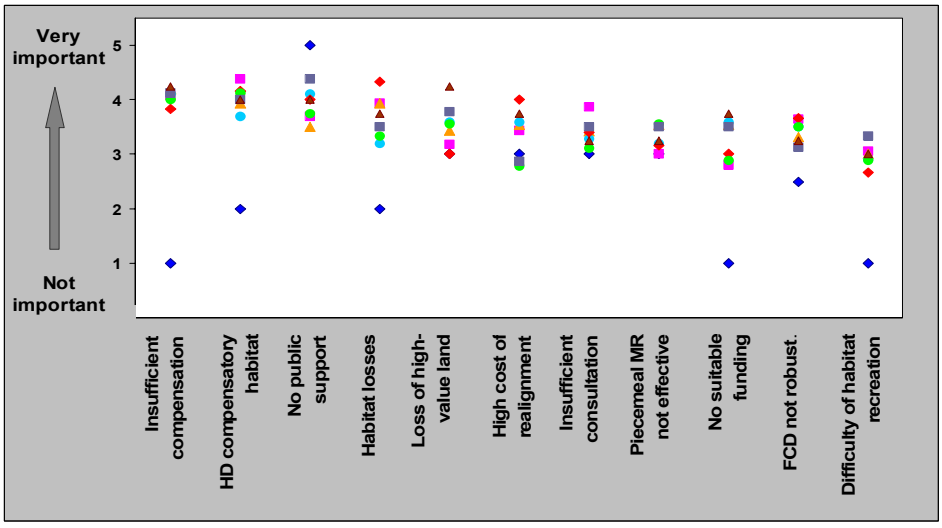
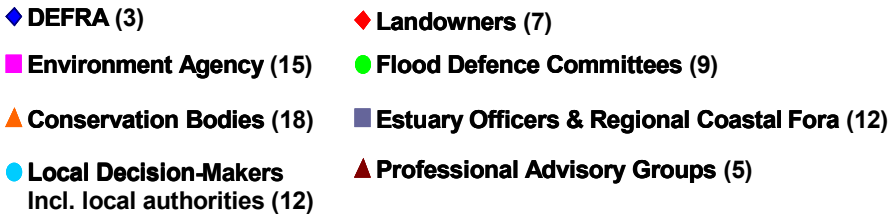


Figure 3.5 Constraints to Managed Realignment Identified by Consultees





the drivers, both methods essentially result in the same ranking (Table 3.5), with the *provision of sustainable and effective flood/coastal defence* being seen as the most important driver, followed by *coping with future sea level rise*; *providing habitat, meeting the legislative requirement of the Habitats Directive,* and *reducing costs of flood and coastal defence.* This contrasts slightly with the expressed motivations for Managed Realignment given in response to question 11 of the Questionnaire (discussed in Section 3.2.1), where cost reduction was most often mentioned.

Table 3.5 Ranking of drivers

Rank Position	Question Number	Abbreviation		Times scored "very important"		Mean Score
				Number	%	
1	14	Sustainable FCD	Providing sustainable and effective flood and coastal defence	61	82	4.7
2	22	Sea Level Rise	Essential for a long term strategy of coping with sea level rise	41	55	4.3
3	16	Habitat Creation	Providing environmental benefits in terms of habitat creation	41	55	4.3
4	21	Habitats Regulations	Habitats Regulations (means of compensating for habitats lost elsewhere through reclamation or coastal squeeze)	32	43	4.0
5	18	Cost Reduction	Reducing costs of flood and coastal defence	27	36	3.7
6	15	Control	Controlled breach better than dealing with an accidental breach	19	26	3.5
7	23	Funds not available	DEFRA funding not available for holding the line	18	24	3.0
8	19	Low cost habitats	Low cost means of recreating natural habitats	14	19	3.2

Figure 3.4 shows the ranking of drivers by different stakeholder categories. Broadly speaking, there is good agreement among the eight stakeholder classes about the most important drivers, and the differences can generally be explained. For instance, the Environment Agency and conservation bodies ranked the Habitats directive significantly higher than the professional advisory groups and DEFRA's Flood Management representatives did, reflecting their organisational interests and obligations. Note that the order of drivers changes very slightly (costs and Habitats Directive are reversed compared with the overall data set) because the scores given have been averaged within the categories.

The ranking of the constraints specified in the questionnaire was less clear cut (Table 3.6). The issues that were most frequently identified as "very important" were *financial compensation*; *Habitats Regulations*; *potential loss of valuable land*; *public support* and *insufficient consultation*. In terms of the mean scores, the ranking changed somewhat (the last column shows the ranking by mean score), and *freshwater/terrestrial habitat loss* is perceived overall as a more important issue.

Table 3.6 Ranking of constraints

Rank Position	Question Number	Abbreviation		Times scored "very important"		Mean Score	Rank Position by Mean Score
				Number	%		
1	37	Insufficient compensation	Insufficient financial compensation to landowners	28	38	3.7	2
2	33	HD Compensatory Habitat	Habitats Regulations	22	30	3.8	1
3	30	Loss of High-Value Land	Potential loss of land with high property value	19	26	3.4	5
4	36	No Public Support	Lack of support from public opinion	18	24	3.7	3
5	38	Insufficient Consultation	Insufficient consultation	16	22	3.0	8
6	29	High cost of realignment	Potential high cost of Managed Realignment	15	20	3.1	6
7	26	Habitat losses	Potential loss of terrestrial and freshwater habitats	14	19	3.5	4
8	34	Piecemeal MR not effective	Managed realignment is ineffective if carried out on a piecemeal basis	13	18	3.1	7
9	31	No Suitable Funding	Lack of access to or information about suitable funding	11	15	2.9	10
10	25	FCD not robust	Insufficient robustness of flood and coastal defence	10	14	3.0	9
11	27	Difficulty of habitat recreation	Difficulty of recreating an environmentally diverse habitat	6	8	2.9	11

Figure 3.5 shows the category ranking of the constraints. As in Figure 3.4, the average scores for each category result in slightly altered rankings because the greater variability in the overall data set has been attenuated by the statistical treatment. There is reasonable unanimity about the two main constraints, landowner compensation and the Habitats Directive, but the remaining themes are scored with more variability. Nevertheless, the mean scores of even the lowest ranked constraint (the difficulties of recreating an environmentally diverse habitat) corresponded to moderately important. The most striking feature was the outlying

responses from the DEFRA respondents, reflecting their different, controlling, role in flood and coastal management. In all case, however, it should be noted that the views expressed were those of individuals and not necessarily the positions of the organisations to which they belong, so the priorities identified do not represent a statement of policy by any of the organisations.

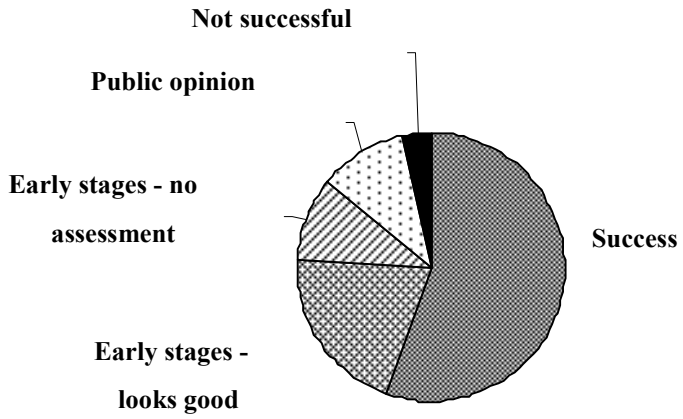
3.2.3 *Practical experience*

Of the organisations that responded to the questionnaire, 42 (57%) have had some practical experience of Managed Realignment, and of these, 29 respondents provided descriptions and brief assessments of the experiences. The following coastal sites were most frequently mentioned: Abbotts Hall, Northey, Orplands and Tollesbury in Essex; Alkborough and Thorngumbald on the Humber; Brancaster, north Norfolk; and Freiston Shore, Lincolnshire. River sites were also mentioned, particularly in the south-west of the UK (e.g. Plym, Taw, Parrett).

Most respondents said that the Managed Realignment experience had been positive (with projects described as successful in 16 out of the 29 responses, and projects in initial stages were viewed optimistically in a further six responses; see Figure 3.6). Success is measured primarily in terms of habitat creation. In three responses, no assessment was made about the success of the schemes, but the response focused on public opinion and support for the schemes. Indeed, even where projects were rated as successful, the most frequently mentioned concern was to do with the views and participation of the public, as the following quotations illustrate:

- *"Highly successful - both resulted in new inter-tidal habitat, provided valuable scientific and technical info on delivery and as demonstration sites. The importance of partnership working was a key issue."*
- *"Successful, but consultation process to arrive at solution was weak."*
- *"Successful if PR is well managed."*
- *"Too early to say but … a consulting approach has been taken. This has advantages in that you hopefully get community support, but the downside is that it tends to result in compromise solutions… not necessarily good decisions."*

Figure 3.6 Respondees' Experience of Managed Realignment



One scheme was described as unsuccessful, and the lack of success was attributed mainly to capital-intensive execution. The complexity of the planning process was mentioned several times for existing and proposed projects. This was followed up as a topic for discussion in the Regional and Case Study workshops (Sections 5 and 6).

3.2.4 *Perceptions of decision-making*

Finally, we asked our respondents how they felt their opinions were received by decision makers. Two thirds of respondents were satisfied that their views were taken into account, even if they were not necessarily statutory consultees. Some sample responses are:

- *"We are taken seriously - the issue will be thoroughly discussed through the second SMP and strategy study process."*
- *"Taken seriously. The government/EA would be foolish to fail to take proper account of our views. The political damage of failing to take account could be considerable."*
- *"I have no reason to doubt that our views would be taken seriously - provided that we have the responses to formulate our views in the first place, and assuming that we are properly consulted at an early stage in the process."*

About one in five respondents were uncertain about how their views would be taken into consideration. Some responses expressed specific concerns that were further addressed in the Regional Workshops because they appear to be recurrent themes. For example:

- *"Our concerns tend to be dealt with subsequent to decisions having been made, rather than influencing decisions."*

- *"There is a need to "drip feed" information to the public on sea level rise. It is not until the public understand the problems we all face (including financial) that we will change much."*

- *"At the local and regional level, coastal engineers dominate fora on shoreline management. They are primarily only knowledgeable of and keen to promote hard (and soft) engineering, and encourage local authorities to think likewise."*

- *"I am not confident [opinions are taken seriously]. The processes of developing Shoreline Management Plans are very broad-brush and don't take into account local issues."*

- *"National versus local levels have different priorities. Conflicts of interest between competing land and water users at the local level make compromise inevitable and therefore often weak outcomes…"*

3.3 Conclusions

The questionnaire survey had a very good response rate across the full range of different types of stakeholder interests. Most stakeholders expressed a high level of interest in flood and coastal management issues generally, and considered that Managed Realignment was an issue that affected their organisation directly. A large proportion of respondents are influential in flood and coastal management decision-making because of their strategic and operational interests, or as lobbyists and consultees, or as representatives of those people most likely to be directly impacted by changes in flood management policy.

There was general consensus on the ranking of drivers identified in the questionnaire. Managed realignment is a means of providing sustainable and effective flood and coastal defence, and it should be seed as part of a long term strategy for sea level rise. The fact that it provides environmental benefits is also very important to respondents. For all the stakeholders apart from the DEFRA

respondents, reducing costs of flood and coastal defence was seen as an important consideration, but it is not the main driver for the implementation of Managed Realignment.

The overall ranking of constraints is less clear-cut, but the major obstacles have been clearly and unambiguously identified as the lack of financial compensation to landowners; the need to provide compensatory habitats under the Habitats Regulations; and lack of public support. The stated views of DEFRA respondents seem to tend to diverge from those of other stakeholders on specific issues. This suggests that successful shifts in policy towards the implementation of cost-effective and environmentally beneficial realignment schemes requires the careful alignment and targeting of policy instruments with regard to the views of these key stakeholders.

4 Implementation of Managed Realignment Overseas

4.1 Rationale and approach

The political, social, cultural, and technical situation in other developed countries and thus the context in which Managed Realignment is discussed or implemented may be very different to that in the UK. It would be inappropriate, therefore, to directly apply lessons learnt in other countries to the UK situation, without simultaneously reviewing the social and political basis underlying the coastal/river management process. It would be similarly inappropriate, however, to attempt to achieve a balanced view of drivers and constraints to the implementation of Managed Realignment in the UK without considering and learning from the overseas experience.

To bring the UK review into the international context, a review of Managed Realignment schemes in other European countries and in the United States was carried out. This comprised two key tasks:

(a) Contacting a total of 29 individuals of a variety of organisations in the EU (The Netherlands (NL), Germany (D), Denmark (DK), Scotland (SCO)) and the United States (USA) (west coast and Mississippi Delta) with the request for information. Respondents were asked to complete a selected sub-set of questions drawn from the general questionnaire sent to practitioners in England (Section 3).

(b) Following up individual contacts by telephone or email to collect additional and more detailed information on drivers/constraints to riverine and coastal Managed Realignment schemes and strategies in the selected overseas countries.

The analysis of the questionnaires was carried out in two stages:

(i) An initial summary of the ranking of the main drivers and constraints to Managed Realignment as identified by the consultees; and

(ii) A country-by-country summary of all other statements made by consultees with regard to the situation of planned/implemented Managed Realignment schemes.

In the interpretation of these results, it should be borne in mind that, due to the time constraints, the study is by no means complete as it draws upon only a limited number of questionnaires, interviews, and other information. It is thus possible that a slightly different picture would emerge if questionnaires were sent to a more comprehensive sample of people with interest or responsibilities for coastal management in these countries (including, for example, representatives of landowners/farmers, tourism, trade, and other associations/stakeholders). Nevertheless, the results of this analysis and the summary of additional information obtained during the consultation process provide some interesting clues as to the importance of specific drivers and constraints to Managed Realignment in a selection of overseas countries. These results are presented in detail in Section 4.2 below.

4.2 Results

4.2.1 Information obtained from questionnaire responses

Although a wide range of individual responses and information not related to the questionnaires have been received, the completed questionnaires allow for some more direct comparison to be made between the responses of individuals. A total of ten questionnaires were returned (i.e. a 30 % return rate): two from USA, two from Germany, three from The Netherlands, two from Denmark and one from Scotland. The following provides a summary of the information extracted from the questionnaires.

All but two of those who replied (i.e. eight) stated that they have an influence on flood and coastal defence options (Table 4.1). Although several Dutch practitioners with a known influence on flood and coastal defence decisions (from the Rijkswaterstaat and WL Delft Hydraulics) were contacted, they were reluctant to reply (either they did not reply at all or they stated that the issue is considered to be too politically sensitive). Those persons from The Netherlands who did reply were an ecologist and geomorphologists from a government research station (NIOO) and a Dutch University (Utrecht). Out of the eight respondents who claimed to have an influence on flood and coastal defence decisions, three stated that they were able to influence defence options 'very much': two were working in the German federal government and one at the Danish Coastal Authority (Kystdirektoratet). Three respondents stated that they have a moderate influence

on defence options (one from a private coastal consultancy in the US, one from the Danish government and one from a Scottish University). The remaining two stated that they are not able to influence defence options very much (both from the academic sector in the US and the Netherlands).

Table 4.1

Influence on flood and coastal defence options

Degree of Influence	Number	Countries
Very much	3	D, DK
Moderate	3	USA, DK, SCO
Not very much	2	USA, NL
None	2	NL

Only four of the eight respondents had any practical experience of Managed Realignment (NL, USA, D, SCO). Out of those four, three provided further information. All ten respondents, however, stated that they could see a case for Managed Realignment and five respondents stated that they had specific interests in ensuring that Managed Realignment does or does not occur (USA, NL, D, SCO). Four respondents stated that they did not have any such interest (NL, DK, D) with one person having no opinion (USA).

In the following summary of 'drivers' and 'constraints' to the implementation of Managed Realignment as identified by the ten respondents, answers that were listed by four or more respondents (i.e. 40% or more) are highlighted in grey in the respective tables.

4.2.2 *Drivers*

Table 4.2 summarises the importance of drivers as perceived by respondents.

Lower defence costs: Five regarded this as very important (from NL, DK, USA, SCO), two as moderately important (NL, D), two as not very important (USA, DK), and one did not have an opinion (D).

Improved flood and coastal protection: Four regarded this as very important (from DK, NL, SCO), one regarded this as moderately important (USA), and three regarded this as not very important (USA, NL, DK), with two (D) having no opinion.

Table 4.2

Drivers identified by respondents

Issue	Importance	Number	Countries
Lower defence costs	very important	5	NL, DK, USA, SCO
	moderately important	2	NL, D
	not very important	2	USA, DK
	don't know / no opinion	1	D (stated that higher costs would apply)
Improved flood and coastal protection	very important	4	NL, DK, SCO
	moderately important	1	USA
	not very important	3	NL, USA, DK
	don't know / no opinion	2	D
Benefits in terms of habitat creation	very important	4	USA, DK, D
	moderately important	4	NL, DK, SCO
	not very important	1	D
	don't know / no opinion	1	NL
Potential improvement in water quality	very important	3	USA, NL, DK
	moderately important	0	
	not very important	4	NL,D, SCO
	don't know / no opinion	3	USA, D, DK

Benefits in terms of habitat creation: This was regarded as very important or as moderately important by eight of the respondents (USA, DK, D and NL, DK, SCO respectively), as not very important by one (D), with one person having no opinion (NL).

Potential improvement in water quality: This was regarded as very important by three (USA, NL, DK), and as not very important by four (NL, D, SCO), with three having no opinion (USA, D, DK).

4.2.3 *Constraints*

Table 4.3 summarises the importance of constraints as perceived by respondents.

Technical feasibility (e.g. feasibility of recreating inter-tidal habitats): This was regarded as very important by three (USA, NL) and moderately important by three (USA, DK, SCO), and not very important by three (D, DK), with one person having no opinion (NL).

Direct Managed Realignment costs (e.g. construction, monitoring costs, etc…): This was regarded as very important by two (DK, D), moderately important by four (USA, D, SCO, DK), and not very important by two (NL), with two people having no opinion (NL, D).

Compensation issue (compensating landowners for the loss of property value): This was regarded as very important by three (DK, D, SCO), moderately important by three (NL, D, DK), and not very important by three (USA, NL), with one person having no opinion (NL).

Legal constraints (e.g. requirements of the Habitats Directive to replace any habitat lost): This was regarded as very important by two (USA, DK), moderately important by five (USA, NL, D, SCO), and not very important by one (D), with two persons having no opinion (NL, DK).

Political acceptability (the principle of Managed Realignment not accepted at a political level): This was regarded as very important by six (DK, NL, D, SCO), moderately important by one (D) and not very important by one (USA), with two people having no opinion (USA, NL).

Table 4.3

Constraints identified by respondents

Issue	Importance	Number	Countries
Problem of technical feasibility	very important	3	USA, NL
	moderately important	3	USA, DK, SCO
	not very important	3	D, DK
	don't know / no opinion	1	NL
Problem of direct costs	very important	2	DK, D
	moderately important	4	USA, D, SCO, DK
	not very important	2	NL
	don't know / no opinion	2	NL, D
Problem of compensation issue	very important/	3	DK, D, SCO
	moderately important	3	NL, D, DK
	not very important	3	USA, NL
	don't know / no opinion	1	NL
Problem of legal constraints	very important	2	USA, DK
	moderately important	5	USA, NL, D, SCO
	not very important	1	D
	don't know / no opinion	2	NL, DK
Problem of political acceptability	very important	6	DK, D, NL, SCO
	moderately important	1	D
	not very important	1	USA
	don't know / no opinion	2	USA, NL

4.3 Summary of Questionnaire Responses

Based on the returned consultation questionnaires, it appears that the most prominent **driver** behind Managed Realignment in those five overseas countries consulted was that of lower defence costs. Improved flood and coastal protection and habitat creation were also regarded as important by the 10 respondents. Improvements in water quality were generally regarded as least important.

With respect to the **constraints** to Managed Realignment, the problem of political acceptability appears to be the most important factor (identified by individuals of all five countries) limiting the implementation of Managed Realignment as a coastal management strategy. Most respondents regarded issues of direct cost and legal constraints as moderately important and no clear general picture emerged with regard to issues of technical feasibility or financial compensation. An explanation for the discrepancies in responses regarding these latter two issues may be that they are intrinsically linked to a complex set of economic, social, legal, and psychological issues that differ considerably between the individual countries. As the issue of financial compensation is of considerable importance as a constraint in the UK (Table 3.5), it is recommended that a special review of compensation arrangements overseas be conducted (see also Sections 4.6 and 13).

Although based on a relatively small number of responses, the above analysis does indicate some interesting differences, however, with respect to the particular countries concerned (see Figure 4.1 (a) and (b) for a graphical representation of these country-by-country questionnaire results of drivers and constraints to Managed Realignment respectively).

With respect to **Germany**, habitat creation is clearly a key driving factor, while issues of lower defence costs and better flood/coastal protection are not considered to be relevant and the opinion was even raised by one government contact that such schemes would raise defence costs. One of the other benefits of Managed Realignment that German respondents listed was the political issue of satisfying the demands of the nature conservation lobby, which is politically relatively powerful in Germany. One respondent suggested that Managed Realignment should be funded according to the 'polluter-pays' principle. Political acceptability and financial compensation issues were regarded as the main constraints to the implementation of Managed Realignment by the German respondents. The general feeling expressed in the questionnaires was that issues relating to Managed Realignment will only be taken on board very cautiously by the flood and coastal defence authorities in Germany and that Managed Realignment would only be considered if it did not lead to a reduction in the protection status or an increased cost of flood defences and was accepted by the local population.

In **Denmark**, both lower defence costs and improved flood and coastal protection were listed as important drivers to Managed Realignment schemes, although habitat creation and improvements in water quality were regarded, by one correspondent at least, as equally important. In Denmark, however, few Managed

Realignment schemes are in existence. Both respondents (one from the Danish Coastal Authority and one from the Danish Hydraulics Institute) mentioned the existence of schemes but were unable to provide information as to their location and date of implementation. The political acceptance of Managed Realignment schemes was also stated as one of the circumstances under which the Danish Coastal Authority would consider Managed Realignment. The Danish Coastal Authority representative further stated that public funding should be used for the financing of such schemes.

The consultation confirmed that out of those countries consulted, **The Netherlands** has the most experience with the issue of Managed Realignment, although the topic was regarded as highly politically charged by all respondents. This was confirmed by the reply of the Head of the Coastal Group of WL Delft Hydraulics who stated that "*Indeed this subject is politically sensitive, possibly in the Netherlands even more than in the UK*".

Although most respondents from the Netherlands suggested that lower defence costs and improved flood protection constitute the main benefits of Managed Realignment, it appears that there is a tendency for the Rijkswaterstaat to publicise Managed Realignment-related schemes based on issues of habitat (re-)creation or improvement.

Technical feasibility and political acceptability were listed as very important constraints to Managed Realignment by two of the three Dutch respondents. No official information appeared to be available regarding the issue of financial compensation. Without a detailed study investigating this issue further, it is unclear whether the issue of financial compensation was not listed as a primary constraint. Given that political acceptability was rated as being very low, it is likely that this is one of the reasons for financial compensation not (yet) being discussed in detail.

The respondents from the **United States** regarded lower defence costs and habitat creation as the main drivers/benefits of Managed Realignment, although it was pointed out by several respondents that this depended to a large extent on the local situation of each particular scheme. The circumstances in which a case for Managed Realignment could be identified were listed as: low value of land, high 'value' of habitat, a need for defence in the light of sea-level rise, and dredge disposal. In addition, recreational/public use of the Managed Realignment space was also listed as being of importance.

As with the Dutch respondents, the US respondents also regarded technical feasibility as one of the main constraints to the implementation of Managed Realignment. Interestingly, however, the US respondents were the only ones to regard political acceptability as not an important constraint to the implementation of Managed Realignment. In addition to the constraints listed in the questionnaire, respondents also commented that the 'scientific' case for Managed Realignment would always be viewed sceptically because 'society' was essentially suspicious of 'science'.

The Scottish respondent suggested that, in **Scotland**, lower defence costs and improved flood defence protection are the key drivers, while financial compensation and political acceptability are the main constraints to the implementation of Managed Realignment. The circumstances under which a case for Managed Realignment is made in Scotland include (i) loss of habitat; (ii) cost of seawall maintenance, (iii) frequent flooding of a site and (iv) the development of a long-term sustainable coastal strategy.

4.4 Supplementary Information

In addition to the returned questionnaires, a series of telephone calls and email correspondence led to supplementary information being obtained throughout the overseas consultation period. The following provides a summary of this information by country.

4.4.1 Germany

(a) Rivers and Estuaries

Dr E. Lübbe, of the German Federal Ministry for Consumers, Food, and Agriculture (Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft), provided a range of additional material on Managed Realignment that has been carried out on some of the rivers and estuaries in Northern Germany (such as the Elbe near Hamburg (Figure 4.2)). The drivers for such Managed Realignment were primarily nature conservation issues. It is interesting to note that these schemes appear to be perceived (by the Ministry) as improving flora and fauna but leading to a higher risk of flooding of surrounding areas and thus higher defence costs (E. Lübbe, pers. comm.). It is unclear, however, to what extent this perception is based on scientific studies/evidence or driven by socio-political factors. Furthermore, financial compensation of landowners is regarded as "very necessary" and "unavoidable" and the schemes are deemed suitable only in areas of agricultural land use. In some instances, Managed Realignment

was planned at a particular location but not taken up due to the resistance of the local population (i.e. the constraint of low political acceptability of the scheme overruled the 'habitat creation' driver).

(b) Open Coasts

In Germany, the Federal Government (the Bund) finances all coastal defences through the Ministry for Consumers, Food, and Agriculture (Bundesministerium für Verbraucherschutz, Ernährung und Landwirtschaft). There is virtually no coastal Managed Realignment in existence in Germany, but those schemes that have made it through to implementation have done so because they were driven by nature conservation / habitat creation issues and did not encounter constraints due to land ownership. (This was the case of the former East German region of Mecklenburg-Vorpommern, where the affected areas of land have always been state-owned). In the region of Mecklenburg-Vorpommern, defences around agricultural land are not now actively maintained. A storm-surge of 1995 overtopped several seawalls in this area but they were then not repaired or raised and former agricultural land has been left to revert back to the inter-tidal area.

With the exception of these special circumstances of state ownership of the land, however, the policy in Germany is to defend at all costs and not to consider Managed Realignment in terms of cost-benefit calculations at all (E. Lübbe, pers. comm.). A government leaflet on 'coastal defence' in the region of Schleswig-Holstein states that '*de-poldering or the discontinuation of seawall maintenance is only possible in exceptional circumstances*'. A separate leaflet for the region of Niedersachsen states that '*the removal of sea defences can only be ordered by the highest coastal defence authority if the sea wall has been so severely damaged that the repair is not justifiable*'.

The questioning of A. Kellermann of the 'Nationalparkamt' ('national parks authority') of the German Waddensea on the topic of Managed Realignment led to the following response, which indicates that the political constraints in Germany far outweigh any of the drivers for the implementation of coastal Managed Realignment:

"*De-poldering is currently not being discussed and will not be discussed in the foreseeable future. The reason is simple: coastal defence has a very high priority here and the landward re-alignment of sea defences as a prevention can only be discussed outside of the*

public domain. It would not be advisable to raise discussions in any other way until the need to take action becomes acute.

"We are very proud of our common inter-tidal management which we have carried out together with the coastal defence authority of the region ('Land') for several years. Through this management we have at least managed to reduce the effect of grazing on two-thirds of the inter-tidal area and were able to leave the salt marshes to develop naturally".

Recent developments in the research sector, however, indicate that, in spite of such a categoric rejection of 'de-poldering' by some, there is also an increased awareness that some adaptation to climate change and related sea-level rise may be necessary and may need to include Managed Realignment strategies. Dr Ida Broeker from GKSS Hamburg, for example, provided some information on a study ('KRIM') currently being carried out by the University of Bremen on the adaptations to climate change in the coastal zone. The project takes into account possible adaptation strategies in the face of rising sea levels at particular locations as case studies on the German North Sea coast. Further information can be found on the internet: http://www.krim.uni-bremen.de.

4.4.2 *The Netherlands*

The National Institute for Coastal and Marine Management (RIKZ) as part of the Rijkswaterstaat of The Netherlands, holds responsibilities for the provision of knowledge and expertise relating to the sustainable use of estuaries, coasts and seas and for flood protection. The mission statement of the RIKZ includes two key points of emphasis: (i) the protection of land against tidal flooding and (ii) the sustainable use of coasts and estuaries, suggesting that the adoption of Managed Realignment schemes would essentially be driven by these two main concerns.

(a) Rivers and Estuaries

Managed realignment is carried out on large river systems in The Netherlands (e.g. Meuse, Rhine and Ijssel) for a variety of reasons: more natural management of flood plains, nature reconstruction/ecosystem reconstruction and flood protection (P. Hoekstra, pers. comm.).

This information was confirmed by Dr Aart Kroon of the University of Utrecht, who mentioned that the main driver behind recent efforts to realign rivers was the high river levels in the early 1990s that almost led to

a serious flood event. After this event, much effort was focused on new procedures for river management and it seems that the politically most debated topic now relates to the re-creation of 'natural' river courses. At many locations, new tributaries are dug out and dredged for this reason (examples are the Zandmaas and the Blauwe Kamer River).

A government report on the Rhine and Meuse rivers in the Netherlands outlines in much detail how a re-naturalisation of the two rivers is part of a long-term strategy for an increasingly sustainable river management (Middelkoop and Haselen, 1999) and how this strategy is underpinned by ecological and hydrological scientific knowledge.

(b) Open Coasts

One form of coastal Managed Realignment that has been carried out in Holland has been the creation of small supra-tidal inlets ('slufters') in order to improve ecological gradients related to the salt/brackish to freshwater gradients (i.e. driven by conservation interests) (A. Kroon, pers. comm.). Examples of such schemes include 'De Kerf' at Schoorl in Zeeland on the former island of the Oosterschelde storm surge barrier and 'Rammekenshoek' close to Vlissingen, also in Zeeland. Both schemes were carried out to achieve a wider ecological variety on the dune area with no regard to safety issues (as the width of the dune field is ca. 2.5km). The latter, however, was also created to compensate for the loss of inter-tidal areas resulting from the deepening of the Westerschelde estuary (see below), a topic that is widely politically debated at present.

Dr Piet Hoekstra from the University of Utrecht is often responsible for assessing the quality of environmental impact assessments carried out by the national Dutch EIA committee in relation to changes in use of areas earmarked for Managed Realignment. He mentions that Managed Realignment is in discussion for the Western Scheldt estuary with the main driver begin nature conservation and an artificial increase of the tidal prism to enhance scour in channels (to reduce dredging). However, ideas were put forward and were not well received by the local population. Local areas suffered substantially from the 1953 floods, which makes Managed Realignment a very difficult issue for people to come to terms with from a psychological perspective.

Dr Jacco Kromkamp from the Netherlands Institute for Ecology, Centre for Estuarine and Coastal Ecology (NIOO), also provided information on the Westerschelde estuary where, in 1997, dredging and deepening of the main channels started in order to allow bigger ships access to the port of Antwerp. Accompanying measures included protection of mudflats and salt marshes. As a result of the dredging activities the water level has risen 10cm. In Belgium there are special polders which will be flooded when the river Schelde contains too much water. In Holland there is a debate about allowing some polders of the Westerschelde to revert back to the inter-tidal zone in order to create more "space" for the estuary, which, from an ecological and flood management perspective, is needed. This, however, faces stiff opposition from the local population.

When asked whether Managed Realignment should take place, Dr Kromkamp stated that there should be compensatory habitat for the losses of inter-tidal areas due to dredging activities in the Westerschelde and that new nature conservation areas should be created. This would give some fringing polders back to the Westerschelde through the artificial breaching of existing seawalls and the building of new seawalls further inland, thus creating new inter-tidal areas in which salt marshes and mudflats can develop.

Surprisingly, one Managed Realignment scheme has been carried out in the controversial area of the Westerschelde, where, in 1990, after successive breaching, it was decided to let a 100 ha reclaimed grazing area (Sieperdarschor) revert back to salt marsh (Leal, 1998; Kornman and van Doorn, 1997). It appears that this was only possible, however, as a result of intense pressure from nature conservation groups and supportive local authorities. More recent schemes that involve de-poldering and thus the creation of large inter-tidal areas have been carried out in the province of Friesland and are termed 'nature-building' projects by the authorities involved. In most recent cases, however, local opposition appears to be very strong and is captured in numerous newspaper articles (see, for example, Trommelen, 2001 and De Graaf, 2001).

An existing conflict between local and national government representatives in Managed Realignment related issues was also identified by the Dutch contacts included in this review.

Other projects related to Managed Realignment in The Netherlands that were mentioned by Ms Litjens van Loon of the Ministry of Transport, Public Works and Water Management are as follows:

- "Space for the River": a research about the possibility to give land back to the river instead of raising defences: Wim Silva of the Ministry of Transport, Public Works and Water Management.

- "River and Land": a strategic view on Holland in the water. The idea is not to raise the defences, but to let the water flow and 'live in' the water. The infrastructure and houses can be floating in that case: contact Jan Visser of the Ministry of Transport, Public Works and Water Management.

- Emergency polders: a study to locate emergency polders, which will be flooded in case of a threatening flood. This flood can for example threaten a big city, and the idea is to re-route the flood to a less populated polder on purpose in that case: Ruud Hoogendoorn of the Ministry of Transport, Public Works and Water Management.

- The Kerf and the Slufter and the Zwin: three areas where the dunes are wide enough for safety. The first row of dunes is taken away over a few hundred meters, and an inter-tidal habitat is created. Contact: Moniek Loffler of the Ministry of Transport, Public Works and Water Management.

- The commission "water management 21st century". Contact: Joost de Ruig of the Ministry of Transport, Public Works and Water Management.

- Winterpolders in Friesland (a coastal zone where land is given back to the sea): contact Jan Langenberg of the water board in Friesland.

Internet links to some of the above projects can be found on http://ww.rikz.nl, http://waterland.net, http://www.wateractueel.nl, http://www.minvenw.nl.

Further relevant information can be found at: http://www.minvenw.nl/cend/dco/home/data/international/gb/index.htm.

4.4.3 *Denmark*

Out of those countries included in this survey, Denmark appears to have the least amount of information available on Managed Realignment and no additional information (other than the returned questionnaires) was forthcoming. Given its geographical position and the relative isostatic stability or uplift of this area, potential flooding due to sea-level rise is likely to be less of a political issue. Although some habitat creation schemes exist, they do not appear to be considered as flood defence or coastal protection measures.

4.4.4 *USA*

In estuarine settings, various schemes have been carried out in the US over the past 30 years or so. Some schemes involve the breaching of levees around areas that were previously used for agriculture or some other human use. The key driver behind these schemes appears to be that of 'habitat creation', without any specific coastal protection motivation. Examples include sites in Delaware Bay, old rice ponds in South Carolina, pastures in estuaries on the NW Pacific coast, and on a large scale in San Francisco Bay and the Sacramento San Joaquin delta.

A series of coastal and fluvial wetland restoration schemes that have involved some degree of 'Managed Realignment' of defences have been carried out in the San Francisco Bay area (http://www.sfbayjv.org/projects.html). The drivers behind such schemes are to a large extent improvements in water quality and lower defence costs with the main constraint being technical feasibility.

In the Mississippi delta, flood protection first began in the 18th century with the construction of levees around the river to protect the natural levee of the river from flooding urban and agricultural land (J. Day, pers. comm.). In the 20th century, the focus shifted towards also providing protection from coastal flood damage due to hurricanes leading to the construction of back levees. In addition to Managed Realignment, there are thus issues relating to the location (and extent) of such levees and decisions as to where to place or where to terminate protection through levees are influenced to a large extent by cost, substrate (ability of the ground to support a levee), and politics.

Nevertheless, there are examples of schemes that are more akin to what would be termed 'Managed Realignment' in the UK as they deal with the breaching of existing levees to restore ecological habitat. Descriptions of such schemes in the Mississippi delta area can be found at:

http://depts.washington.edu/calfed/calfed.htm

http://depts.washington.edu/calfed/breachii.htm

http://rubicon.water.ca.gov/delta_atlas.fdr/daindex.html ('Delta Atlas', for general background).

At the 1999 Estuarine Research Forum, a special session on breached levee restoration was held and proceedings will be published as a special issue of Restoration Ecology in due course (unfortunately this has not occurred in time for inclusion in this report).

The additional information gathered indicates that a lot of literature exists in the US about the 'drivers' (i.e. habitat creation) and less about the constraints to the wider implementation of Managed Realignment schemes.

4.4.5 *Scotland*

Several comments were received from Dr James Hansom at Glasgow University, who mentioned that there are two schemes that are well-advanced in Scotland: one 71ha site near Grangemouth on the Firth of Forth and one site of about 20ha on Cromarty Forth on land purchased by RSPB. Several other scoping studies are underway. The Forth has undergone a scoping study by Glasgow University in conjunction with GEOWISE consultancy. Bids have been submitted for a scoping study of the Solway, and Managed Realignment on Moray Firth will be considered in detail as there was widespread support by the main stakeholders at a recent climate change impact seminar. Clyde Firth is to follow suit but the project officer of this project has left, leading to a delay in the scheme. Dr Hansom also mentioned that there is a fairly high expectation that views will be heard and taken on board at the local level during the consultation process.

4.5 Compensation

The survey of Managed Realignment overseas has shown that the issue of financial compensation is regarded as being of surprisingly low importance by consultees in The Netherlands and the United States. In The Netherlands, this appears to be related to the fact that the issue of Managed Realignment is extremely politically sensitive (and thus issues of financial compensation are unlikely to be addressed publicly).

This initial overseas review, however, identified the need for a more detailed review of the legal and administrative framework for Managed Realignment schemes in other European countries. A fully comprehensive review of existing legal and administrative practices across Europe is clearly beyond the scope of this Phase 1 project and would require considerably more time and resources. It was, however, possible to extract some additional information on the financial compensation issue either directly or indirectly (through further details on planning and economic considerations) from individual contacts in The Netherlands, Germany, and Denmark.

4.5.1 *The Netherlands*

In recent years, The Netherlands has seen a series of 'ontpoldering' ('de-poldering') schemes both in the South (e.g. Scheldt Estuary: 100 ha 'Sieperdaschor') and the North (e.g. 135 ha 'Nooderleech' polder in Friesland). The key 'official' (i.e. publicly mentioned) drivers behind all of the schemes that were brought to the attention of this project by the Dutch contacts and/or were identified through the project teams own literature search were nature conservation issues rather than coastal defence considerations. This does not mean that coastal defence was not an important issue under consideration, e.g. where the allocation of government funds to such schemes is concerned. If improved coastal protection was an issue, however, this was clearly not used publicly as a justification for the schemes – although attempts have recently been made to create increased public awareness that may then allow coastal defence issues to be used publicly as a justification for Managed Realignment (see below).

(a) Planning

In The Netherlands, special planning rules apply to areas of 'special natural value or high cultural and historical or archaeological value' ('*bijzonder natuurwaarden of monumentale eenheden van grote cultuurhistorische of archeologische waarde*'). Such areas are identified and planning rules are contained in the '*Planologische Kernbeslissing Nationaal Ruimtelijk Beleid*' (PKB) spatial planning regulations. Most rural coastal areas fall under this planning legislation which outlines the possible use of compensation for changes in land-use. In principle, local authorities have to ensure that the 'landscape quality' of these areas in maintained. Should intervention be permitted after careful consideration of local needs, a decision has to be made regarding compensatory measures *before* this intervention takes place. Compensation has to satisfy the following conditions:

(i) no net loss of value is caused;

(ii) compensation should take place by creating/obtaining land with equal value close to the affected area;

(iii) if compensation as outlined in (b) is impossible, then compensation should take place by gaining qualitatively similar value from another area;

(iv) if neither (b) nor (c) can be fulfilled then financial compensation can be offered; and

(v) compensation should, wherever possible, be given at the moment of intervention.

(b) Political issues

It appears that there is a great reluctance within the public administration of The Netherlands to publicly discuss 'Managed Realignment' as a possible coastal defence (instead of solely as a nature conservation) issue. A statement issued by the Dutch Secretary of State for Transport and Waterways (Rijkswaterstaat) on 7th February 2002, however, shows an increased political confidence in addressing the need for more (economically) sustainable longer-term coastal defence options. In her statement, Monique De Vries mentions three areas of the Dutch coast for which the government currently cannot guarantee protection from flooding beyond the next 50 years (West Zeeuws-Vlaanderen, the coast of Delfland (Hoek van Holland – Kijkduin), and parts of the coast of North Holland (Den Helder – Callantsoog)). The statement sets out that the aim is to carry out cost-benefit analyses for particular coastal defence options for these areas to decide whether to consider defence options that involve areas 'seaward' or 'landward' of the current line of defence. This is to be achieved through close collaboration with other government ministries, provinces, and local councils and water bodies.

It is also worth noting that the Dutch government has recently (2. May 2002) launched the '*Neederland leeft met water*' ('The Netherlands lives with water') campaign. This campaign is aimed at raising awareness in the general public of the fact that they live in a '*waterrijke land*' ('watery land'),

largely below sea level. A press release (2. May 2002) by the Rijkswaterstaat states:

'For centuries, we have kept the sea and rivers at bay with hard defences. The high water of 1993 and 1995 has opened our eyes. See level is rising, the ground is lowering and it is raining harder and more often. We must deal differently with the water. The water management of the Netherlands has thus been radically changed. Instead of keeping the water outside of our doors, we must give the water room and let it into our daily lives.' (Translated from a press release issued by the Rijkswaterstaat, 2nd May 2002).

In addition, a news report in the 'Provinciale Zeeuwse Courant', a regional newspaper for the area of Zeeland in the south of The Netherlands, also indicates that, at least locally and in principle, it has been possible to increase the political acceptability of Managed Realignment. A news report of 19th February 2002 on the outcome of the recent debate on the future management of Zeeland states that:

'A few years ago, the government of the [Zeeland] province decided not to pursue the idea of de-polderisation [Managed Realignment]. The political resistance was too great. It now seems that 44 percent of those questioned were prepared to give land back to the sea if this is necessary for reasons of public safety. The word 'de-polderisation' has been carefully avoided in the Zeeland debate; instead, the discussion focuses on creating 'buffer zones' as a natural way of reducing the risk of flooding to a minimum.' (Translated from a newspaper article in the 'Provinciale Zeeuse Courant', 19th February 2002).

(c) Economic considerations

Information on financial sources for the purchase and management of Managed Realignment schemes in The Netherlands has been difficult to obtain. It appears, however, that, in a number of schemes, such as the Noorderleech scheme mentioned above, a combination of European Union funds (such as LIFE-Nature), non-governmental organisation (in this case, WWF) funds, and government funds (from the province of Fryslan and the national government) have been used to acquire and managed the Managed Realignment area.

In terms of economic considerations in the context of the compensation issue it also has to be remembered that the area of 'hinterland' that lies

below mean sea level is considerably larger in The Netherlands than in the UK. This significantly affects any economic valuation that takes into account the potential flood damage of land that is protected by a current line of defence and compares this to the potential flood damage to land that would be protected by a new (more landward lying) line of defence. In The Netherlands, Managed Realignment would lead, in most cases, to an insignificantly small reduction in the potential flood damage. Although it could be argued that the risk of damage is much reduced in the presence of a wider inter-tidal area (Möller et al., 2001), it is unclear, as yet, how widely applicable this principle is (e.g. in environments characterised by widely different hydrodynamic and/or geomorphological characteristics).

4.5.2 *Germany*

As became apparent in the questionnaire responses from Germany, Managed Realignment is not generally considered as a coastal defence option and the dominant principle of coastal defence management is to maintain the status quo (Section 4.4.1). As a result, financial resources for potential compensation are limited and there is certainly no general mechanism by which such compensation is possible. It is nevertheless instructive to consider the current government funding sources for coastal defence and nature conservation schemes in Germany and, in particular, the restrictions that apply to such funding sources.

The execution of coastal defence schemes in Germany is the responsibility of the individual 'Länder' (regional government). Although Article 74 Nr 17 of the Federal Law allows the Federal Government to overrule local responsibility, this has, so far, not happened in practice. Regional laws govern coastal planning but Federal funds can be drawn upon for schemes if the schemes are 'beneficial for the general public and if the involvement of the Federal Government would lead to an improvement in the quality of life' (Lübbe, 1997). This includes schemes that lead to 'an increased protection against storm surges at the coast of the North and Baltic Sea and along tidal stretches of rivers' (Lübbe, 1997).

Between 1962 and 1995, investments in coastal defence schemes totalled 8.6 billion DM of which the Federal Government contributed 3.2 billion DM since 1973. These funds were used predominantly to rise the height and shorten the length of defences. The Federal Government meets up to 70% of the cost of coastal protection measures in each individual German 'Land'. It is generally understood that the construction of **new** defence lines is only eligible for Federal funding if the length of the new defence line either remains the same or is reduced. A retreat of

the existing defence line is only eligible for funding if these criteria can be met and if the effect on assets and people's lives is negligible.

In addition to the above, land purchase and measures necessary for the conservation and maintenance of natural habitats are eligible for funding if they are directly related to the coastal defence scheme concerned. Managed retreat for the purpose of nature conservation, however, is not eligible for Federal Government funding. This restriction also includes the realisation of the HELCOM-recommendation 15/1 of 8th March 1994 which suggests the designation of a protected coastal zone (of between 100 and 300 m width landward of the current line of defence) with, amongst others, restricted forestry and agricultural use. A statement by the government of Schleswig-Holstein entitled 'Guidance and aims of coastal defence in Schleswig-Holstein' thus makes it clear that 'the landward realignment or abandonment of seawalls is only possible in exceptional circumstances'. A government statement of the Land Niedersachsen reads: 'The re-alignment of sea defence lines, i.e. the re-exposure of an area that is currently protected by seawalls, can, according to regional law, only be carried out if the seawall has been destroyed or so badly damaged that repair is not justifiable'. The government of Niedersachsen (Lübbe, pers. comm) also argues that realigning the current seawalls to a position further landward is more costly than increasing the height/strength of the existing defence line. Furthermore, it is argued that due to subsidence, the new, landward lying defences would require further height increases (and thus incur maintenance costs) much sooner than seawalls that exist on already compacted ground.

Interestingly, the German Land of Mecklenburg-Vorpommern is an exception to the above general rules, as more than three quarters of the low-lying coastal areas and approximately half of the cliffed coastline is retreating (overall, ca. 65% of the coast is retreating at an average rate of ca. 50 cm per year (Lübbe, 1997)). It is accepted that this retreat cannot be halted in the long-term. As a result, coastal defence in Mecklenburg-Vorpommern is restricted only to built-up areas (a policy described as 'flexible response' (Lübbe, 1997)).

4.5.3 Denmark

It was not possible to obtain direct information or statements on the availability of financial compensation for Managed Realignment schemes in Denmark. The statutory spatial planning system in Denmark does not include marine areas, although the Planning Act of 1992 defines a *coastal planning zone* that extends 3 km

inland from the coast. Planning within this zone occurs at the level of each municipality and has to comply with national and regional guidelines and directives. Key national aims for coastal zone planning are (a) to protect the undeveloped coast and (b) to ensure full public access to the coast. Although applications can be made for national funding, it is unclear to what extent this can be used for financial compensation purposes.

It appears that there have been (and perhaps will be) few cases where financial compensation would be necessary as, in addition to the 3 km planning zone, the Nature Protection Act of 1992 (amended 1994 and 1997) established a 300 m protection zone along the Danish coast. In this 300 m zone land use is heavily restricted and a report produced by Coast*link* (Bridge, 2001) states that 'there is a general tolerance and understanding of restrictions (without financial compensation) for the sake of nature conservation or aesthetic appeal. This tends to be the case for both individuals and local authorities, even where councils will realise a revenue loss arising from a reduced tax base' (p66).

4.6 Conclusions

The information obtained in this review of Managed Realignment as a strategy for river and coastal management in a selection of overseas countries suggests that, out of the European countries studied, The Netherlands and Scotland place the largest emphasis on the use of Managed Realignment as a **sea defence/flood protection** option. In contrast, Germany, Denmark, and the United States appear to place a higher importance on Managed Realignment as a means of **habitat creation/restoration**.

With respect to the constraints to the implementation of Managed Realignment, there appears to be a cross-Atlantic difference with respect to the importance given to the '**political acceptability**' of such schemes. None of the contacts in the United States regarded 'political acceptability' as being a main constraint, while it featured high on the list of constraints of all contacts in the European countries.

The degree to which **technical** constraints are regarded as important varies considerably between the individuals consulted. It is interesting to note that this particular constraint features high on the list of the Dutch respondents. This may be linked to the relatively high priority given to technical and scientific investigations into the design and performance of river and coastal environments in The Netherlands. These give rise to an increased awareness of the amount of

technical and scientific knowledge needed for the successful completion of sustainable Managed Realignment schemes.

The issue of **financial compensation** is regarded as being of surprisingly low importance by consultees in The Netherlands and the United States. In The Netherlands, this appears to be related to the fact that the issue of Managed Realignment is extremely politically sensitive (and thus issues of financial compensation are unlikely to be addressed publicly). However, a recent government campaign has been started to raise public awareness of the inevitability of having to turn to innovative flood management schemes.

A number of lessons can be learnt from the overseas review for the UK situation, in particular:

(a) Human experience/memory of past flood events (such as reported by various contacts in the NL) can be a key factor in determining the lack of political acceptability of Managed Realignment. With regard to coastal defence on the North Sea shores of the Southeast coast of the UK, e.g., the storm surges of 1953 and 1978 are such significant events. It appears that (e.g. in the Netherlands) flood defence management and planning benefits from an approach that fully acknowledges the psychological impact such events have had on the public perception of flood and coastal defence issues. Flood defence management and planning in the UK might equally benefit from such an approach.

(b) The Dutch experience has also shown that a careful and inclusive public awareness campaign can be successful in changing public attitudes and reducing scepticism towards Managed Realignment. Once an increased public awareness of the problems associated with the application of past approaches of 'hard' defence lines to the new scenarios of sea-level rise and climate change has been achieved, Managed Realignment may become significantly more politically acceptable as a *sea defence* option.

(c) The experience of the Netherlands and Germany has shown that technical and scientific knowledge of the functioning of Managed Realignment sites is key to its successful implementation and cost-efficiency. In the case of Germany, for example, it appears that information on the sea defence capacity of intertidal environments has not been accessible to those with coastal defence and management responsibilities. As a result, this key

'driver' is not taken into account when Managed Realignment is considered. On the other hand, consultees in the Netherlands were acutely aware of the ecological and hydrodynamic functioning of natural intertidal areas. It appears that, as a result, Managed Realignment sites in the Netherlands are well instrumented and monitored, ensuring that as much as possible can be learnt from Managed Realignment implementation in order to improve the sustainability of future schemes. This approach seems to have resulted in a situation where the Dutch government can now gain the confidence of the public in Managed Realignment as a viable alternative to previous flood defence approaches (see point (b) above).

(d) The case of Denmark indicates that it is important to put proactive planning regulation in place in areas that may, in the long-term, be required for Managed Realignment. It appears that, due to stricter planning regulations in a well-defined *coastal zone*, Denmark is benefiting from a situation where natural coastal change is easier to accommodate. Planning regulation in the coastal zone should thus be thought about pro-actively in the UK to prevent future costs associated with Managed Realignment schemes that may become necessary in areas that are currently not being considered for Managed Realignment. In other words, planning needs to take into account the natural variability and changeability of the coastal zone.

(e) The overseas review of financial compensation issues has shown that mechanisms for compensation for the purpose of implementing Managed Realignment are both necessary and unavoidable. The case of the Netherlands in particular illustrates that the uptake of Managed Realignment can be greatly increased if more funding (including compensation) options are available. The combination of national government and EU funding schemes has benefited Managed Realignment implementation in the Netherlands.

In addition to providing an indicative list of drivers and constraints in the overseas context, the results of the overseas survey raise an interesting set of additional issues, which should be addressed in further research:

(a) Funding routes for coastal management schemes differ between the individual countries. It is important, for example, to consider the degree to which such schemes are funded through the public sector, as this may be

related to the level of public awareness and/or acceptability of such schemes.

(b) The national significance (and hence public perception) of coastal defence differs widely between the countries included in the survey (due to, for example, different lengths of coastline relative to the countries land area).

(c) The role of financial compensation as a mechanism for the implementation of Managed Realignment schemes overseas could be investigated further to assist in the process of developing policy on this issue in England and Wales.

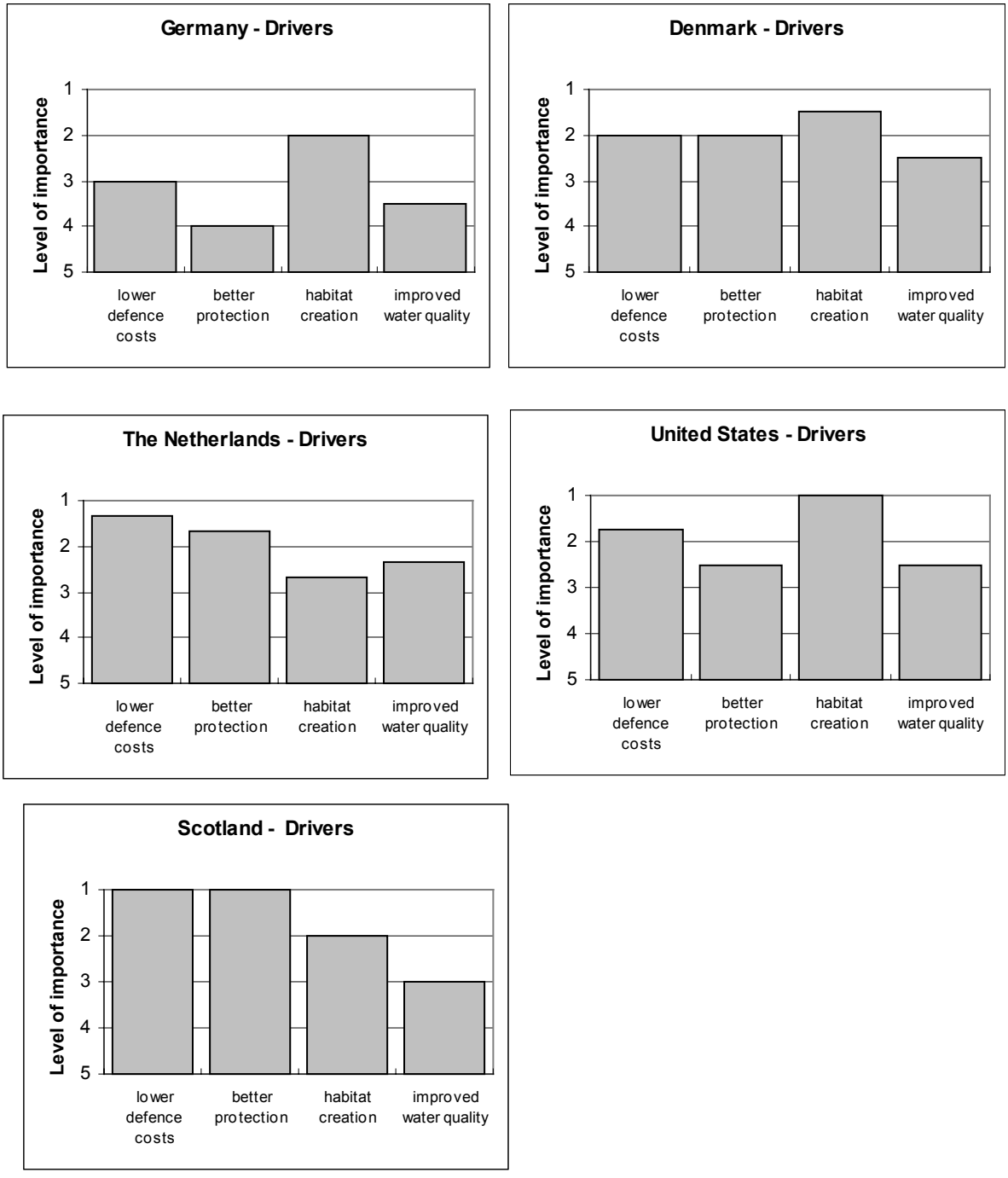
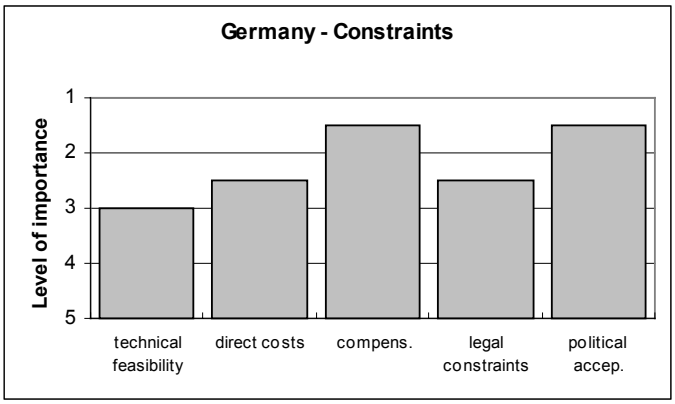
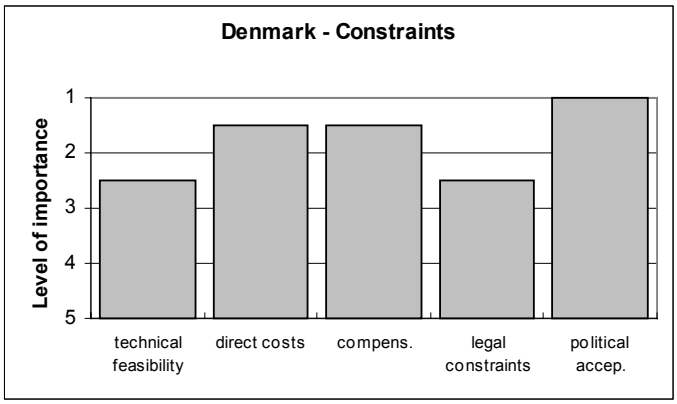
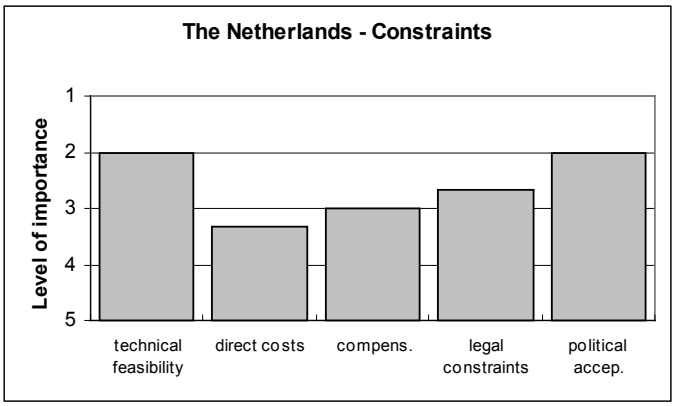
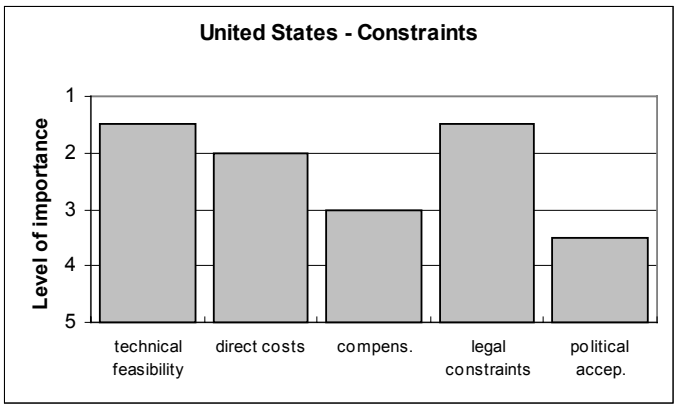


Figure 4.1 (a): Comparison of level of importance awarded to different MR **'drivers'** by questionnaire respondents from different countries (NB: if more than one respondent from one country, means of the levels indicated were used; the number of respondents per country is listed in section 3.2.1)
(Level of importance: 1 = 'high', 2 = 'moderate', 3 = 'low', 4 = 'no opinion')









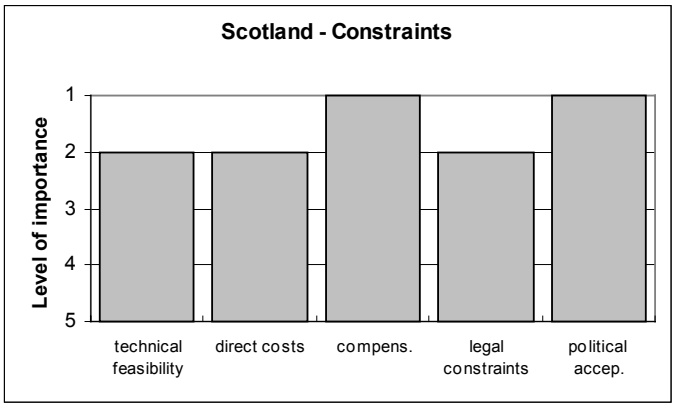


Figure 4.1 (b): Comparison of level of importance awarded to different MR **'constraints'** by questionnaire respondents from different countries (NB: if more than one respondent from one country, means were used; the number of respondents per country is listed in section 3.2.1)
(Level of importance: 1 = 'high', 2 = 'moderate', 3 = 'low', 4 = 'no opinion')

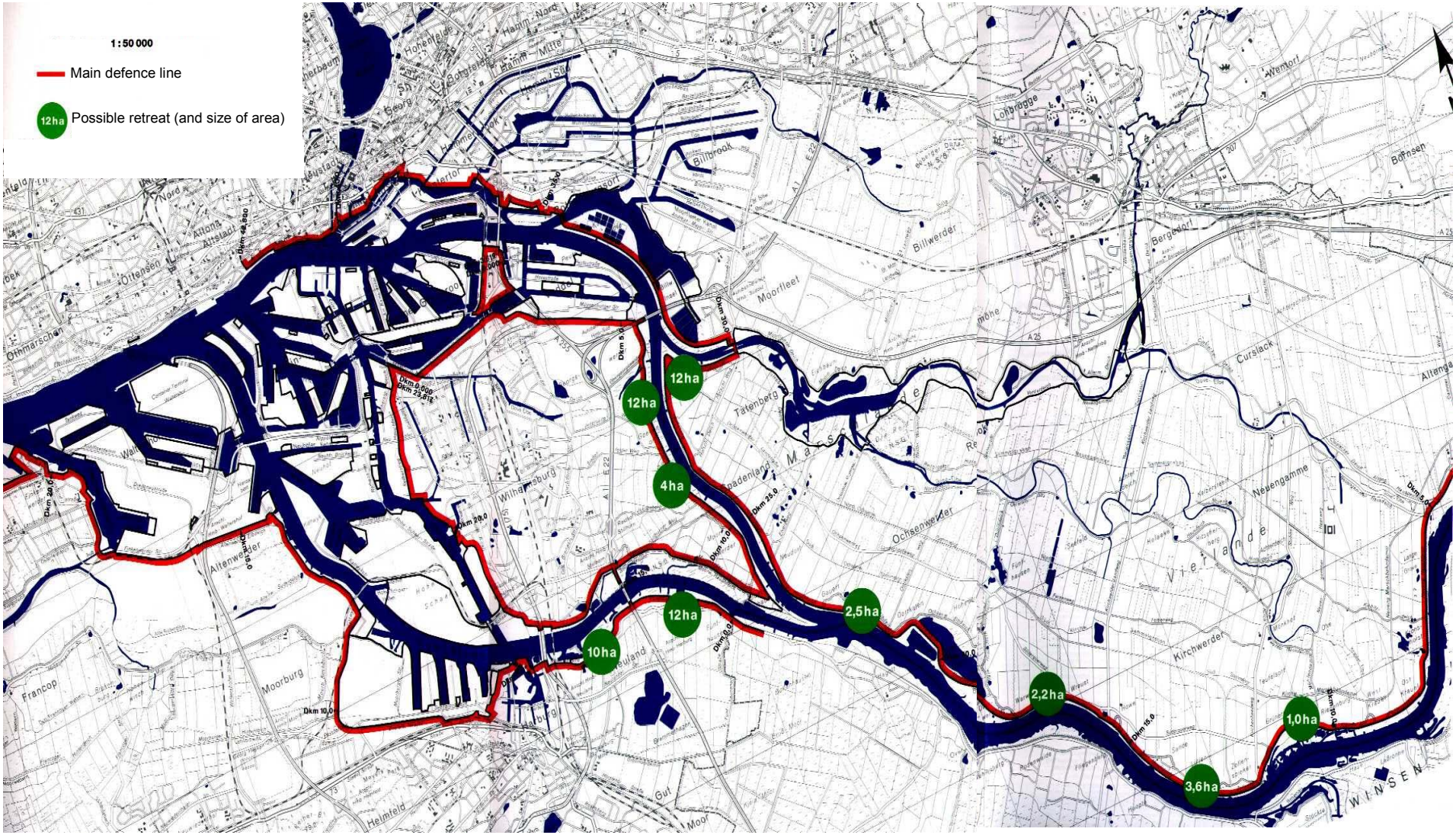


Figure 4.2 Areas of managed realignment on the River Elbe at Hamburg (not all schemes were carried out due to strong opposition by the local population in areas close to the more developed regions) (source: Freie und Hansestadt Hamburg, Baubehörde – Amt für Wasserwirtschaft)

5 Regional Workshops

5.1 *Objectives*

Regional workshops were held in Leeds (7 January 2002, covering the North-West and North-East regions), Swindon (10 January 2002, covering the Thames, Wales, South and South-West regions) and Cambridge (17 January 2002, covering the Midlands and East-Anglia regions). The aims of the regional workshops were to get feedback on the national questionnaire results, explore further the views of participants on themes identified through the questionnaire and identify any possible regional differences in views on Managed Realignment. The list of invitees reflected the broad categorisation used in the questionnaire: DEFRA; Environment Agency; Conservation Bodies; Local Government and Coastal Defence Groups; Landowners; Flood Defence Committees and Drainage Authorities; Coastal Fora and Estuary & Project Officers; Professional Advisory Groups. A good representation of the various interest groups was achieved, as reflected in the list of participants included in Appendix D. To minimise the concerns about possible bias in these participatory stages of the research, the workshop venues were selected to be neutral.

In this section we have presented quotations from participants in italics. These are the expressed views of people at the workshops; they are not necessarily endorsed by the authors of this Review. The purpose of the workshops was to gather opinions and analyse perceptions.

5.2 *Format and Conduct*

All workshops followed the same basic agenda, and all were chaired and facilitated by Professor Tim O'Riordan of CSERGE. After the welcome, an overview of the project was given by DEFRA and Halcrow representatives and the participants had the opportunity to ask further questions about the project itself.

The CSERGE researchers then presented a summary of the results of the questionnaire that had solicited the views of national-level representatives of key stakeholder organisations (Section 3). The discussions during the workshop were semi-structured. Discussion was permitted to flow freely around the issues raised in the overview presentations, but care was taken to address the main drivers and constraints that had been identified in the questionnaire scoping study. When issues were not directly addressed, the participants were generally prompted with

open-ended comments. For example, the comment "*Some Managed Realignment sites exist that were not in the SMPs*" (Leeds) led to a discussion of Shoreline Management Plans, and their usefulness in viewing the coastline in a more strategic way than in the past. Where issues needed specific clarification, targeted questions were asked. In Swindon, for instance, in a discussion of how the Habitats Directive acted as a constraint to Managed Realignment, the issue of the commitment to recreation of salt marsh habitats was raised. The participants were asked directly "*So are the BAPs (Biodiversity Action Plans) a driver for Managed Realignment, or are there other factors*?"

After the initial plenary discussions, the participants were separated into three pre-selected groups. It was intended that each group had at least one member from each major stakeholder grouping (the Environment Agency, a conservation body, a landowner representative, and so on), so that the full range of experiences and opinions would be represented. These groups were instructed to focus on one of three different scenarios:

(i) In the first, decisions are tightly constrained in economic terms, and participatory involvement in decision-making is minimal;

(ii) In another scenario, the aim of all decisions is to maximise environmental benefits, and all decisions are consensually reached by participatory involvement of a very wide range of stakeholders; and

(iii) In the third scenario, a hybrid of the two extremes, there is moderate financial flexibility for funding defences; moderate amounts of public engagement in decision-making and moderate efforts for environmental gain.

Considerable care was taken to explain that these scenarios were not representations of "past, present and future". They are tools for the visualisation of what might be the necessary conditions for the implementation of Managed Realignment options, and the possible consequences; and as such, the two extreme scenarios were chosen to reflect world-views that were as different as possible. Participants were asked whether Managed Realignment would be a viable option in their scenario, and to what extent. If they felt that it would not happen under the conditions of the scenario, why not and what would the results look like in practice? Participants' responses to this creative, imaginative approach were generally very positive. Shaping a discussion of coastal and floodplain management in this way allowed participants to think in abstract terms. They tended not to refer to existing, real-life institutions and practices in terms of their perceived

shortcomings, but did indeed focus on the processes of coastal management and how best to optimise them in the frameworks of each scenario.

The same CSERGE researchers facilitated the same scenario group in all three workshops. To avoid re-discussing similar issues too many times, the scenario discussions in the latter two workshops began with a brief outline of some highlights of the earlier workshops, to allow participants to build on previous findings.

After the scenario break-out discussions, the groups were reunited for a closing plenary session, in which the main points explored under each scenario were presented to the whole group. This generally resulted in further discussion, which tended to crystallise around the principal issues that were seen to be critical to the successful implementation of future Managed Realignment schemes.

The following section summarises the discussions of the three workshops, following the broad structure of the main drivers and constraints or obstacles identified in the questionnaire. The report consists of a discussion based on textual analysis of transcripts of the discourses in the regional and case study workshops. The discussion remains as qualitative as possible, since the aim here is to represent and reliably reflect the many views expressed, rather than to assess which views are "more important" or "more strongly held". In this dialectic approach, the focus has been on searching for concordance of expression. The summary specifically links themes that were explored in all the workshops. Agreements and divergences between stakeholder groups are highlighted, as are any systematic regional differences that were seen. In each of the workshops and case studies, topics which could be classed under the same broad heading, like "Funding" or "Conservation", were addressed very differently, and the quotations selected are intended to cover the range of viewpoints. With so many participants, themes often fade and recur in the course of the discussions, and it cannot be assumed, if an issue is not being spoken about at length, that it is not being thought about, or that it is not an important theme, particularly in a workshop with a pre-set timetable. Nevertheless, this report makes some qualitative indication where themes *did* dominate the discussion, or where they were expected to but did not.

5.3 *Analysis of discussion contents*

In both Swindon and Cambridge, the brief discussion preceding the overview of the Questionnaire moved away from factual queries about the technicalities of the Project. In both cases, several participants referred to the intangible benefits and subjective values associated with flood defence and coastal management, particularly in the context of changing social and political acceptability. The incongruity of these dynamic and not easily quantifiable issues with the more objective and rigid scoring and funds allocation demands was mentioned, particularly with regard to the difficulties that then arise in *"moving towards strategic change"*, or *"integrating other human uses of the coastline or floodplain"*. These two unprompted discussions are highlighted here because all the themes raised in these first five minutes of the session were echoed later in the discussion, when the constraints and drivers were explored in more detail. This tends to confirm that the questionnaire did indeed draw out very significant and topical issues that Flood and Coastal Defence practitioners deal with in practice.

The provision of sustainable flood and coastal defence, with a long-term, strategic view of coastal management in the context of changing sea levels were the drivers that scored most highly in the questionnaire (Section 3). In the questionnaire, the role of Managed Realignment in flood and coastal defence and in habitat creation were separate questions, framed in both the technical/environmental and policy contexts. In all the discussion, however, there is the repeated theme that both these roles, together, are *integral* to the strategic viewpoint.

5.3.1 *Sustainability and Strategic Views: the Main Drivers*

In the discussions about sustainability, five main strands developed: sustainability in terms of the robustness of the system over a longer-time scale; the balance between nature and humanity; harmony in the multiple use of coasts; spatial or population scale issues; and economic sustainability. The latter will be discussed in more detail below, because in the workshop discussions, there was a strong tendency to address the economic issues in greater depth and in a more specific, focussed way.

Several people asked what a **sustainable timescale** might mean. *"Is that looking ahead 30 or 50 years?" "SMPs should look 100-200 years ahead. CFMPs [Catchment Flood Management Plans] should also look ahead." "DEFRA is currently taking a ~20 year view." "But Countryside Stewardship only looks at a 10 year scale."* (Swindon)

The establishment of functioning habitat itself can be said to take a long time: *"Schemes [establishing land-banks] could take 80-100 years."* There was concern that this

process of natural environmental development would face an intractable conflict: *"Political will has a 3-5 year time scale." "Engineers want to maintain the status quo."* Coastal Habitat Management Plans (CHaMPs) and the second-generation SMPs were seen as a definite move towards a longer-term strategic view for Managed Realignment.

There was some discussion about how to define the effectiveness of Managed Realignment. While for a few participants, the definition of successful Managed Realignment *"should surely be that it provides good flood defence"*, the uncertainties of coastal change, particularly over *"a hundred year future time scale"* are very significant, and technical knowledge about the effectiveness of Managed Realignment versus that of solid defences becomes very important. Conservation organisation representatives argued that Managed Realignment success should be defined in terms of habitat creation success.

Participants frequently discussed these matters in terms of the **demands of humanity on the natural world**. *"We are like Canute – nature will be dominated! But the future does look like a concrete wall all along the east coast unless this changes." "Sustainability must mean working with coastal processes."* From this perspective, it was clear that there is general acceptance that in many parts of the country, both current defences and land use in coastal and floodplain areas are in direct – and unsustainable – conflict with nature. However, the discussion only occasionally went beyond this. *"Farmers know the issues. We agree that it's better for our land to be flooded than for Selby to be underwater"* (Leeds). *"We are ignoring big, long-term and more expensive questions: there are large numbers of people behind very expensive coastal defences that may be vulnerable… Do we talk about moving people?"* (Cambridge). It was much more common that discussions of unsustainability returned quickly to the more manageable issues of individual schemes. Given the complex issues embedded in questions like, *"What are the costs of Managed Realignment per human being, compared with the costs per bird?"*, this redirection of discussion is perhaps understandable.

Managed realignment was often seen as a way of introducing a more **balanced use of coasts**, with **multiple demands** being accommodated. As briefly mentioned above, the role of Managed Realignment in pairing habitat creation or restoration with functional flood defence is a potentially powerful argument in its favour. In this respect, sustainability was described as an *"elastic concept, balancing lots of things"* such as the seaward uses of the coastline; grazing marsh; a return to other productive uses of coast and floodplain habitats, such as wildfowling or samphire farming; and other sporting or

recreational uses. These uses were all mentioned in the general discussion. The Case Study workshops discussed in Section 6 explore these in more detail.

There are several ways in which scale issues need to be addressed in Managed Realignment programmes. The most immediately obvious is **spatial scale**. Schemes are small compared to the extent of coastline or of river margins, and there was very considerable discussion in all three workshops about this. In fluvial systems, for example, *"if Managed Realignment is the sustainable option, then it has to be put in place over big stretches of river. There are great lengths of raised flood defences."*

The point that was discussed most thoroughly was that there is a clear need for the decline in inter-tidal habitat area to be reversed, and this presents very real challenges. However difficult it may be to define, natural habitats have a minimum size threshold below which the likelihood of loss of ecosystem viability is high. With regard to recreated habitats, the assumption that equal areas will result in equal quality habitats is particularly risky. Finding suitable areas of conservation land was described as a difficulty. Furthermore, larger areas of land are likely to involve multiple landowners, increasing the difficulty of negotiations and implementation of the schemes. As mentioned above, there are some realignments that have been done informally, rather than as a consequence of formal river or shoreline planning, and these are generally just a few hectares in area. These are some of the reasons that *"Managed Realignment looks opportunistic, not a strategy"*, a theme that was emphatically repeated throughout this study.

Related to the spatial scale is the issue of seaward habitats and their human uses and how they relate to land habitats. This was discussed in Cambridge and Swindon, but not specifically mentioned in the Leeds workshop. In regard to marine and landward "habitat swaps", for example, where a setback of defences on freshwater grazing marsh would create more salt marsh, several people mentioned a "salami effect" where repeated small losses would lead eventually to an unsustainably small, unstable ecosystem.

Several scale issues relate to people. Two particular trade-offs were recurring themes: where costs and benefits (whether financial or less tangible) affected the wider public versus an individual, and where they might be felt differently at a local scale compared with a regional or national scale. The first of these trade-offs will be discussed in detail in the Compensation and Funding section below. The **local versus broader scale** touched on national commitments to inter-tidal zone recreation, and the effects on the communities where those habitats will be located.

Since those communities also benefit from the flood defence, should just the local beneficiaries pay? In an illuminating discussion from the Leeds workshop, some of these issues are clarified:

- *"…50p per person would be enough to solve England's flood problem."* [Note: research by Halcrow suggests that the figure is actually about £6 per person per year (Halcrow 2001)]

- *"But looking at the local choice, if I have 50p, do I spend it on flood defence or schools or something else? The spenders are detached from the benefits. There's no political kudos in saying someone else will benefit from your 50p! Unless beneficiaries pay, this will remain a political issue."*

It is perhaps in this particular context that the interplay between Managed Realignment's roles in flood defence and in habitat restoration and creation is most stark. It was clear that there are national needs for habitat as well as local needs for flood defence. It appears that there is a need for information and debate on this issue to improve public acceptance.

While most definitions of sustainability include the economic aspects in equal emphasis with social and environmental sustainability, in the workshops, the issue of **economic sustainability as a driver** for the implementation of Managed Realignment was only discussed briefly, and indeed in Swindon, it was not specifically mentioned at all. That is not to say that it is not a compelling factor in reality. The current situation is recognised to have elements of economic unsustainability: *"Ignoring coastal defence is the least sustainable, most expensive option." "We won't hold the line, though – it can't happen, either legally or financially." "Funding is a driver: whatever the Treasury gives is not enough. It is rationed, and we have a long, low-lying coast." "Funding drives Managed Realignment…".* Clearly it is a very significant driver from the point of view of those responsible for funding defences: this was evident in the Questionnaire; and in both Leeds and Cambridge, the DEFRA representatives made clear statements that the costs of flood and coastal defence are an incentive to use Managed Realignment: *"Cost is a driver." "In choosing the best value-for-money option, it is important to recognise the two motivations for Managed Realignment [flood and coastal defence and international habitats]"* – here, spending optimisation is seen as the primary aim.

There is somewhat of a disparity between the DEFRA view and that of the other key stakeholders – both the users of the coasts and floodplains, whether

landowners or conservation bodies, and the organisations responsible for the management of those areas, like the Environment Agency. Economic and financial concerns were very often seen as *constraints* rather than drivers, and the discussion focussed very much more on issues of funding, valuation and compensation, which are discussed in Sections 6 and 7.

5.3.2 *The Habitats Directive: both Driver and Constraint*

The workshops indicated that the Habitats Directive can be a powerful driver for increased use of Managed Realignment, particularly in coastal defence. People referred to requirements for increased areas of inter-tidal and wetland habitat (though in fact these are contained in Biodiversity Action Plans rather than the Habitats Directive): *"We have a Europe-led requirement to create 50 ha of salt marsh each year…"* There also is a need to mitigate or compensate for lost habitat areas when lands are developed, and Managed Realignment is often the only way to do this. *"The habitats regulations are being used as a driver. [Our development] has been approved on the grounds of over-riding public interest, but we have been given a clear remit to "rebuild" 8 ha of inter-tidal zone…"* The experience in the South-West (the Swindon Workshop) seems to be most driven by the Habitats Directive.

However, many people talked about inconsistencies in the legislation, and rigidity and ambiguities in its interpretation. *"Living with the Habitats Directive is imperative. It is difficult because of the English Nature approach! What are the other European Community opinions?" "The Habitats Directive is high-cost – we've chosen a reductionist approach, not the real meaning of aiming for sustainable habitats." "Sometimes the regulations mitigate against natural processes: preservation is favoured over environmental gain." "The Habitats Directive is a real hindrance because it doesn't allow us to work out a dynamic working system." "In fluvial systems, like the Ouse Washes, complexity arises where both nature conservation and artificial structures have been designated."*

The ambiguities in the Directive are particularly awkward to address in the case of realignments onto existing designated sites. "[The implication of] *the Habitats Directive has different slants for SPAs (Special Protection Areas) and SACs (Special Areas of Conservation) – for SACs, it is a driver, but for SPAs, it is likely to be a constraint, especially for grazing marsh and freshwater habitats."* The need for compensatory habitat and the perceived complexity of changing designations become obstacles to the implementation of Managed Realignment. *"The equivalence requirements result in delay and escalating cost." "The Habitats Directive wasn't intended to be that rigid. Like-for-like habitats is a difficult requirement." "Realignment over SPA designated land throws out real compensation issues – what scale? Should we compensate for area or function? And we focus on*

just the bird habitats. When we're faced with coastal squeeze on reserves, the solution is to realign the Habitats Directive!"

These are not seen as intractable problems, however. *"Porlock is an example of an SSSI* [but not subject to the Habitats Regulations] *that made a transition from freshwater to inter-tidal habitat." "The English Nature view is that we need more, different ways to see the Habitats Directive in a broader light. It provides for consensus…" "We need a broader view than direct compensation [for habitat loss]. The Directive could let us consider a selection of coastal SACs that have key criteria of structure, functional processes, etc, so if we change the site [by Managed Realignment], we could see the response of those process to ensure that the whole system maintains its integrity."*

Adding to the complexity is the view that habitat creations are piggy-backing on the flood defence funding allocations: *"Managed Realignment wouldn't be an option if it weren't for flood defence measures – Habitats alone wouldn't drive it. It might not be the main purpose, but that's where the money comes from." "The Habitats Directive is a strong piece of legislation compared with flood defence legislation. But compensatory habitat is paid for on the back of flood defence measures, which still take a very parochial line." "Funding drives Managed Realignment. The benefits are habitat creation."* This interplay between the twin motivations for Managed Realignment has been discussed in the context of sustainability, but here, it is explicit that although the Habitats Directive leads coastline managers towards Managed Realignment, it can only follow in practice via the flood defence budget.

5.3.3 *Economic and Financial Constraints to Managed Realignment*

Funding issues were the focus of the discussion for a large proportion of all the workshops, and funding underpins many of the other themes. DEFRA funds Managed Realignment schemes from its national Flood and Coastal Defence programme. Participants were broadly unanimous in stating that this is not a satisfactory state, given that habitat concerns are often as important a motivation for realignments as defence. It was felt that in some schemes, habitats alone lead to a realignment decision in an area with no pressing flood defence need. There was, for example, a perception that Cley/Salthouse is an example where the realignment *"…scheme is motivated by the Habitats Directive, not the village."*

One alternative channel for funding Managed Realignment where the aim is habitat recreation or restoration is the **agri-environment schemes**. The limitations of using Countryside Stewardship in this way were the unattractive rates; the short timescale of the scheme relative to the essentially irreversible land-use changes (e.g.

reverting to salt marsh); the fact that the scheme is discretionary; and scale concerns where multiple landowners may need to collaborate to make a viable area of habitat. *"When it comes to replacement of land, agri-environment schemes are inadequate."* A further shortcoming was that the *"separate streams don't work"*, given the changes in flood defence. *"The management of a new site comes from a different purse – conservation management by the landowner is separate from flood defence budget. Reconciling the two streams is a way forward."*

Other alternatives are *"the Habitats Directive, wildlife conservation organisations, pro-bono donations from landowners,"* and **private finance initiatives**. The Broadlands Case Study looks at the latter in more detail. In the Cambridge workshop, the view was expressed that more *ad hoc* funding would contribute to a *"crenellated coast"*, where *"individual landowners with resources will defend their own frontage…"*

Other cost issues relate to the implementation itself.

- Technical studies: there was broad acceptance that the underlying knowledge base for Managed Realignment is still far from complete, and in order for it to be successfully implemented, this knowledge needs to be acquired. *"…Many supporting studies are needed… We want the coastline to be sustainable, so it needs to be done properly."* There was some concern that this obstacle to implementation perhaps is being thought to be more serious than it necessarily is: *"Not all projects need millions of pounds spent on studies." "It is important to consider the cost of data gathering, but how acceptable is that in the decision-making process?"* Technical constraints other than costs of acquiring the data are discussed further, below.

- Consultation: *"Costs of consultation are high… appeals and public inquiries add to the cost and time."* Issues to do with public participation and information were seen as a major constraint in their own right, and this is discussed further below.

- Land costs. Whereas concerns were expressed about "property blight" on river floodplains where defences might be realigned, such concerns were not serious for participants taking a coastline perspective, and the following views were expressed more often: *"With sea level rise, opportunities for land acquisition are fewer, and costs will potentially increase." "Habitat creation land is in demand. We can see a situation where the market price will go up and up… but that is only if habitat creation is the motive for Managed Realignment."*

The issue that was discussed most intensively was **compensation** payments to landowners. *"The technical side might mean that Managed Realignment is a lower cost option than other defences, but compensation issues drive costs right up."* Compensation payments were seen as inconsistent by many. *"Landowner compensation is important to everyone except to DEFRA."* Since, as several people pointed out, defences protecting developed land are unlikely to be realigned, farmers feel the direct impacts most strongly. *"CBA [cost-benefit analysis] puts agricultural land in too cheaply, with the ratio corrector." "Farming water is an option. There's a price, though, so compensation must be right." "Developed land, with property, can be valued. With agricultural land, the income is 'replaced', but the changes can compel a loss of viability. It can't be a simple formula for compensation."* There is a widely held view that it is unfair *"…when decisions are made for the public good (taxpayer savings, or nature conservation), and an individual loses land and gets no compensation."*

Of course, agreeing that the current situation can be perceived as unfair or inconsistent rather begs the question of what fair and appropriate compensation might be, and who would pay compensation to the landowners. If farmers have been encouraged and given financial incentives for decades to drain land for agricultural practices in accordance with national policy, when that policy changes, it might follow that encouragement and financial incentives should also be the tools for compliance for the new approach.

Compensation payments and a strategic system-wide or longer-term view are closely linked. *"For setback in line with sustainability aims, where there's no compensation, or inadequate compensation, …landowners …will defend their own frontage, and we'd end up with the same estuary with the same complications as before."*

5.3.4 *Information and Perceptions – Political and Cultural Constraints*

Consultation and public involvement were seen as one of the critical steps to successful implementation of Managed Realignment. *"People want defence, more money, and there can be local resistance to a strategic view."* However, this is generally seen as a time of change in favour of realignment. *"With public opposition, it isn't easy to get schemes through." "Meetings… to reach consensus [are] a cost effective approach." "Social acceptability of these ideas [restricted use of floodplains] is rising."*

The local authorities were often described as having an "engineering mindset", favouring hard solutions to coastal defence, and where the general public is not fully informed about the alternatives, these "tried and tested" methods can pass almost unquestioned. *"Engineers' point of view is 'maintain the status quo', defend for some*

occasional floods. But ecological niches don't form with that kind of pressure." This links in with issues of risk management. Conservation bodies and coastal managers are generally risk averse, and the sparseness of experience in Managed Realignment means that its outcomes are still uncertain.

The government's viewpoint was also questioned: *"Central government and English Nature seem to have ignored stakeholder input."*

5.3.5 *Experience and Technical Constraints*

The time taken for supplementary studies and the need for systems knowledge was a major theme in the Cambridge workshop, where a larger proportion of participants worked in preparing those studies, and were involved in most of England's estuarine realignment experiences.

The difficulty of creating habitat *"to a recipe"* was emphasised, leaving the option of pragmatism in taking a wait-and-see approach.

The need was expressed for co-operation across agencies, perhaps with more accessible databases, or organised networks for ideas exchange. *"All the information generated in flood defence works is also important to bird organisations."*

5.3.6 *Planning and the Legal or Regulatory Context*

"*Creating habitat is easy compared with the hurdles of bureaucracy and planners.*" This was echoed several times in the workshops. As mentioned above in the context of the types of solution presented to the flood defence problems, there is a planning mismatch with policy, or a lag behind changing policy. The current situation is one of unintegrated levels, with local strategic plans having statutory powers, but not formally meshing with SMPs, CHaMPs, and other documents. There are enormous local variations in the composition of the committees that make decisions, and this adds arbitrary elements to the decisions to implement different defence options. The Design and Build approach, in particular, was criticised because it holds up implementations, particularly for "*river schemes that don't have detail and certainty*".

There may be other legislative constraints that managers should be prepared for. The Human Rights Act was mentioned several times, particularly in association with compensation for property loss and impacts on communities of realignments. As discussed regarding the Habitats Directive, flexibility of legislation is needed to match the uncertainty and dynamism of the systems.

5.3.7 *Specifically Fluvial Concerns*

Realignments are most often envisioned in the coastal zone, particularly as a response to rising sea levels. Fluvial aspects tend to relate more to flood holding, perhaps linked with longer-term climate change and extreme events planning. An example was given of the Environment Agency's concern near the Thames barrier, where upstream flood plain changes will have a pronounced effect. There was clear, consensual emphasis on the need for a strategic catchment-scale vision: *"The current view needs to shift to whole systems… At Boothferry Bridge, the river is tidal; it all impinges on a large part of the Vale of York…"* (Leeds). CFMPs are key to this vision. Further informal discussion with fluvial representatives at the workshops confirmed the importance of optimal planning and linkage with other planning tools, like the LEAPs and the River Basin Management Plans associated with the Water Framework Directive.

The urban/rural question arises with particular significance in river realignments. "*Flood storage may be just for a 1 in 10 year event, but Managed Realignment means the land is lost… it is no longer agricultural land.*" However, information is targeted, and farmers are aware of the issues, and are broadly prepared to experiment – perhaps more so than on coastlines, because they are more aware than many people of the issues of flooding. "*On a catchment scale, wetland creation is a message being passed on to farmers*".

5.4 *Group Discussion on Scenarios*

The rationale for the use of the scenarios was outlined briefly in Section 5.2. The national level questionnaire survey provided a snapshot of the current key stakeholders with roles in flood and coastal management. However, the environmental and regulatory contexts are changing. Scenarios are one way of addressing this dynamism by giving the participants scope to envisage the future creatively, without being caught up in the perceived shortcomings of existing institutions. The participants were divided into three groups, and for each group, an internally consistent and plausible scenario was presented.

Notes were taken by participants and facilitators on flipcharts visible to all participants in the group. The discourse centred on the question, "What would it take to get a Managed Realignment scheme through in this context?" Discussions addressed planning, economic, financial, political and social aspects.

In the first group, the scenario narrative centred on a restrictive regime of funding and limited participation. In this scenario, flood and coastal management decisions tended to be made and implemented in an authoritarian manner, with economic

optimisation at the national level being the guiding principle. Under these comparatively tight controls, participants felt that the pursuit of Managed Realignment as an option was unlikely, because classic financial cost-benefit assessments would not be able to appraise some of the mixed or less tangible benefits. The reactive nature of management would mean that quickly implemented solutions to flood and coastal defence needs would be favoured. Participants envisaged *unmanaged realignment*s occurring, where breaches occur when maintenance of defence could not be justified. In practice, it was felt that not all of the results would be bad: natural processes would be restored, albeit in an unmonitored and unplanned way, so the environmental gains could in fact be significant. However, social concerns, especially locally, would be very serious, with unsatisfactory risks to property or persons, and economic losses could be significant too. Individuals with means may well construct their own defences, with a consequent crumbling of whatever strategic planning had been in place. The political costs of this scenario are potentially staggering, with a high likelihood of negative community reaction, and the risk of penalties for failing to comply with international policy instruments.

The intermediate scenario can be seen in terms of achieving current policy targets with regard to optimising a range of social benefits, not just economic or environmental benefits. Stakeholders are more actively included than in the first scenario, and some longer-term thinking prevails, with associated increases in spending on strategic management. In this group, there were many circumstances where Managed Realignment could be favoured over alternatives. There was some very creative thinking about funding and planning. Compulsory purchase was seen as a necessity, with the half-serious suggestion of extending death duties in the coastal zone to the extent that uneconomically defended properties would be appropriated "by" the floodplains or inter-tidal zones. National land-use zoning and relocation would be a solution to the continuing problem of unsuitable development. "Selective consultation" – the active exclusion of awkward participants – was suggested as a means of avoiding the tangled and protracted debates that sometimes characterise participatory community involvement in flood and coastal decision-making. These quite draconian suggestions strongly suggest that the current situation is widely perceived as serious and unsustainable. On a more realistic note, potential solutions to the shortcomings and perceived unfairness of compensatory payments included multi-source funding, national and local flood defence levies, and harmonised agri-environment and flood management schemes with a longer time-scale. Streamlining planning was a recurring theme.

In the third scenario, environmental gains were the focus of decision-making, with a somewhat hardline definition of sustainability underpinning the participation process. Decisions would be deliberated extensively at community level, and long-term planning would dominate over cost savings. Participants felt that despite the best intentions, actually implementing Managed Realignment under these conditions would be difficult. Costs and time requirements would escalate beyond practical limits. Again, risks to people, property and habitats would be unsatisfactorily high while waiting for consensus to be reached; decisions – although consensual – would not be reactive enough to cope with the dynamic coastline and floodplains. Whether the social and political contexts would allow the environmental gains they nominally aimed for to be achieved was a moot point. However, this scenario highlighted the fact that existing institutions have scope for improvement in educating and informing the public, more harmonious and transparent liaison among themselves, and a pressing need to address the processes of decision-making (closing the gap between policy and practice) in the context of changing coastlines, floodplains and social demands.

5.5 Conclusions

The regional workshops allowed verification of the results of the questionnaire. Participants broadly agreed with the results of the national survey, but underlined possible regional and local variations. Some participants also underlined that some of the factors overlapped, which made it difficult to rank them. The wide-ranging discussion lead to a more in depth analyses of broad themes raised by the survey. The main issues which have consequences for future implementation of Managed Realignment as a strategic flood and coastal defence option include the following points:

- **Flood and Coastal Defence.** There was a general consensus across regions that providing sustainable flood and coastal defence is the main driver. This is difficult to separate from economic and sustainability issues since theoretically, existing defences can always be technically strengthened, but often at unacceptably high social costs. Environmental benefits were considered as important, but participants agreed that so far Managed Realignment had been opportunistic, and environmental benefits had not been maximised. To get the full benefits of Managed Realignment, there needs to be a strategic approach, integrating wider socio-economic consequences of Managed Realignment. The second round of SMPs and the CHaMPs are seen as a step in the right direction.

- **Financial compensation**. Compensation (including land purchase) was high up in the list of constraints, and many participants felt that there could not be a comprehensive and strategic Managed Realignment policy without appropriate compensation. Currently, however, flood and coastal defence is not a duty, available funds are limited and compensation can only be paid in certain limited circumstances (Section 10). Compulsory purchase is an option that tends to be avoided, but it might become necessary for a strategic policy. One solution may be to mobilise other sources of funding for legitimate flood and shore management, possibly linked to environmental/habitat gains, complementary to flood defence expenditures.

- **Habitats Directive.** The Habitats Directive was seen both as a major driver, requiring recreation of inter-tidal habitats to compensate for habitats (mostly SACs) lost to development or coastal squeeze; and as a constraint, as Managed Realignment can result in the loss of freshwater habitats such as grazing marsh (mostly SPAs). In the latter case, the legal requirements (Section 11) can create long delays in the planning process. Many participants proposed that there should be a more flexible interpretation of the Habitats Directive, which recognises the dynamic nature of fluvial and coastal habitats, with criteria for suitable compensatory habitat sites based on structural and functional processes.

- **Cost of Managed Realignment.** One of the drivers of Managed Realignment is reduced flood and coastal defence costs. However, cost can also become a constraint as different factors such as high levels of financial compensation, delays due to the planning process and the potential need for research into hydrodynamics can raise the overall cost of schemes. In some circumstances Managed Realignment may have relatively low capital costs compared to holding the line, but maintenance costs are long term, and should be costed for the whole scheme life. Because maintenance cost estimates need to be reliable and identified in advance, strategic budgeting becomes an important requirement.

- **Planning process.** The planning process is complex and often causes long delays. Participants felt that it would be dangerous to short-circuit the system, but that it should be possible to increase the speed of the process without losing its effectiveness. There was also a feeling that many of the issues are due to the novel nature of Managed Realignment and that experience could provide useful information for future cases and accelerate the process. Some

participants mentioned the option of land banking as a way of streamlining the planning process. There is a need to ensure that all planning authorities work harmoniously and according to an agreed strategy.

- **Funding issues.** The main source of funding for Managed Realignment so far has been flood and coastal defence budgets. However, there are other benefits from Managed Realignment, particularly if a more strategic approach is adopted. Other sources of funding will have to be found. There will have to be funding "packages" rather than single sources of funding. There is opportunity for collaboration between possible funding organisations. The agri-environmental schemes are a possible complementary source of funding (Section 10), but do not prove very attractive to landowners, because of the short time frame for payments. These contrast with the long time frame of Managed Realignment benefits, and the relative irreversibility of the change in land use. The schemes also need to be better adapted to dealing with multiple landowners.

- **Technical constraints.** Technical barriers and lack of scientific understanding can be quite significant, in particularly in relation to lack of process information (Section 7), which may lead to Managed Realignment having unforeseen negative consequences elsewhere on the coast, in an estuary or along a river. There was also a general consensus that it can be difficult to predict with certainty what type of habitat would emerge from a particular Managed Realignment scheme. This is likely to cause problems if one of the aims of Managed Realignment is to create a like-for-like habitat to compensate for areas lost elsewhere in the context of the Habitats Directive. Anticipatory habitat creation would help reduce the risk of failure, though this in turn requires proactive planning and resources.

- **Consultation and public support.** Appropriate consultation and follow-up after initial consultation are both important. Managed realignment is a complex issue. The public needs to be involved more, with benefits of Managed Realignment clearly explained. It will, however, probably take several decades for people to fully appreciate the potential benefits. Involving stakeholders is not easy. It is time consuming, intensive in management time, and can lead to outcomes that are not in the best interests of strategic flood management. Concern that engagement with stakeholders may over-raise expectations was expressed informally by the Environment Agency and DEFRA, but it was not mentioned as an issue in any of the workshops. In the

Halvergate (River Yare) case discussed in Section 6, stakeholder expectations were discussed, but their critical comments about the preliminary engagement were more to do with consistency of the consultation materials at different stages of the process, and its transparency. The emphasis is very much on the execution of consultation, whereas the principle of the need for participation itself is assumed.

6 Case Studies

6.1 *Objectives of case studies*

The objective of the local case studies was to get a local-level perspective on issues raised in the questionnaire and in the regional workshops, with the aim of identifying the specific factors that facilitated or constrained Managed Realignment in the case studies. Holding case study discussions with stakeholders provided the opportunity to probe the different perceptions of the process of implementing realignments. There was also a need to explore which constraints discussed in the regional workshops really did present obstacles in practice. An implicit objective was also to investigate whether the case studies could provide any useful lessons to facilitate implementation of Managed Realignment elsewhere.

Three case studies were examined: Thorngumbald, in the Humber estuary; Brancaster, North Norfolk; and Halvergate Marshes, along the river Yare in Norfolk, chosen because they represent a variety of physical contexts (estuary, open coast and river), and involve a range of stakeholder categories. Although none of the schemes are complete, they have all been devised and implemented within the current policy context. Established schemes elsewhere in England were implemented prior to the SMPs or the implementation of the Habitats Regulations, and from that point of view, they are more limited as learning experiences. Clearly, the technical expertise that has accumulated with the earlier experiences is not to be underestimated, as the discussions above have emphasised, but this present study has the clear aim of looking at the future of Managed Realignment. Thus, although the final success of the case study schemes cannot be guaranteed, a clearer understanding of the process they have underwent is topical and useful.

In this section we have presented quotations from participants in italics. These are the expressed views of people at the workshops; they are not necessarily endorsed by the authors of this Review. The purpose of the workshops was to gather opinions and analyse perceptions.

6.2 *Context of case studies*

6.2.1 *Thorngumbald, Humber Estuary*

The Thorngumbald site is located some 10km to the south east of Kingston-upon-Hull on the north bank of the Humber Estuary. The reach extends downstream from Thorngumbald Lighthouses to Little Humber and is approximately 2.5km in

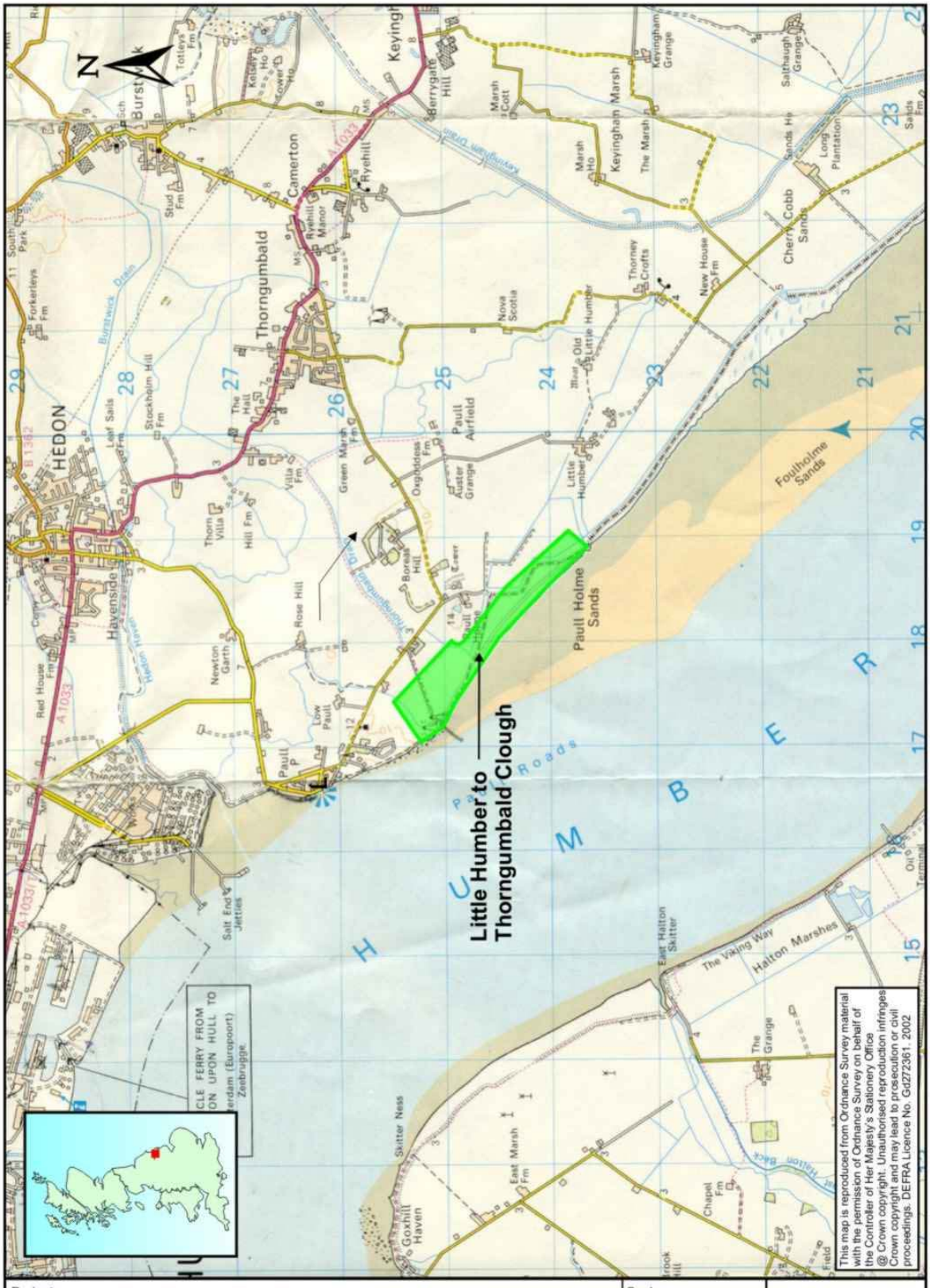
length. (Figure 6.1). The existing tidal defence along the reach comprises an earth embankment fronted by a relic saltmarsh. An extensive inter-tidal mudflat exists seaward of the relic saltmarsh (Figure 6.2). Towards the downstream end of the reach, the outer part of the mudflat gives way to the Paul Holme Sands.

The saltmarsh has suffered in the past from erosion, to such an extent that, in places the mudflat exists right up to the toe of the embankment. Elsewhere the toe of the embankment has been eroded to from a vertical face. Along the upstream 600m length of the reach, the seaward face of the embankment is protected by a full height rock revetment. Downstream the protection to the defence is very patchy and consists of a variety of materials that have been provided, in an ad hoc manner, and at various times, both to the lower part of the seaward face of the embankment and to the seaward "cliff" of the saltmarsh.

The land immediately behind the tidal defence is predominantly arable with small areas of pasture, open space and woodland. It also includes a major gas distribution station, two lighthouses, properties and farms. Ultimately the defence provides protection to the Salt End chemical complex and the eastern suburbs of Kingston-Upon-Hull. The importance of the site area for nature conservation is recognised by its national and international designations. The site area is within the Spurn Head to Saltend Flats Site of Special Scientific Interest (SSSI) and the Humber Flats, Marshes and Coast Special Protection Area (SPA)/Ramsar site.

The defence does not provide an adequate level of protection. Its current level is estimated at less than 1 in 10 years. This level reduces to 1 in 1 year in 50 years time, allowing for sea level rise. Scour of the embankment could also occur on any high spring tide when combined with a rough wave regime. Taking these two factors together, it was estimated that the defence would fail within three years (Environment Agency, January 2001).

The scheme principally comprises the construction of a new tidal defence embankment set back approximately 500m behind the existing defence along the upstream section of the read and approximately 200m along the downstream section. In addition, armouring works will be carried out to the area around Thorngumbald Lighthouses and to the major gas pipelines which cross the site. Amendments will be made to the local land drainage system, in particular the construction of a pumping station to convey flow from Thorngumbald Drain over the new embankment.



Project **MANAGED REALIGNMENT RESEARCH**	Scale 1:50,000	Halcrow
Figure Title **LOCATION MAP OF THORNGUMBALD CLOUGH**		Figure 6.1

GRAPHIC UNIT/CEFAAI14/LB/13.06.02

Potential borrow area from Thorngumbald Clough

General view of defence

Project	Scale	
MANAGED REALIGNMENT RESEARCH	NTS	Halcrow
Figure Title		Figure 6.2
THORNGUMBALD MANAGED REALIGNMENT SITE		

GRAPHIC UNIT/CEFAAI15/LB/13.06.02

The proposed scheme will provide a level of protection of 1 in 200 years and has a benefit to cost ratio of 93. Under DEFRA Guidelines and on a reach specific basis, the proposed scheme would not have been the preferred option. This would have comprised a partial realignment improvement. However, the Thorngumbald scheme is intended to provide compensatory habitat for other works within the Humber Estuary where minor encroachment into the SPA is proposed. Without this compensatory habitat the preferred options for these other works would not comply with the requirements of the Habitats Regulations. More expensive solutions would need to be progressed thus increasing the cumulative costs of the overall works proposals within the estuary.

Approximately 80 ha of inter-tidal habitat will be created by breaching the existing defence in two phases. Initially it is not proposed to carry out any work in this area and let it develop naturally. If future intervention is necessary, such as artificially adjusting land levels, this will be developed as part of the ongoing management plan for the area.

Construction of the scheme commenced in 2002 with the main earthworks being undertaken in the spring and summer of 2002. It is intended to breach the existing defence in 2003.

6.2.2 *Brancaster West Marsh, Norfolk*

The Brancaster West Marsh site is situated on the North Norfolk coast, approximately 1.5km due north of the Brancaster village and approximately 2km west of the Brancaster Harbour estuary mouth and spit (Figure 6.3). The existing tidal defences on the northern (seaward side) comprise a natural sand dune system armoured with gabion baskets (Figure 6.4). The defences protect an area that is mainly freshwater grazing marsh, but also includes the practice ground for the Royal West Norfolk Golf Club. The Engineer's Report states that "Extensive and periodic winter storm damage has jeopardised the integrity of these defences and has resulted in increased maintenance costs to the extent that they are no longer economically viable to sustain" (Environment Agency, May 2000).

The grazing marsh has a high conservation value and is part of the North Norfolk Coast Site of Special Scientific Interest (SSSI) and Special Protection Area (SPA). The adjacent salt marsh and foreshore are within the North Norfolk Coast Special Area of Conservation (SAC).

The scheme involves the removal of the gabions and re-profiling of the dune system to allow the natural coastal processes to operate. A clay embankment 300m landward of the existing defence line is being constructed to protect the majority of the SPA (Figure 6.5). The scheme will convert 7.5ha of existing freshwater grazing marsh into salt marsh, which will offer protection to the new embankment as well as forming a new saline habitat. The grazing marsh is being purchased with DEFRA grant aid. The Royal West Norfolk Golf Club is constructing another new counterwall on the eastern side of the site to protect its practice ground (Figure 6.5).

The standard of protection afforded to the land behind the new embankment will be 1:50 years, compared to the existing standard of 1:5 years. The benefit cost ratio of the scheme is 1.2, compared to a benefit-cost ratio of 0.92 for a hold the line scheme. The Non Intervention option was not considered acceptable, due to the resulting impact on the SPA and the safety risk to the public of allowing the existing defences to deteriorate further. It is anticipated that the new defences of embankment protected by salt marsh will be sustainable for 60 to 150 years.

An aerial photograph of the whole site is shown in Figure 6.6.

6.2.3 *Halvergate, River Yare (Norfolk Broads)*

Flood defence in Broadland is the responsibility of Broadland Environmental Services Ltd (BESL), a private consortium formed to deliver services under a public-private partnership arrangement. BESL is contracted to provide and maintain the standard of flood defence and pattern of flooding that existed in 1995. It must maintain this for the duration of the contract (20 years) and an additional life of between 2 and 7 years beyond the end of the contract.

The existing flood defences along the left and right banks of the River Yare comprise continuous floodbanks that in some locations are fronted by steel sheet piling, small lengths of concrete revetment and vegetated rond (a rond is the land between the river and the flood bank). The width of the rond varies along the river length and in some locations the rond has eroded to such an extent that the floodbank is situated close to the river channel. On the outside bends of rivers in meanders, the velocity of the water has caused erosion to the extent that there is no rond remaining. Steel and timber piling has been used to prevent further erosion of the river channel edge and to provide stability to the floodbank. The floodbanks in many areas have a low narrow crest and steep backface which make them vulnerable to overtopping and collapse.

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Project: **MANAGED REALIGNMENT RESEARCH**	Scale: 1:50,000	Halcrow
Figure Title: **LOCATION MAP OF BRANCASTER WEST MARSH**		Figure 6.3

GRAPHIC UNIT/CEFAAI16/LB/13.06.02

Existing Coastal Defences (North Side of Retreat Site)

Existing Counter Wall (West Side of Retreat Site)

Project	Scale	
MANAGED REALIGNMENT RESEARCH	NTS	Halcrow
Figure Title: **BRANCASTER WEST MARSH MANAGED REALIGNMENT SITE**		Figure 6.4

GRAPHIC UNIT/CEFAAI17/LB/13.06.02

Construction of New Counter Wall (East Side of Retreat Site)

New Counter Wall (East Side of Retreat Site)

Project	Scale	
MANAGED REALIGNMENT RESEARCH	NTS	Halcrow
Figure Title		Figure 6.5
BRANCASTER WEST MARSH MANAGED REALIGNMENT SITE		

GRAPHIC UNIT/CEFAAI18/LB/13.06.02

Project	Scale	
MANAGED REALIGNMENT RESEARCH	NTS	Halcrow
Figure Title: **BRANCASTER WEST MARSH MANAGED REALIGNMENT SITE - AERIAL PHOTOGRAPH**		Figure 6.6

GRAPHIC UNIT/CEFAAI19/LB/13.06.02

The flood alleviation solution BESL is proposing comprises a combination of floodbank strengthening, floodbank setback, erosion protection and small lengths of new steel piling. The case study focused on compartment 11 where realignments involving the replacement of sheet piling with setback floodbanks and vegetated ronds are proposed (Figures 6.7 and 6.8). The river-marginal areas involved in the proposed realignments are comparatively small. In the example case study, the floodbank will be realigned approximately 80m inland from the river's edge. The new setback floodbank will be protected initially by a typically 15m wide reed rond, whilst the rest of the setback area will be raised gradually to the required height to sustain good quality reed growth. The scheme is within Broadland SPA and The Broads cSAC and will involve a change of habitat from grazing marsh to reedbed within the setback areas.

In order to minimise impacts of the scheme it is proposed to source material from as close to the works as possible. Material will be taken either from newly dug soke dyke within the folding or from existing soke dyke that will be widened. Material to build up the ground levels on widened ronds (in the case of setback proposals) will be primarily sourced through the use of dredgings.

6.3 Format of workshops

The Thorngumbald and Brancaster workshops were held in informal rooms near the realignment sites, and the participants had the opportunity to visit the sites. The Halvergate workshop was held at the University of East Anglia. Half-day discussions were scheduled, but in common with the regional workshops, the agenda for the discussion was not rigidly predefined. Considerable care was taken to ensure balance in the mix of participants at the workshops, and that all types of interested parties were represented (see lists of participants in Appendix E). In the case of the Halvergate scheme, it was decided not to invite individual landowners but to document the project on the basis of practitioners' experience of its development. A classification of participants in each workshop is given in Table 6.1.

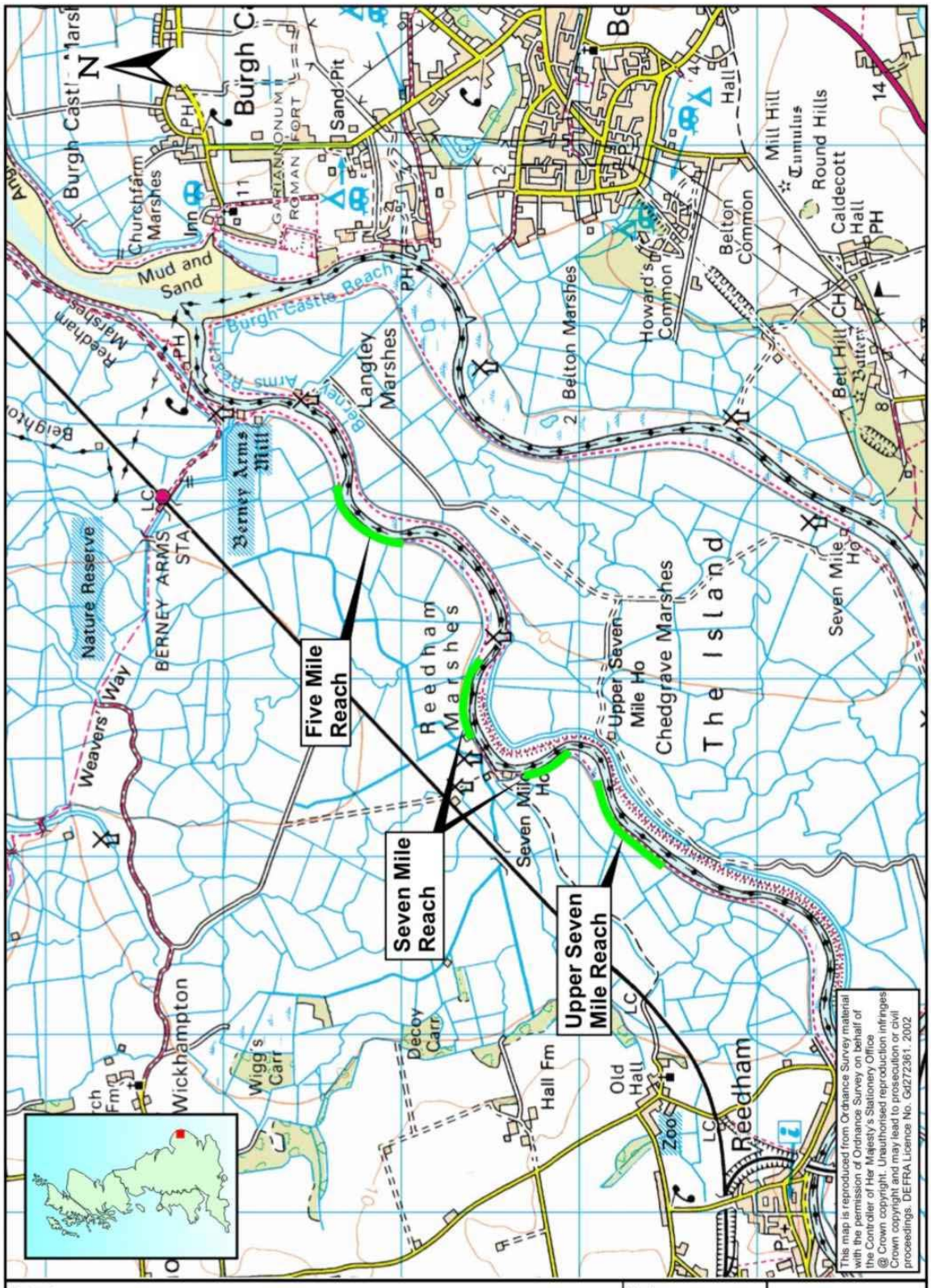
Table 6.1 Participants in each Case Study Workshop

	Thorngumbald	Brancaster	Halvergate
Local decision-makers (local authorities, parish councils and local flood defence committees)	2	4	1
Landowners and representatives	1	3	0
Technical	2	3	4
English Nature	1	5	1
Environment Agency	5	2	2
Conservation Bodies	2	3	2
Community representatives	1	2	1
Project staff	4	4	4
Total participants	18	26	15

6.4 Report on the discussions

In each case, the first question addressed was "***What was the main motivation for the Managed Realignment?"***

At Thorngumbald, flood risk had been identified at the site in the 1990s survey following the Towyn floods. Raising the defences on line was difficult because the location is an SPA, and there were further safety and cost concerns about providing rock armour protection to the defences. A range of options entailing similar or lower costs was considered, and since compensatory habitat was needed for developments and encroachments in the SPA elsewhere in the estuary, a setback option was chosen. The justifications, therefore, were primarily economic and technical, with the significance of environmental drivers being recognised as a result. "*We weren't looking for a realignment site… but I'd say it would be inevitable that this site would be realigned this way now, following the SMP and CHaMP.*" "*Hold the line issues* [were a driver for realignment] – *the approach was difficult, putting rock armour in and using the village road meant there was lots of local opposition.*" Environmental considerations did however come to the foreground at later stages, and the need to provide compensatory habitat for loss of habitats elsewhere in the estuary through maintaining hard defences, development and coastal squeeze led to the choice of the full realignment option.



Project: **MANAGED REALIGNMENT RESEARCH**	Scale: 1:50,000	Halcrow
Figure Title: **LOCATION MAP OF FIVE MILE REACH, HALVERGATE**		Figure 6.7

GRAPHIC UNIT/CEFAAI20/LB/13.06.02

Piling, 7 mile reach

Realignment Area

Project	Scale	
MANAGED REALIGNMENT RESEARCH	NTS	Halcrow
Figure Title		Figure 6.8
HALVERGATE MANAGED REALIGNMENT SITE		

GRAPHIC UNIT/CEFAAI21/LB/13.06.02

At Brancaster, the erosive coast dynamics mean that under a Non Intervention policy, the dune system would be breached, with consequent saline inundation of Brancaster West Marsh, which is a designated freshwater habitat. There was some demand for protection, given the conservation value of the grazing marsh, but opposition to the idea of hard defences (which can be seen not to be effective adjacent to the site). Acceptance that holding the line is unsustainable meant that setback was chosen. The justification here was principally environmental. "*There's an SPA on one side, and SAC on the other. It's an unsustainable system – very obviously, the link between the beach and dune system would be destroyed by a hold-the-line option. The driver actually came from both sides.*"

In the Halvergate scheme, economic sustainability is a major driver. The existing defences are in poor condition, and are close to the end of their useful life. Tidal river stretches are eroding, and sections that are protected by timber and/or steel piles have led to the river channel being scoured at the beds, rather than the natural erosional/depositional processes taking place on meanders. Realignments and naturally vegetated ronds are the sustainable, cost effective way of providing flood protection. "*The issue is the problem of solving a previous problem that the steel piling didn't solve, or exacerbated*". But as the discussion developed, the other benefits were also mentioned: "*In cost terms, setback wins. Also, the consultation issue: key stakeholders are in favour of setback, and habitats benefit too.*"

At all sites, the need to emphasise benefits for the local community was clear, so that people would support the scheme rather than create delays during any public enquiry. At Thorngumbald, the local community was at first opposed to the scheme, as people expected significant disruption by works traffic through the village. As soon as an alternative route was found, however, they soon recognised the potential benefits from the scheme. The community expectation is that the amenity gain of the realignment will boost the local community. *"When we talk about how agriculture used to be, the numbers are more like the people now employed for natural area management. It's a possible economic opportunity, and there's the incidental jobs like the pubs and guest houses." "Paull is a visitor attraction, with its scheduled ancient monuments."* They are also addressing the practical issues of this local regeneration: *"There's an issue of information flow to local people here. What about visitor information?" "The EA could provide information boards – probably at the car park. Paull Parish Council is concerned that they would get defaced pretty quickly."* Partnership solutions are proposed, for example, *"English Heritage had lighthouse information boards – different bodies could chip in together. This kind of group will be more common, and can resolve some of the issues."*

At Brancaster, the benefits were more difficult to sell to the local community. "*The common land is privately owned, but we can take "profit" – products like samphire, fowl, lavender, shingle, fish, whatever – from it. There are blocks from Holme to Burnham Overy. In total there are ten rights. The Common Rights holders formed an association, and took up the management role. Owners have freehold rights subject to common rights. The CR holders never saw the scheme as bad – there are advantages in the scheme…It was not a sea defence issue – no flood property risk. It was to do with finding out what drives the community – what do they want a scheme for?*"

6.4.1 *Were the Habitats Regulations a constraint or a driver?*

At both Thorngumbald and Brancaster, people said the schemes were seen as test cases for the Habitats Directive, and for realignment implementation. In the Thorngumbald scheme, the scheme implementation was more complex because of its location next to an SPA. As an example, creek formations on the foreshore are changes, albeit changes that occur in natural dynamic systems, and "*tight interpretations don't allow change",* so that approval had to be sought on the grounds of overriding public interest. However, the Habitats Directive can also be seen as a driver, as part of the high cost of the reinforcing the existing defence was due to the constraints of the SPA ("*There's already rock armour on the other side of Paull, but the SPA location limits our options. Placing the rock armour from the top or side of the bank is not efficient, or safe, so it really adds to the costs"*). Participants said that Habitats Directive issues were not constraints, just *"problems to overcome, not reasons to stop". "Going through the whole process was necessary, to cover all the bases.*" People were concerned about the consequent delays though. "*The time it's taken: 6 years from identifying the need to do something about the bank to getting to the site… That time isn't just down to the Habitats Directive. It's not possible to tease out the bits. Other schemes are taking similar times.*" Some participants considered that land banks would help to reduce the delays due to Habitats Regulations. *"It's the order of something – decide the option, then buy the land. If the EA had a bank of land for habitats, it would facilitate schemes*".

At Brancaster, this issue was not addressed head on. There will be a shift from freshwater grazing marsh to salt marsh. It is clearly a significant effect, and it was assessed with regard to site integrity. Because the salt marsh area is small (7 ha out of a 40 ha grazing marsh), the scheme was accepted as not adversely affecting the integrity of the site. The loss of conservation value was not significant enough for compensatory habitat to be needed.

In the Halvergate case, there was broad consensus for the setback, in principle, but "*the Habitats Regulations artificially fix the features of Compartment 11.*" It was seen as a

constraint by the participants involved in the partnership. However, one of the representatives from a nature conservation body said that it shouldn't be seen as a constraint – the Directive "*lets us move things to compensate for external forces*". The crux is that the new ronds will not be new habitats. The grazing marshes, which will be reduced in area as a result of defence setback, support qualifying species (wintering wildfowl), but the proposed new reedbeds are not a qualifying feature for the site. Nonetheless, there appears to be a consensus within the environmental organisations (English Nature and RSPB) that setback is the best approach, though at the same time there is resistance to agreeing that the proposed works are "directly connected with or necessary for the management of the site". The route through the Habitats Regulations has yet to be determined, but some concern was expressed that opportunities are being missed. "*There's a feeling that there was going to be more gain than there actually will be… there was the possibility that washlands habitats might be created, but that hasn't been the case.*" This follows from the focus on flood defence issues, and the fact *that "to get through DEFRA, the CBA must be beneficial. There's little room for manoeuvre.*" This may develop in the next few years of the Partnership, since "*the issue of compensatory habitats off-site…is still to be discussed with DEFRA*".

6.4.2 *Technical Constraints*

At both Brancaster and Thorngumbald, technical aspects were discussed in detail, but the learning experience associated with technical hurdles was generally seen as valuable: *"strategic R&D".* At Thorngumbald, "*some original assessments went up blind alleys… proposals were non-starters*", and failed at the first statutory consultation stages. Supporting investigations are needed for the borrow pits, the fauna on the sites, the modelling of the channels, and so on. These are costly, time-consuming, and sometimes are not directed appropriately to the issues involved. There is also an issue of consultants being used rather than in-house experts who can build up knowledge in Managed Realignment.

At Brancaster, the need for material to create a set-back line of defence is being met partly by the construction of a borrow pit (to become a new freshwater lagoon/reedbed) and partly by demolition of the existing flood defence bank. This avoids the need to import material to site in lorries. The Royal West Norfolk Golf Club has been given consent to construct its own defence along a retreated alignment in order to protect its practice ground, and has benefited from using the same contractor as the Environment Agency is using for constructing the main realigned bank.

6.4.3 *Consultation and Public Participation*

Also discussed were issues of communication and public participation in the process. It was found that local communities were very well informed, very interested in the wider implications of the scheme, and generally speaking, effectively engaged in the process. At both Thorngumbald and Halvergate there are heritage interests, and the discussions with the various organisations concerned were time-consuming and not always straightforward. This engagement has added to the time of implementation in all cases, and at Brancaster in particular, there was concern that the consultation process should match the scale of the scheme. Experiences at both Thorngumbald and Brancaster were described very positively. Thorngumbald has a steering group monitoring and providing advice during the process. Thorngumbald's experience reinforces the conclusion that despite the time and complexity, the consultation procedure needs to be done thoroughly and must not be rushed: *"it is an important process where lots of people are involved, and it needs the time element."* At Brancaster, it was also said that the way forward was having a multi-agency team. Their experience was that discourse leading to "*conflict resolution is slow, but functional. It can't be done remotely.*" Brancaster's local self-appointed Sea Defence Consultative Committee was a forum where different groups "*could have their own rows*" separate from the formal decision-making process, so local consultees could present a more concise and united view. At Halvergate, however, there was some dissatisfaction with the early stages of consultation*: "Public consultation has separate issues from statutory consultees*". "*How do you rank all these comments? Some organisations are way out at Lowestoft. How important can their views be*?" Participants also recognised that there could be an excess of consultation "*You need to take care in this involvement – time overload can be a problem with extensive consultation. There is a huge time demand on individuals.*"

Public participation and stakeholder engagement are seen as being major issues and are being addressed in a systematic manner, so there can be assumed to be some isomorphic learning from experiences elsewhere. A paper by Myatt *et al* (in press) examined public perceptions of Managed Realignment at Brancaster West Marsh and identified the need to improve public understanding on flood defence benefits, sustainability and the environment as key recommendations for future schemes.

6.4.4 *Land Use and Financial compensation Issues*

At Halvergate, the land use changes have not been fully explored nor approved. However, the contractual arrangements with BESL mean that, to some extent, some constraints on compensation payments are circumvented: *"The motivation for our PFI [Private Finance Initiative] scheme is risk transfer, and that allows us… to disperse*

funds differently [from DEFRA's score approach]." In the other two cases, the land loss and related financial compensation were not particularly problematic, either with respect to the landowners, nor with the wider social implications for the local communities. At Thorngumbald, land purchase was a significant issue and time-consuming to resolve, but probably did not have a significant effect on the overall scheme programme.

At Thorngumbald, the view was expressed that the land purchase should not be seen as a precedent (interestingly, in the other workshops where Thorngumbald was mentioned, this point was also made), because the landowners involved may be seen as untypical in their willingness to reach a commercial settlement. "*The more emotive scenario wasn't here.*" With regard to the compensation, *"Flexibility is needed. Market price offers only are inadequate unless it's just a small strip of land. Here, where there was a considerable chunk of land, you need to think creatively." "Buying land [elsewhere, for the landowners] was considered. One wanted to buy farm land, so land banks might have helped, but in the end, it didn't work out, and the problem was overcome with cash instead."* Members of Paull Parish Council emphasised the fact that, as lower grade agricultural land, the area that will become salt marsh was not considered as an overly significant social or economic loss: "*It wasn't really important to local people. It was agricultural land, maintained by big machines. There's not really any job loss – this farming round here is low cost high output."*

At Brancaster, the landowner had been interested in changing freshwater marsh to salt marsh for some time: "*In 1995, English Nature proposed a salt marsh habitat scheme. We completed an application for the old scheme, and about then everything was phased out."* The alternative agri-environment schemes were problematic -*"halving the payments didn't help anyone's persuasive powers."* Adding to the debate on the land use change at Brancaster, the "*Owners have freehold rights subject to common rights"* to benefit from natural products of the area. There were concerns about changes to Commoners' Rights, which have played quite an important part in Brancaster's community life. Again, "creative" approaches to the constraints on financial compensation have been proposed. *"There was local concern for [the landowner], but there's a wider perception that it is all arbitrary. Look at the Lincshore project to protect Butlins! Or £1.4 m to protect Holkham caravan sites. Then "why me" becomes an obvious question. Heacham to Snettisham should all be set back but there are private interests being protected. There's a perception that easy targets are being picked off."* One participant said "*with regard to compensation, life just isn't fair. …something could be done, like payments in kind? With the EA, that helped to reduce costs…*"

6.4.5 *Recreation and Navigation*

At Brancaster, the land adjacent to the realignment site belongs to the Royal West Norfolk Golf Club, which has long been an important stakeholder in local coastal management. "*It is important that the Golf Club isn't just pleasure – it is economically important here – the biggest employer and income generator between Hunstanton and Burnham Market. It has a huge local role."* The Golf Club had previously proposed hard defences, but these faced strong local opposition. The club is now constructing its own defences for their practice ground. *"The EA did abandon us! The driver for [our solid defence] was survivability. We pay for half of that. A legal contest is not possible. It is a moral issue… RWN have put money in since 1990 – MAFF grants protected us before (the rock armour). Neither the government nor RNA pays now. The outcome for us is satisfactory, but costly."* The Common Rights holders also use the coastline, but they were somewhat more in favour of the realignment. *"The Common Rights holders formed an association, and took up the management role… The Common Rights holders never saw the scheme as bad – there are advantages in the scheme. The Cornwallis agreement says land would revert to common land if it reverts to salt marsh. It was more to do with maintaining the local community rights – the vanguard of local usage of the land… It links in to local sustainability." "The local detail comes from local experience – like the bridge (two sleepers) and the demand for sloes for local gin-makers. The land and the people merge – it isn't just a question of local opinion – it's local life, local experience."*

In the Halvergate case discussion, recreational use of the Broads was recognised as a key issue, but it was not specifically discussed, except with regard to navigation. This emphasis is largely to do with the participants: the Broads Authority is a navigation authority, and the only key local stakeholder present had business interests in boating and navigation. The concerns expressed about the navigability of the channel are closely linked to issues like: navigability of the channel *"I'm concerned about the soft bank – the picture shows a sloping bank. For navigation, will there be marker posts?*", "*The Broads Authority is a navigation authority. The concern is that risks to navigation will rise*"; the technical modelling of the system; and the lifetime of the project, both in regard to the PPP contract, and the natural dynamics of the river *("There are navigation issues – you lose on defined bank with Managed Realignment. If the opposing bank is set back, then there's a serious effect", "You are just buying time. The meander would naturally go way back.*"). These are all uncertainties at present, since the scheme has not yet gone through the planning stages, but they are recognised. Parallels with the other two cases exist, in that broad-based consultation is planned. The proposed mechanism in the Broads is the creation of Citizens' Forums, to play a part in deciding how the ongoing dialogue can be provided, and link with the many levels of planning in the Broads.

6.5 *Conclusions*

The case studies re-emphasised some of the themes identified from the Regional Workshops, giving clear examples of the problems encountered with implementing Managed Realignment. Although some of the factors were judged to be site specific (e.g. pipeline constraints at Thorngumbald, the Private Public Partnership at Halvergate), there were some general lessons to be learnt for future schemes:

- The importance of getting the **community** involved and supporting the scheme at an early stage was underlined throughout the case studies, as it can help avoid major delays, for example resulting from holding a Public Inquiry. The difficulty is in finding how best to "sell" the scheme to local communities, as this will vary from one scheme to another. At Thorngumbald, social and recreational benefits were perceived as important, while at Brancaster, the local community was concerned about preserving valuable habitats. The issue of retaining public access was a theme in several schemes. In all cases, consultation and communication through all the stages of the scheme were seen as vital. In the first two case studies, steering groups, or user fora were set up to provide inputs during the first phase of the scheme, but also with a role in the monitoring phase. A similar approach is planned for Halvergate. This type of structure should be recommended for future Managed Realignment schemes.

- The **Habitats Directive** is likely to cause significant delays. It is likely that the case studies have in effect acted as test cases, with the consequence of particularly **long delays**, and that the process is likely to accelerate as more schemes are implemented. However, it is worth keeping in mind that experience suggests that Managed Realignment schemes will almost always take longer than classical schemes, which can be an important issue in the context of urgent flood works.

- **Technical issues** about how best to help natural succession of habitats, model channels and the development of creeks, as well as obstacles such as the presence of heritage resources and how best to protect them, can be costly and time-consuming. Some practitioners may argue that the resources involved in addressing such issues have proved disproportionate compared to the benefits. In some case studies, some costs and delays could have been avoided by better **in-house expertise** within implementing organisations.

- **Land owner compensation** appears to have been a key factor in the success of the Thorngumbald and Brancaster schemes in reaching implementation. In both cases, the retreat area is being purchased by agreement with the landowners. DEFRA funding has been made available in both cases as the created salt marsh will form an integral part of the new flood defence. In addition, at Thorngumbald, the creation of a large inter-tidal area, which could potentially provide compensatory habitat for losses elsewhere in the estuary, and the contribution of the scheme to objectives identified in the Shoreline Management Plan contributed to DEFRA agreeing to fund the scheme, including land purchase expenses. The situation with compensation at Halvergate has yet to be finalised, but it was interesting that the operating authorities stated that there is more flexibility to disburse funds for this scheme as the public-private partnership is not bound by DEFRA rules on eligibility for funding.

- At each site, some **innovative and creative approaches** were taken to deal with site-specific issues. Some of these experiences, such as conservation gains from borrow pits used as material source areas or the use of material from the old defence line to build a private counterwall to protect the Golf Course in Brancaster, may be applicable to other schemes.

Some lessons in terms of how river sites differ from coastal sites also emerged, both from the regional workshops and the case studies. Many of the issues are very similar, both in terms of main drivers (sustainable flood defence, reduced defence costs and the need for a strategic approach), and regarding constraints such as financial compensation, delays due to the Habitats Directive, and the complexity of the planning process. The following differences emerged:

- There is pressure on the coast due to sea level rise, which makes holding the line a more costly option. However, the issue of climate change also affects rivers, with predicted increased precipitation and flood risks. Managed realignment can increase flood storage capacity in river catchments.

- The consequences of climate change in rivers, where flooding is likely to be more seasonal than on the coast, in some circumstances could allow financial compensation for occasional flooding, rather than acquiring the land or permanent land-use change. This is likely to simplify financial compensation issues, and facilitate the use of instruments such as agri-environmental schemes, since land use change is not irreversible.

- Rivers are part of catchments, so the role of catchment management is highly relevant. From the perspective of strategic planning, the situation is analogous to the role of Shoreline Management Plans in the coastal context. However, as Catchment Flood Management Plans have not yet been made public, it is difficult to discuss a strategic approach to river realignment at this stage.

7 Role of Shoreline Management Plans

7.1 Background

Shoreline Management Plans (SMPs) were conceived as a strategic approach to coastal defence that would determine policies principally driven by coastal processes, as well as taking into account technical, economic and environmental objectives and constraints.

Stage 1 of the research project (Section 2) identified all the management units for which SMPs identified managed retreat (including Managed Realignment) as the preferred policy option, and also examined the progress made towards implementation. In Stage 2, a review was undertaken of the way in which SMPs identified sites for Managed Realignment, focusing particularly on the extent to which natural processes and/or the capacity of Managed Realignment schemes to act as 'natural' sea-defences was taken into account.

A large part of this research project is concerned in the identification of drivers and constraints to Managed Realignment of a cultural, political, technical, economic or political nature. Frequently, however, the natural function of an area identified for Managed Realignment constitutes a key cornerstone of the social, political, or economic case that is made. If this is the case, natural process knowledge can both 'drive' and 'constrain' justifications of Managed Realignment in that it may allow planners to focus on a particular function of the natural or the proposed re-created environment. One such function, for example, is the potential sea defence value of salt marshes that are re-created through Managed Realignment schemes. It is these natural functions of Managed Realignment (sea defence, habitat creation, water quality improvement, etc.) that are often invoked as providing the rationale for the implementation of Managed Realignment schemes in particular situations.

As these natural functions provide such a key part of the political and economic assessments of Managed Realignment, it is necessary to focus in some detail on the degree to which individual SMPs have taken knowledge of the regional and local natural processes into account when recommending individual sites for Managed Realignment.

There is thus a number of possible ways in which (and degrees to which) natural process knowledge could link into the economic, social and political 'drivers' behind Managed Realignment:

- **Natural process knowledge 'drives' political, social, or economic justification of Managed Realignment**: i.e. Managed Realignment is recommended for a particular site *because* the currently available knowledge of natural processes at that site suggests that the economic and/or social or political value of the site will be improved by Managed Realignment (e.g. through an increased sea-defence capacity or conservation value);

- **Natural process knowledge 'constrains' political, social, or economic justification of Managed Realignment:** i.e. Managed Realignment is discussed as an option but its implementation is delayed or negatively influenced by currently available knowledge suggesting that the natural processes resulting from Managed Realignment would act to the political, social or economic detriment of the scheme;

- **Natural process knowledge is not taken into account at all:** Managed Realignment is recommended for a particular site *in spite of* the fact that no knowledge is currently available on the potential benefit of the natural processes that would operate on the site after Managed Realignment (in this case, natural processes are neither a 'driver' nor a 'constraint').

In addition to these relationships between natural process knowledge and political, social, or economic reasons for or against Managed Realignment, natural process knowledge (or the lack of it) can also influence the time-scale over which Managed Realignment is recommended to be a feasible management option. With more information on the long-term behaviour of a coastal area, more confident predictions of its future behaviour can be made and decisions to implement Managed Realignment can be made with a greater degree of confidence.

The aim of this investigation was thus to:

(a) Establish the degree to which knowledge of natural processes exists within individual SMPs;
(b) Establish the degree and type of links (such as those identified above) that have played a role in the recommendation of areas for Managed Realignment as identified in the current SMPs; and

(c) Extract any additional information from the SMPs that may indicate to what extent the availability (or lack of availability) of natural process knowledge influenced the design, time-scale, and priority of Managed Realignment as a recommended management strategy.

In addition to the information extracted from the SMPs, the assessment draws on the team's experience of monitoring long-term changes in coastal geomorphology and the sea-defence value of salt marshes.

7.2 Methodology

The review focused on 19 representative Managed Realignment schemes identified during Stage 1 (Table 7.1). The schemes were selected to represent a variety of geographical settings (open coast, estuarine, etc.) and to cover as many SMPs as possible, as much of the natural process knowledge contained within SMPs is of a regional nature. It was considered important to compare the type and quality of natural process information with respect to Managed Realignment schemes across different SMPs.

The fact that SMPs have been produced in a wide range of formats with different degrees of emphasis, presentation styles, order of information, and/or methods for arriving at Managed Realignment recommendations provided a significant challenge. The selected methodology was adopted to ensure:

- a more easy intercomparison between individual Managed Realignment scheme recommendations and between different SMPs; and

- an assessment that is as objective as possible, while allowing for expert judgement.

Table 7.1 List of Managed Realignment schemes reviewed

Site Reference (Figures 2.1 & 2.2)	Management unit description
2a	Spurn Peninsula, Humber Estuary
3c	Thornham to Hunstanton Golf Course, North Norfolk
3g	Kelling Quay to Cley Coastguards, North Norfolk
3p	Walberswick to Dunwich Village, Lowestoft to Thorpeness
5a	Inn on the Beach to Langstone Harbour, East Solent
5d	Fawley Oil Refinery to Hythe Sailing Club, West Solent
5f	Satchell Marshes to Badnam Creek, West Solent & Southampton Water
5j	Lytchett Bay, Poole and Christchurch Bays
5k	Hyde's Quay to Holton Point, Poole and Christchurch Bays
5I	S. Haven Point to Hyde's Quay, Poole and Christchurch Bays
7f	West of Appledore, Bridgwater Bay to Bideford Bay
7g	Home Farm Marsh – River Torridge East, River Taw South, Bridgwater Bay
3t	Little Oakley to Dover Court, Essex
3u	Hamford Water, Essex
3w+3x	The Colne, Essex
3y	The Blackwater, Essex
3z+3aa	The Dengie Peninsula, Essex
3ab	The Roach and the Crouch, Essex
3ac+3ad	Havengore to Foulness, Maplin Sands, Essex

7.2.1 *Individual SMP and Managed Realignment Scheme Scoring*

A record sheet was used to summarise the review of individual SMPs and Managed Realignment schemes. An example of such a scoring sheet is included in Figure

7.1. The assessment of natural process information on this sheet was divided into two sections:

(a) identification and assessment of the degree of information on natural processes in the whole SMP (i.e. region-wide); and
(b) a section to identify and assess the degree of information on natural processes *at* the given Managed Realignment scheme location (i.e. site-specific).

The information contained in the SMPs was assessed and a summary of the assessment recorded according to the set of criteria in Table 7.2 (each of which was given a score on a scale of 1 to 10).

Individual schemes were scored independently by two senior research members of the CCRU relative to what would have constituted the 'ideal' degree of natural process knowledge needed to predict Managed Realignment site (and adjacent area) evolution over the time-scale for which the Managed Realignment option was considered. Assessor 1 was Dr Iris Möller and assessor 2 was Dr Frank Thomalla. The independent scoring of schemes by two geomorphologists makes it possible to assess whether the information contained within the SMPs is open to more than one interpretation and, if so, how different those interpretations might be and why they might occur.

Table 7.2 Criteria used for scoring individual SMPs and Managed Realignment schemes

What level of general process information/knowledge is contained within the SMP? (1 = none/little; 10 = complete)	
	long-term (>10 years)
	Short to medium term (<10 years)
What level of site specific process knowledge is mentioned in the SMP? (1 = none/little, 10 = complete)	
	Long term (>10 years)
	Short to medium term (<10 years)
To what extent does the SMP recommend further studies should be carried out? (1 = not at all, 10 = full set of recommendations)	
What is the degree of process uncertainty with respect to the Managed Realignment scheme? (1=little uncertainty, 10 = very uncertain)	
What is the weight that is given to physical processes in the evaluation of the Managed Realignment option? (1 = low, 10 = high)	
How high is the motivation for including natural processes with respect to each of these justifications? (1 = low, 10 = high)	
	Habitat restoration
	Cost (sea defence)
	Accommodation space
	Environmental sustainability
Over what time-scale is Managed Realignment thought to be a viable and 'sustainable' option (1 = short term(<5 years), 5 = medium term (5-10 years), 10 = long term (>10 years))	

7.2.2 *Graphical representation and intercomparison of schemes*

Following the review, assessment, summary and scoring of each of the schemes (Figure 7.2), the two sets of scores were represented graphically in circular diagrams (Figure 7.3). This allows both sets of scores to be compared (to assess

the degree of agreement between the individual assessors) and allows a classification of Managed Realignment schemes according to scores and criteria. The diagrammatic representation of scoring results also enables trends and associations between individual scoring criteria to be identified (e.g. the possible link between a high degree of natural process knowledge and the justification of a scheme on the basis of its potential sea-defence value).

7.3 Results

7.3.1 Scoring of Managed Realignment schemes

The results of the scoring of individual sites are summarised in Figure 7.2, which allows a comparison of overall average scores given by the two assessors with regards to each of the criteria in Table 7.2. This Figure illustrates a good overall agreement on the degree to which information on natural processes is available through the SMPs (Figure 7.2a) and the degree to which this information feeds into the justification of the Managed Realignment schemes (Figure 7.2b). Overall, the SMPs were considered to contain relatively little process knowledge (none of the average scores are higher than 7.5), although the level of general process knowledge (average score of > 5) was higher than the amount of site specific process knowledge (average score of < 4). Both assessors regarded the degree of process uncertainty contained in the SMPs as high (average scores of > 6). With regard to the specific role that physical processes played in the justification of Managed Realignment schemes, both assessors scored their overall importance as medium (scores of 4-5). The reference to physical processes was high (scores > 6), however, when the main driver behind the Managed Realignment scheme was of an economic (i.e. cost) nature. Other 'drivers' behind Managed Realignment that were backed up by natural process knowledge related to habitat creation, increased 'accommodation space' within estuaries and increased environmental sustainability. Coastal process knowledge, however, was deemed by both assessors to have been of relatively minor importance to those justifications of Managed Realignment. On average, Managed Realignment schemes as discussed in the SMPs were designed for the short to medium term (i.e. 5 to 10 years), as indicated by the average scores of between 6 and 8 (Figure 7.2b).

With respect to individual criteria, the agreement between the scores of the two assessors was particularly high for the following aspects:

(a) available site specific knowledge (long-term)
(b) available site specific knowledge (short-term)
(c) extent of recommended studies mentioned in the SMPs

(d) degree of process uncertainty that exists in the SMPs
(e) management time-scale of the Managed Realignment scheme

Further detail on the individual scores given to each of the criteria by the two assessors is given in Figure 7.3. Each row of plots in this figure represents one Managed Realignment site. Plots in the left-hand column of this figure show the scoring with respect to the physical process knowledge listed in the relevant SMP, while those in the right-hand column present the scoring given to those drivers/constraints to Managed Realignment that are listed in the SMP as directly linked to physical process knowledge (or lack of it). This figure confirms that the agreement between the scores of the two assessors is good with respect to their assessment of natural process knowledge present within the SMPs (left-hand column in Figure 7.3). There is less agreement between the two assessors with respect to the ways in which physical processes are used in the SMP as a driver/constraint of Managed Realignment for a range of socio-economic aspects (right-hand column in Figure 7.3).

Figure 7.3 also illustrates that it is both very difficult to derive general patterns or associations between sets of criteria from the analysis of these 19 Managed Realignment sites.

With respect to natural process knowledge being available, it is worth noting, however, that:

- With respect to the availability of site specific process knowledge, 15 out of the 19 Managed Realignment sites (i.e. 79%) considered scored less than or equal to 5;

- These 15 sites generally also scored less well on the amount of general (long-term) process knowledge available;

- Those Managed Realignment sites that scored *highly* (i.e. ≥ 6) with regard to site specific process knowledge being available were located in the Western Solent / Southampton Water, Poole and Christchurch Bays and Bridgwater Bay to Bideford Bay areas;

- Process uncertainty was regarded to be an important factor (scoring > 6) in 12 out of the 19 Managed Realignment schemes;

- Half of the reviewed Managed Realignment schemes (10) scored very poorly (≤ 4) with respect to natural process studies (their number, quality and relevance) recommended as part of the Managed Realignment schemes.

With respect to the implications of natural process knowledge (or lack thereof) as driver/constraint, the following general points emerge:

- Only in 4 out of the 19 (i.e. 21%) Managed Realignment schemes, did both assessors agree that physical processes were an important consideration in the discussion of the scheme (both scores ≥ 5);

- In those SMPs that made explicit reference to physical processes with respect to Managed Realignment sites, these processes were more often viewed as a 'driver' than a 'constraint' to Managed Realignment (although in some cases, no statement could be made from the information contained in the SMP);

- The time-scale of consideration for Managed Realignment as a coastal management option was more often (in 15 out of the 19 schemes) given as medium to long-term (5-10 years) than short term (< 5 years);

- The contribution of re-created or restored inter-tidal areas to the lowering of defence costs is seen as important (scores of 5 or above by both assessors) in 13 out of the 19 schemes, although no quantitative information or economic assessment was listed in any of the reviewed cases (and no information was given as to the relative savings due to reduced maintenance commitments on the one hand and lower defence heights behind a more extensive inter-tidal zone on the other hand);

- Natural process knowledge is, at present, not being used to a large extent for the assessment of the 'environmental sustainability' or 'habitat restoration value' of particular Managed Realignment schemes (low scores or no agreement between assessors); and

- Natural process knowledge is often used to justify the necessity for Managed Realignment schemes in providing 'accommodation space' within estuarine settings (8 times out of 19 scores were ≥5).

There are only a limited number of clear associations between the individual criteria used for scoring the degree to which natural processes featured in the selection and assessment of Managed Realignment schemes in the SMPs. A correlation analysis of all scores (i.e. using the scores by both assessors) shows that a significant correlation (values of 0.7 or higher with confidence levels of 0.05) exists only for two pairs of parameters. Not surprisingly, the levels of long-term and short-term general process knowledge are well correlated ($r = 0.70$), as are those of long-term and short-term site specific knowledge ($r = 0.72$).

Some further associations, however, appear when the scores are analysed for each of the two assessors separately:

(a) Assessor 1

According to this assessor's scores:

- SMPs tend to link the case for provision of more 'accommodation space' to that of 'environmental sustainability' when justifying Managed Realignment designations (correlation coefficient, $r = 0.61$);
- a positive link exists between process uncertainty and the time-scale over which Managed Realignment is proposed to be implemented ($r = 0.62$);
- 'habitat restoration' as a justification for Managed Realignment tends to coincide with a relatively low degree of general process knowledge, although this association is weak ($r = -0.59$); and
- 'defence cost savings' tend to be listed as a justification of Managed Realignment schemes when few short term specific site studies are available.

(b) Assessor 2

None of the above associations were picked out as clearly by this assessor, whose scores, however, identified that the case for provision of more 'accommodation space' through Managed Realignment schemes tends to be made *instead of* (rather than in addition to) a case for lowered defence costs ($r = -0.64$)

7.3.2 *General observations on role of natural process knowledge in Managed Realignment designation/implementation*

In addition to the above results derived from the individual and specific scoring of the information listed in the relevant SMPs for the 19 Managed Realignment schemes, several other general observations were made during the review process. These observations were made by both assessors and relate specifically to the role of natural process knowledge in influencing decisions for or against Managed Realignment as a strategic flood and coastal defence option.

(a) It is recognised that it would be the role of the strategy plan and scheme design to collect relevant information and make appropriate assessments of a site once Managed Realignment had been identified within the SMP policy. However, this study showed that there was a significant lack of natural process information, on which the initial SMP recommendation could have been based (none of the reviewed Managed Realignment scheme locations had been sufficiently individually monitored before the Managed Realignment option was considered). This led to a lack of information that could be used to assess the potential sustainability of the scheme with respect to its effect on natural processes. The result was:

(i) a lack of confidence in the expected continued fulfilment of the scheme's flood and coastal defence objectives; and/or

(ii) an emphasis on 'drivers'/ 'constraints' that were of a political, economic, or social nature rather than directly related to natural processes.

(b) Few SMPs referred to lessons learnt from Managed Realignment experience elsewhere as a justification for (or case against) the implementation of the specific scheme. Although it was not the role of the SMPs to consider overseas experience, it is probably true to say that there is a lack of awareness of research and experience of Managed Realignment elsewhere which could contribute to the decision-making process.

(c) The natural process information that is available in the SMPs was regarded by both assessors as being of generally very variable quality and often poorly integrated or improperly referenced as to its source, method of collection, or time-scale over which it applies. In some cases, studies that were conducted in the 1960s or 1970s are used as a basis for a description of present day processes and field measurements carried out

over short time scales (of several days) are often extrapolated to make inferences about the long-term behaviour of a coastal feature. Much of the natural process information is the result of hydrodynamic or morphological models with very little to no field data validation or calibration in the relevant SMP area. This meant that, while some SMPs contained a reasonable *quantity* of natural process information, it was often not suitable as scientific support to the various socio-economic assessments for Managed Realignment scheme implementation.

(d) Related to (c) above, it was also noted by the assessors that much of the natural process knowledge relates to the areas of the coast or estuary below mean water level (e.g. bathymetric and most hydrodynamic data sets). In estuarine environments, in particular, very little information is available on the inter-tidal zone – although it is this area that is of the highest relevance to Managed Realignment schemes.

(e) It was felt by both assessors that, in addition to the lack of specific site information, the lack of strategic long-term natural process information appeared to be a main reason for the uncertainty in the Managed Realignment implementation / design decision-making process.

7.4 Conclusions

This review of 19 Managed Realignment schemes has pointed to some key issues related to the degree to which natural process knowledge is (a) available and (b) used to inform the decision to choose Managed Realignment as a flood and coastal defence option.

Table 7.3 provides a summary of the extent to which reference to natural processes was used in the SMP of each Managed Realignment site as a 'driving' or 'constraining' factor. It should be noted that such a reference to natural processes did not necessarily mean that this was based on what the assessors judge to be good quality scientific information. In many cases, natural processes were invoked as a 'driving' or 'constraining' factor on a rather speculative basis. This was the case, for example, at site 5k (Hyde's Quay to Holton Point), where the point was made that Managed Realignment would provide increased flood protection (due to reduced wave energies) 'along strategic points of the unit', without specific hydrodynamic process knowledge being available to confirm this prediction.

It is clear from Table 7.3 that natural processes were considered to be an overall 'driver' behind Managed Realignment in half of the sites reviewed, while the emphasis on natural processes as either a 'driver' or 'constraint' was less clear in the other half of the reviewed sites. Furthermore, the fact that the reasons for seeing natural processes as 'drivers' are often speculative (e.g. the view that newly created inter-tidal areas will act as wave energy dissipaters over all time scales and during all inundation events). These results thus suggest that, while some natural process knowledge is generally available, it is often not available in a suitable format or does not provide the information needed to come to a clear conclusion with regard to the potential impact of Managed Realignment. Combined with the general need to make Managed Realignment a more politically acceptable management option, it is 'easier' to make the case for natural processes as a 'driver' (as this may achieve a higher degree of political acceptance of Managed Realignment) than as a 'constraint' (which would counteract the need to create a higher political acceptability of Managed Realignment).

The degree to which knowledge of natural processes exists varies widely between SMPs but the natural process information is generally in a poorly collated form and discontinuous through time and space. There appears to be no clear relationship between the relative amount of natural process knowledge available and decisions to opt for Managed Realignment as a flood and coastal defence option. While some SMPs do contain a large amount of process information, it is often not obvious that this information has been used or transferred through to those sections of the SMP that list the justifications for particular policy options. The emphasis of the SMPs lies on the provision of an 'inventory' of past or present natural process knowledge without illustrating the relevance of this information for the various policy options. Given that much of the available natural process data cover a wide range of different spatial areas and time frames (making integration difficult), this is perhaps not surprising. Another DEFRA-funded project led by Halcrow, Futurecoast, has looked at a better understanding of long-term geomorphological tendencies and their relationship to existing management practices. This will help address some of these issues, but the central problem remains a lack of long-term data on forcing conditions such as waves and foreshore levels.

What has also become apparent through this review is that Managed Realignment is perceived as a long-term solution to flood and coastal defence problems rather than a short-term one. The reason for this may be that Managed Realignment continues to be a politically less acceptable coastal management option and it is

thus easier for operating authorities to postpone the implementation and/or argue that the benefits will become apparent only over time-scales beyond their term of office. In view of these considerations, the lack of long-term general and site-specific process information appears to constitute a real and significant problem. The SMP sections that discuss potential Managed Realignment schemes identify a high degree of uncertainty with regard to natural coastal processes and the ways in which they may influence the longer term sustainability of this flood and coastal defence option.

The results of this review have also highlighted a series of possible connections between this lack of natural process knowledge and reasons for implementing Managed Realignment schemes. It is interesting that a lack of long-term process knowledge tends to coincide with habitat restoration being an important driver for Managed Realignment schemes, while a lack of short-term process knowledge tends to coincide with lowered sea-defence costs being the main driver. Although this association may be coincidental, it suggests the possibility that the lack of particular information might enable planners to put forward a particular rationale for Managed Realignment that fulfils a political or economic need but may not be justified from a natural processes point of view. In the absence of long-term natural process information, for example, it may be easier to suggest that Managed Realignment provides a long-term habitat restoration option.

The above discussion illustrates that natural processes cannot be divorced from considerations of political, social, economic or technical nature. Table 7.4 suggests some relationship between natural processes and other influences on Managed Realignment policy decisions.

Lastly, this review confirms the overall importance that is given to Managed Realignment as a way of increasing wave energy dissipation in the inter-tidal zone and thus lowering flood and coastal defence costs. This may be regarded as questionable in the absence of information on the hydrodynamics, ecology, and geomorphology of these areas. This absence of information leads to a lack of quantitative economic assessments on the actual defence cost reduction achieved by Managed Realignment.

Table 7.3
Summary of the extent to which each Managed Realignment site used natural process information

Site Reference	Management Unit Name	Natural Processes as 'Driver' of justification	Natural Processes as 'constraining' justification	Overall, are natural processes a: • Driver; • Constraint; • Not taken into account; or • Not clear from information given
2a	Spurn Peninsula, Humber Estuary	✓Increased accommodation space	✗	Not clear from information given
3c	Thornham to Hunstanton Golf Course, North Norfolk	✓New defences would have adverse impact	✗	Driver
3g	Kelling Quay to Cley Coastguards, North Norfolk	✓Increased accommodation space, current processes make other alternatives unsustainable	✓Potential negative impacts on evolution of adjacent coast (Blakeney Spit)	Driver (main driver: economic?)
3p	Walberswick to Dunwich Village, Lowestoft to Thorpeness	✓Limited gain of valuable habitat	✓Potential loss of protected & valuable habitat	Not clear from information given
5a	Inn on the Beach to Langstone Harbour, East Solent	✓Strong case made: creates 'self-sustaining' geomorphology / hydrodynamics	✗	Driver
5d	Fawley Oil Refinery to Hythe Sailing Club, West Solent	✓Coastal squeeze processes mentioned	✗	Driver
5f	Satchell Marshes to Badnam Creek, West Solent & Southampton Water	✓Speculative: would cause wave attenuation (lower defence costs)	✗	Driver

5j	Lytchett Bay, Poole and Christchurch Bays	✓Coastal squeeze observed. Speculative: would reduce hydrodynamic impact of sea-level rise, provide accommodation Space	✓Potential long-term impact on tidal prism & negative impacts of exchange flows through viaduct bridge?	Not clear from information given
5k	Hyde's Quay to Holton Point, Poole and Christchurch Bays	✓Coastal squeeze observed. Speculative: provide accommodation space, would cause wave attenuation (lower defence costs)	✓Potential damage to fresh-water or terrestrial habitats in some places	Driver
5I	S. Haven Point to Hyde's Quay, Poole and Christchurch Bays	✓ Speculative: provide accommodation space		Not clear from information given
7f	West of Appledore, Bridgwater Bay to Bideford Bay		✓Potential increase in risk of erosion/inundation along part of frontage	Not taken into account (main driver: economic)
7g	Home Farm Marsh – River Torridge East, River Taw South, Bridgwater Bay	✓ Speculative: would cause wave attenuation, accommodation space	✓Potential siltation of estuary as a whole?	Driver
3t	Little Oakley to Dover Court, Essex	✓Accommodation space. Speculative: would cause wave attenuation	✓Potential long-term impact on tidal prism?	Driver
3u	Hamford Water, Essex	✓ Accommodation space, Speculative: would cause wave attenuation		Not clear from information given (main driver: economic)
3w+3x	The Colne, Essex	✓ Accommodation space, Speculative: would cause wave attenuation	✓Potential inevitable 'drowning' of estuary due to sea-level rise?, potential increase in flood risk?	Not clear from information given (main driver: economic)
3y	The Blackwater, Essex	✓ Accommodation space, Speculative: would cause wave attenuation	✓Loss of salt marsh elsewhere in system, potential general negative morphological impact	Driver

3z+3aa	The Dengie Peninsula, Essex	✓ Accommodation space, Speculative: would cause wave attenuation	✓Rapid loss of salt marsh due to sea-level rise?	Not clear from information given (main driver: economic)
3ab	The Roach and the Crouch, Essex	✓ Accommodation space, Speculative: would cause wave attenuation	✓Potential effect of dredging on processes may make scheme unsustainable	Driver (main driver: economic)
3ac+3ad	Havengore to Foulness, Maplin Sands, Essex	✓ Speculative: would cause wave attenuation	✓Potential effect of Managed Realignment on hydraulic regime	Not clear from information given

Table 7.4
Examples of political, social/cultural, economic and technical drivers and constraints for identifying Managed Realignment in SMPs

Factor	Driver	Constraint
Political	Central government's strategy for flood and coastal defence is to work with natural processes wherever possible. Central government-funded Managed Realignment trial scheme at Tollesbury and subsequent R&D studies into resulting effects on natural processes in 1990s.	Local government is often under a lot of political pressure to avoid 'letting nature take its course' (i.e. prevent flooding or erosion). Local accountability for the 'natural process' consequence(s) of Managed Realignment.
Social / Cultural	Environmental and natural process issues have grown in public awareness over recent decades.	Lack of confidence in assessing impact of largely untested schemes on natural processes leads people to favour the precautionary principle and maintain the *status quo* in the short to mid term. Attitude still prevails amongst some people that to allow 'nature to take its course' (i.e. flooding of reclaimed land) is to have failed in our 'duty' to provide flood defence.
Economic	Wave attenuation of inter-tidal zones reduces energy impacting on the backing defence structures (lower repair costs experienced and/or lower defence standards necessary).	Requires more comprehensive post-implementation monitoring of effects on processes due to its influence over a wider cross-shore zone (former backshore, inter-tidal, sub-tidal) compared with some other schemes.
Technical	Working with natural processes provides a better overall flood and coastal defence infrastructure.	Remains a largely untested approach in the UK, therefore consequences on natural processes are uncertain.

Site (Halcrow reference number):
Sub-cell:
Coastal Unit Number:
Name:
SMP:
Implemented: yes no
Type: open coast tidal estuary
Process knowledge overall:

	Bathymetry	**Tidal velocity**	**H/T**	**MHW changes** (time period?)	**Coast geomorphology**	**Sediment transport**
Field data						
Modelling data						
Historical data (min 10year record)						

c = completed, u = underway, o = ongoing, p = planned, r = recommended
Details of studies:

Site-specific studies:

	Bathymetry	**Tidal velocity**	**H/T**	**MHW changes** (time period?)	**Coast geomorphology**	**Sediment transport**
Field data						
Modelling data						
Historical data (min 10year record)						

c = completed, u = underway, o = ongoing, p = planned, r = recommended
Details of studies:

Overall scores for defence options: Hold the line: Advance the line: Retreat: Do nothing:

Evaluation of strategic defence options: Number of process-related factors:

Are the processes a driver constraint neither

MR has been chosen as the best option because it:

(a) Contributes to flood or coastal defence system
Is link to process evidence made? yes no

(b) Provides accommodation space to enable future natural evolution of coastal landforms
Is link to process evidence made? yes no

(c) Creates wetland habitat for purposes of environmental enhancement
(d) To save costs associated with maintaining an uneconomic line of defence
(e) Other:

Do the natural processes contribute to flood defence? (1=low) 1 2 3 4 5

Is MR seen as a short-term medium-term long-term **solution?**

Comments:

Key process uncertainties:

Figure 7.1
Example of summary record sheet for natural process information extracted from SMPs

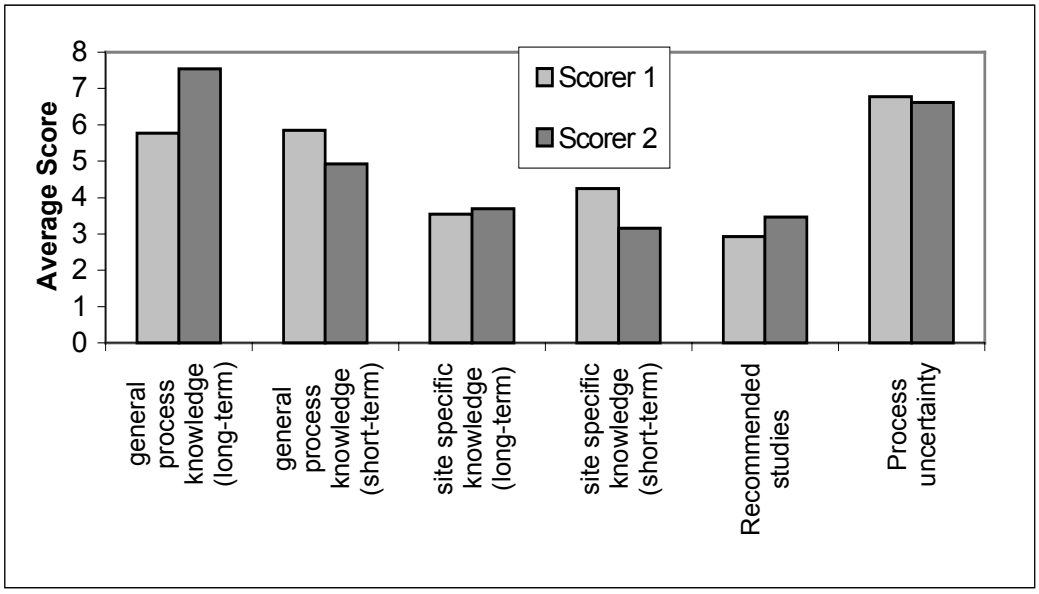


Figure 7.2a
Average scores given by the two assessors (scorers) for process knowledge criteria

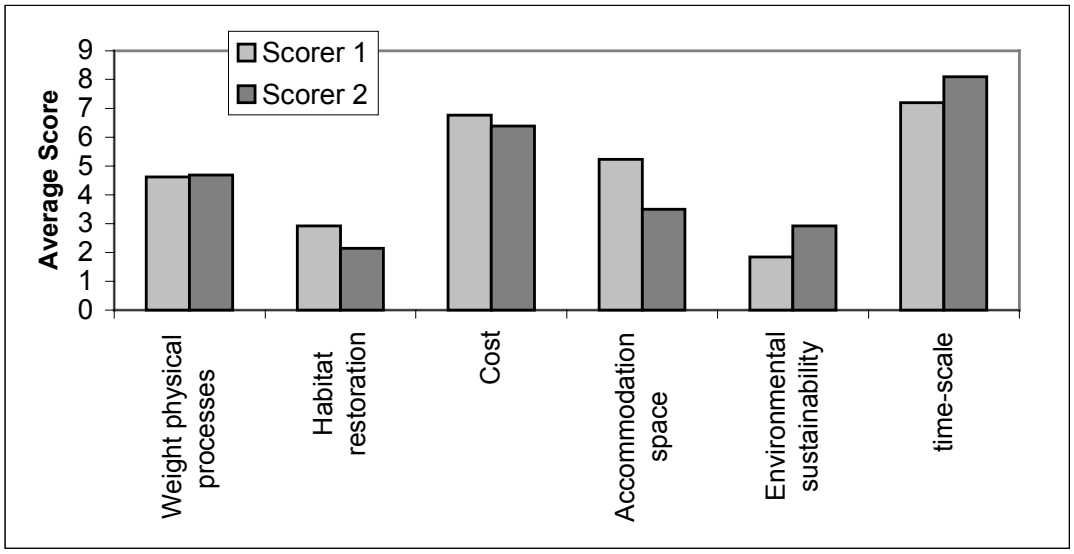


Figure 7.2b
Average scores given by the two assessors (scorers) for importance of process knowledge as a driver behind certain aspects of MR

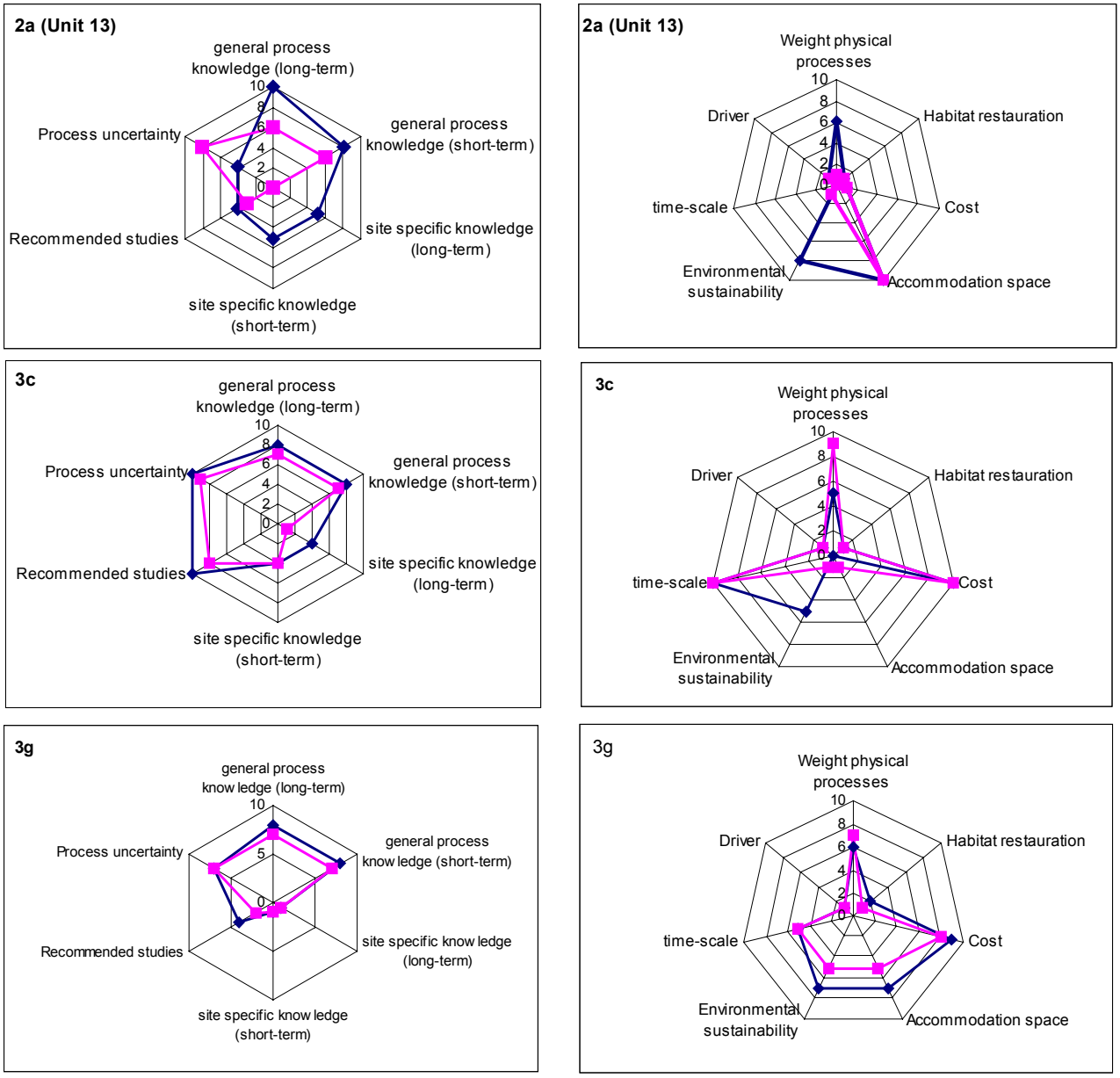
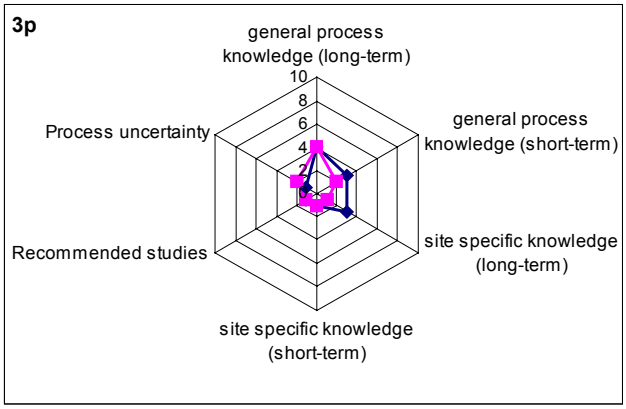
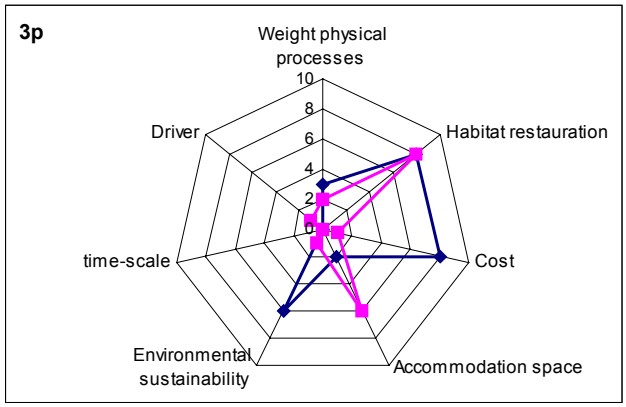
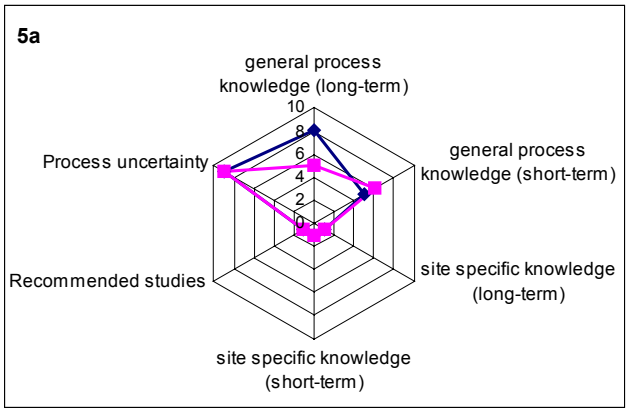
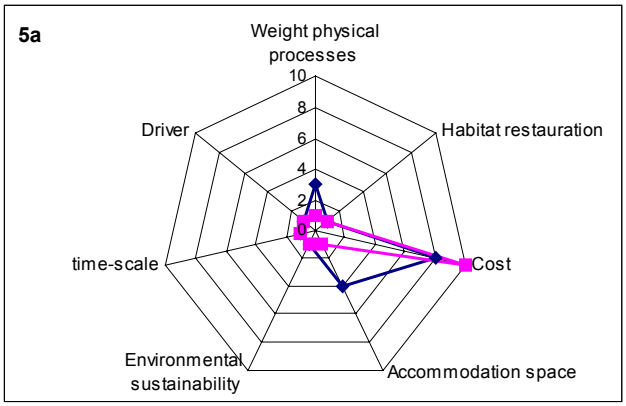


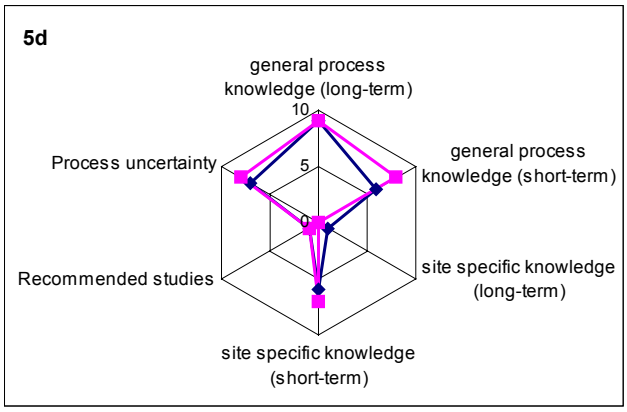
Figure 7.3 Scoring diagrams for each MR site (see Table 7.1 for reference) (note that a high score on the 'Driver' criteria (right-hand diagrams) indicates that natural processes were a 'Constraint')

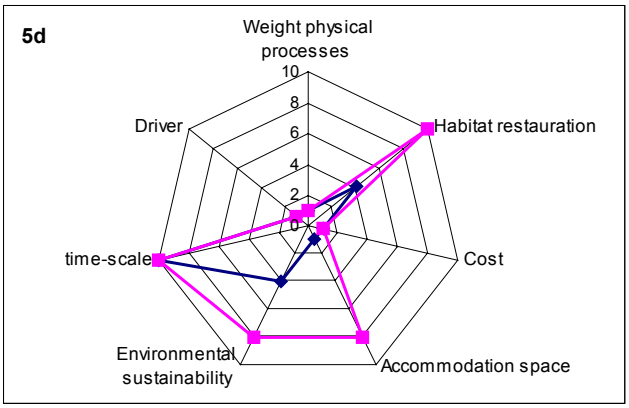

3p
general process knowledge (long-term)
general process knowledge (short-term)
site specific knowledge (long-term)
site specific knowledge (short-term)
Recommended studies
Process uncertainty
10
8
6
4
2
0

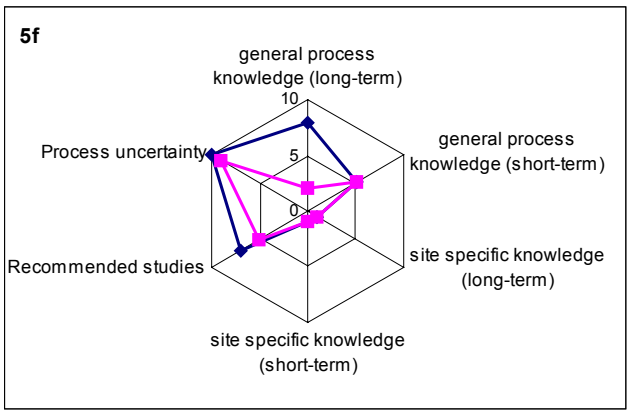

3p
Weight physical processes
Habitat restauration
Cost
Accommodation space
Environmental sustainability
time-scale
Driver
10
8
6
4
2
0

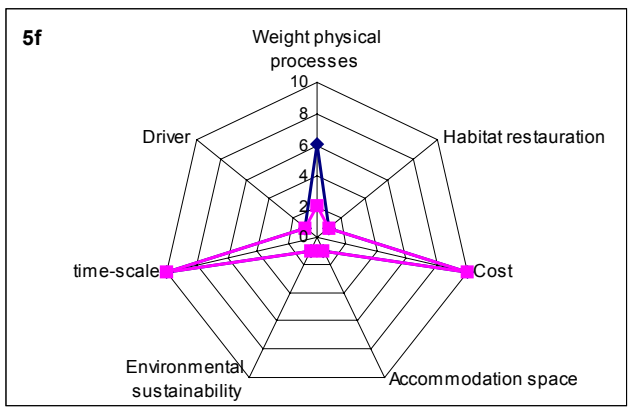

5a
general process knowledge (long-term)
general process knowledge (short-term)
site specific knowledge (long-term)
site specific knowledge (short-term)
Recommended studies
Process uncertainty
10
8
6
4
2
0


5a
Weight physical processes
Habitat restauration
Cost
Accommodation space
Environmental sustainability
time-scale
Driver
10
8
6
4
2
0

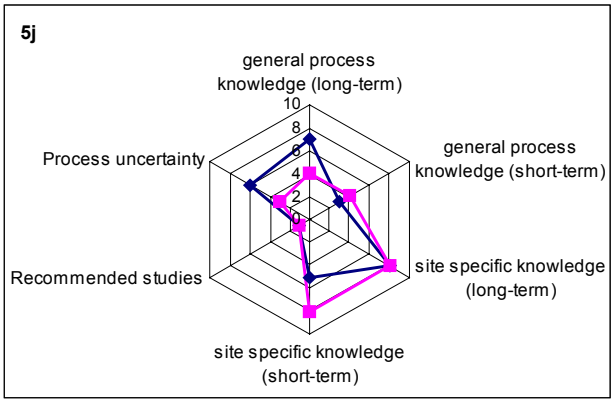

5d
general process knowledge (long-term)
general process knowledge (short-term)
site specific knowledge (long-term)
site specific knowledge (short-term)
Recommended studies
Process uncertainty
10
5
0


5d
Weight physical processes
Habitat restauration
Cost
Accommodation space
Environmental sustainability
time-scale
Driver
10
8
6
4
2
0

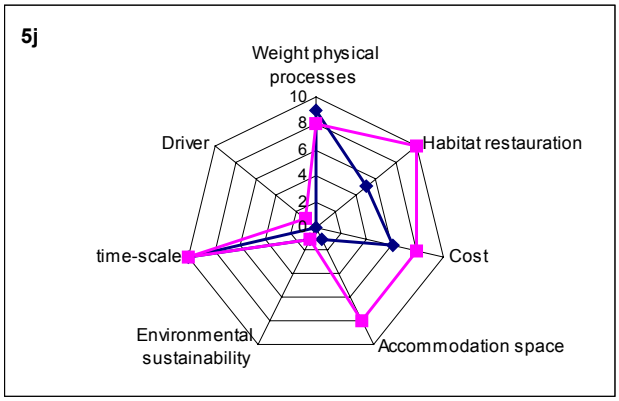

5f
general process knowledge (long-term)
general process knowledge (short-term)
site specific knowledge (long-term)
site specific knowledge (short-term)
Recommended studies
Process uncertainty
10
5
0


5f
Weight physical processes
Habitat restauration
Cost
Accommodation space
Environmental sustainability
time-scale
Driver
10
8
6
4
2
0

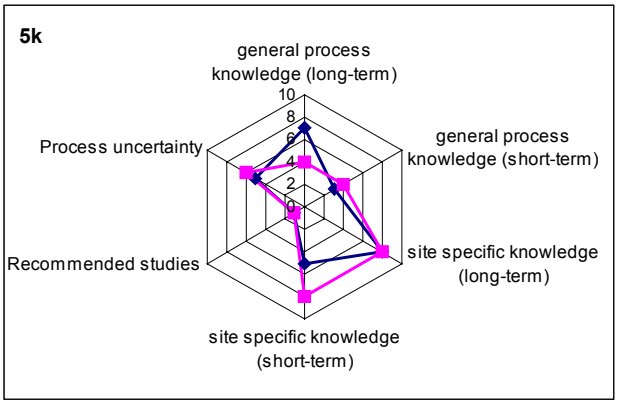
5j



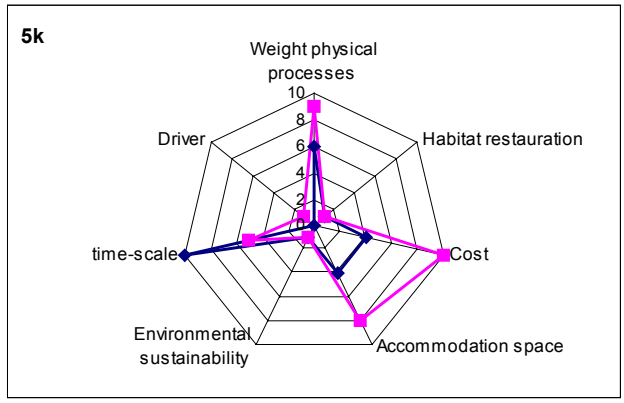
5j



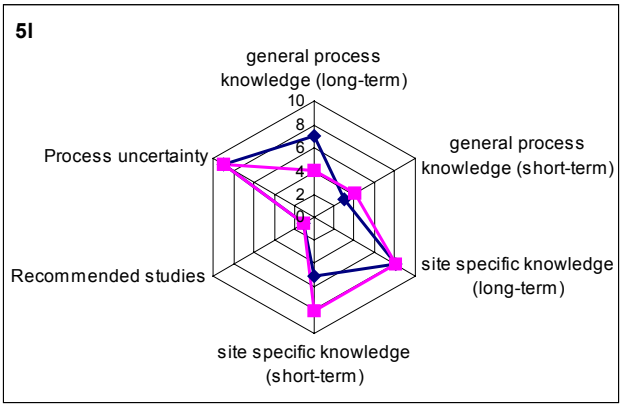
5k



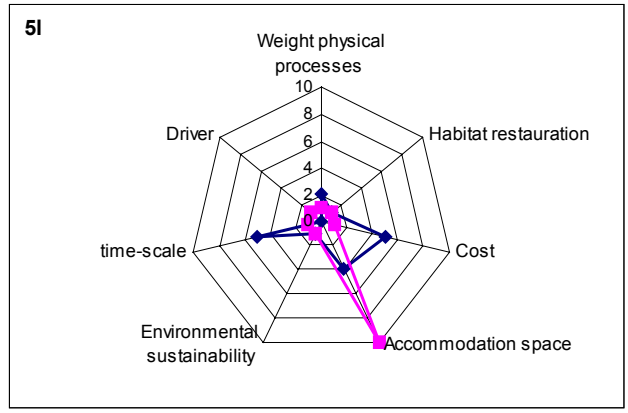
5k



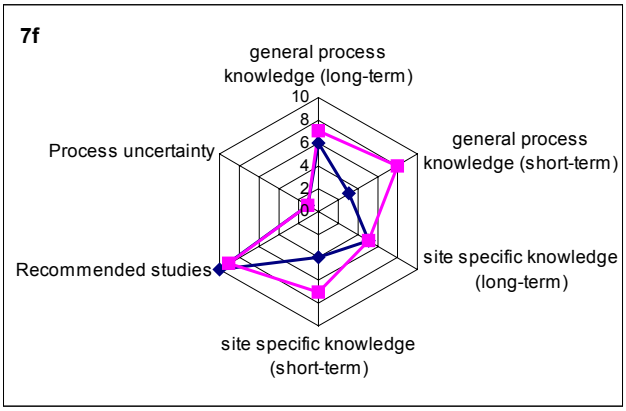
5l



5l



7f



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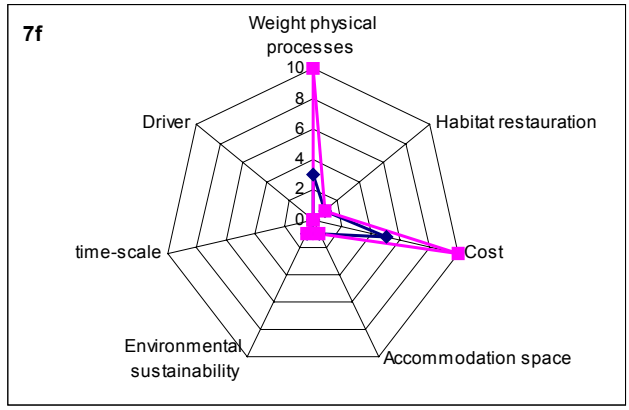

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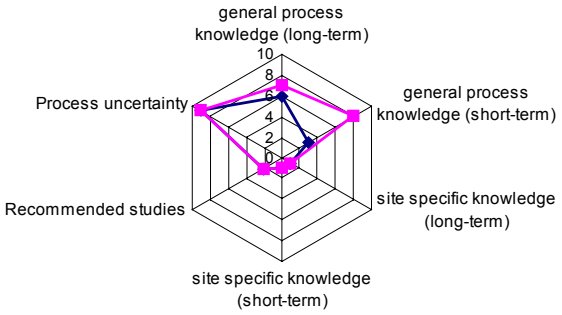

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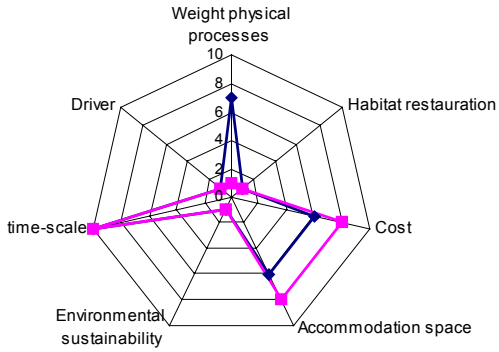

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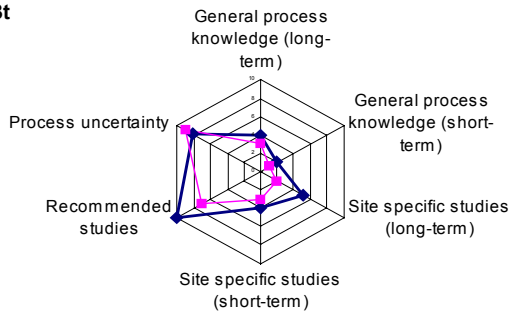

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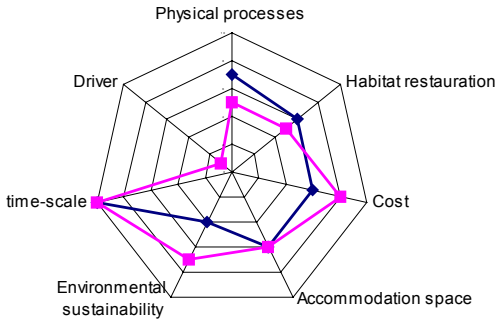

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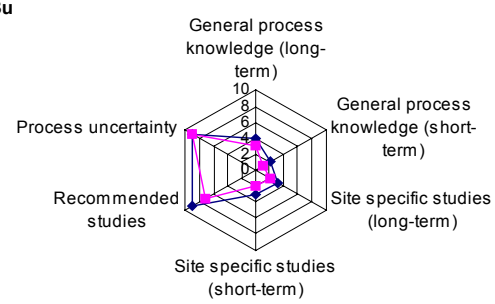

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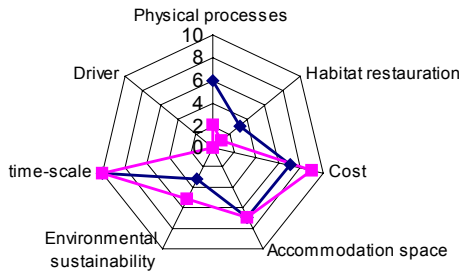

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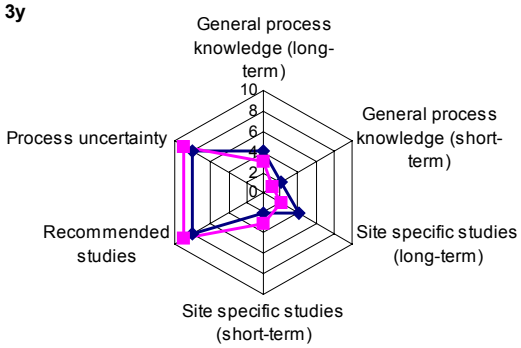

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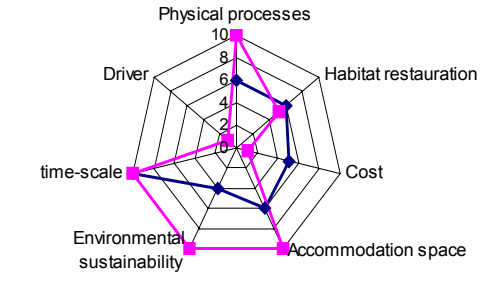

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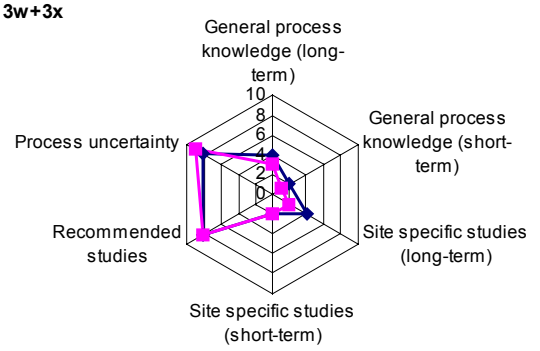

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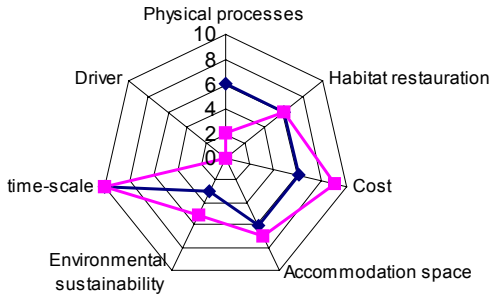

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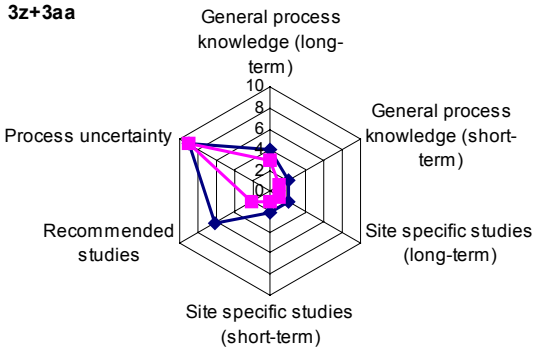

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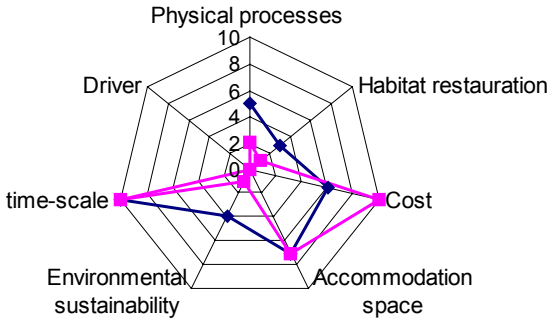

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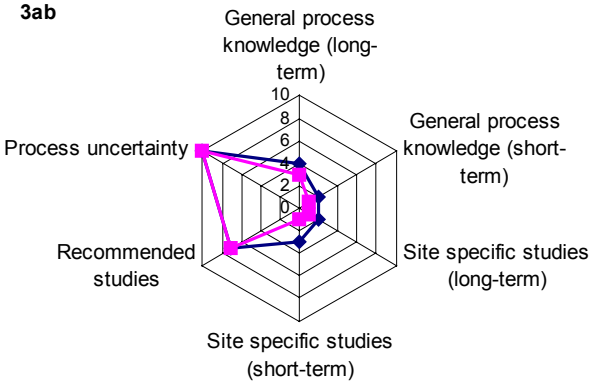

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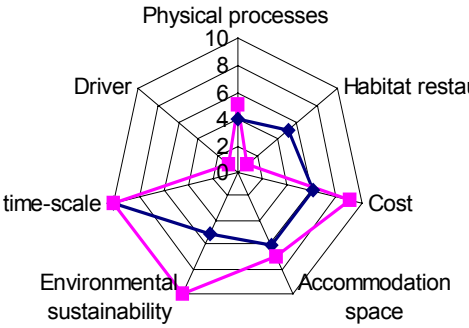

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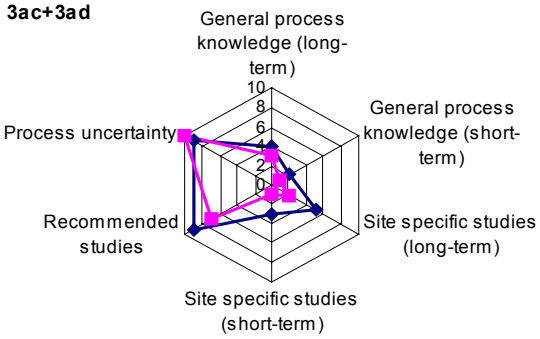

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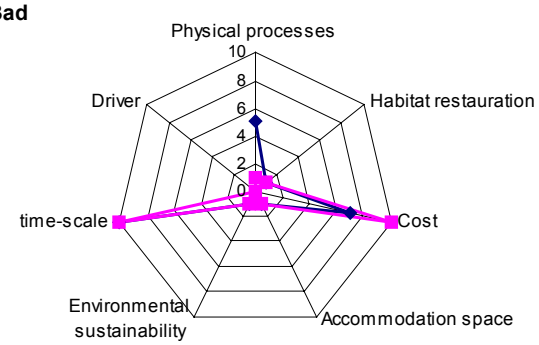


8 Role of Current DEFRA Guidance

8.1 Introduction

The purpose of this Section is to summarise the key features of existing flood and coast defence guidance from central government, insofar as it relates to managed realignment. We have reviewed the following DEFRA documents:

- the five Project Appraisal Guidance (PAG) notes (DEFRA, 1999 and 2000);
- "Shoreline Management Plans – A Guide for Coastal Defence Authorities" (2001);
- "Code of Practice on Environmental Procedures for Flood Defence Operating Authorities" (1996);
- "High Level Targets" (1999);
- Consultation Paper on Managed Realignment: Land Purchase, Compensation and Payment for Alternative Beneficial Land Use (2001);
- Strategy for Flood and Coast Defence (1993); and
- Coast Protection Act (1949).

The review has identified:

(a) Which parts of the existing guidance encourage Managed Realignment to be implemented (drivers)?

(b) Which parts of the existing guidance discourage Managed Realignment to be implemented (constraints)?

Issues relating to economic valuation, financial compensation and nature conservation are discussed further in Sections 6, 7 and 8 respectively.

8.2 Drivers

Existing guidance:

- Recognises that Managed Realignment is a valid option and that setting-back defences can improve the standard of protection (DEFRA, 2001a).
- Confirms that Managed Realignment can attract grant aid funding from DEFRA to operating authorities (provided that it meets the requirements of PAG3) (DEFRA, 2001b).

- Confirms that Managed Realignment will be funded, if essential for the protection of a European site, even when this would not be economically justified as a coastal defence scheme. This means that protection of a European site is a requirement, whereas protection of property is a permissive power (DEFRA, 2001a and Coast Protection Act 1949).
- Allows unreasonable methods to be rejected before economic appraisal on technical or environmental grounds, for example, Hold the Line does not have to be considered if it is not considered to be reasonable. Guidance encourages consideration of the most appropriate shoreline position (i.e. shoreline management policy) through the Shoreline Management Plan, before detailed consideration of how to achieve flood and coastal defence (MAFF, 2000b).
- Considers project appraisal at the level of the UK national economy, so the benefits of holding the line for farmland are lower than they might be if evaluated for local economy (MAFF, 2000b).
- Recognises sea level rise as a factor in decision making and provides clear guidance on the standard values to be used (MAFF, 2000b).
- Recognises flood and coast defences are a "zone" along the shoreline, rather than a structural line (DEFRA, 2001b).
- States that, in addition to statutory obligations when carrying out flood and coast defence works, measures should be taken to safeguard and, where possible, enhance environmental interest and biodiversity (High Level Target 9) (MAFF, 1999b).
- Addresses the negative connotations of "retreat" by substituting the word "realignment".
- Provides for the provision of compensatory habitat for loss of intertidal or floodplain habitat in European sites caused by a scheme. This may justify Managed Realignment on an adjacent section of frontage to re-create the habitat (even where this would not have been economically justified as a coastal defence scheme in its own right).

Other factors inherent in present policy and organisational structures that may incidentally favour or promote managed realignment, albeit not as a result of existing flood and coastal defence policy, include:

- The Countryside Stewardship Scheme can also assist with Managed Realignment, for example through payments for saltmarsh creation on former

agricultural land, although it is administered by a different section of DEFRA (England Rural Development Programme) and is discretionary (DEFRA, 2001a).

- The unification of environmental sections of former DETR and MAFF may assist in common approach.
- Certain costs required for Managed Realignment (but not for other options) tend to be excluded from economic appraisal (e.g. costs to operating authority of land purchase for new inter-tidal or river flood area). This can increase benefit/cost ratio for Managed Realignment scheme. An example is the Thorngumbald scheme.

8.3 Constraints

Existing guidance:

- Does not provide specific encouragement in terms of the evaluation of Managed Realignment schemes beyond conventional benefit / cost analysis (with the exception of payments through the Countryside Stewardship Scheme). For example, environmental value in terms of biodiversity is typically not evaluated.
- Allows payment for use of land acquired for the construction or maintenance of defences, but does not provide a formal mechanism for payment for land converted from terrestrial to intertidal land by Managed Realignment, except in limited cases (Section 10).
- Provides guidance on the assessment of risks relating to all forms of defence and incorporation of the assessment into decision making, but does not make any allowance for the greater uncertainty in the technical achievement (and timescale) of Managed Realignment which translates into greater uncertainties in the benefits and costs when compared to Hold the Line options.
- Results in an imbalance between Hold the Line options (conventionally resulting exclusively in expenditure of public money) and Managed Realignment options (resulting in expenditure of private individuals/organisations money/assets), since a formal mechanism for financial compensation is not in place.
- Requires project appraisal at a scheme level, rather than allowing approval & funding confirmation of a strategy. This may have the result that certain integral parts of the strategy may not be economically justified independently.

This may affect Managed Realignment schemes in particular since the benefits may be geographically remote and only accrued at strategy level.

- Does not create any compulsion on owners of private frontages to realign, even if overall strategy indicates that this is desirable.
- Can be influenced by local political conditions, such as the Local Authority election cycle, which is incompatible with both 5 and 50 year planning.
- Does not provide guidance on resolving conflicts of interest between European sites.
- Does not address all factors relating to climate change as clearly as sea level rise (e.g. potential for increased storminess, changes in offshore wave direction etc) – although these are not so well understood.
- Can only relate to current legislative position in government policy relating to Habitats Regulations.
- Does not allow a reduction in the cost of "beneficial use" dredgings (that might be used for saltmarsh regeneration as part of a Managed Realignment scheme) compared to market value in the calculation of economic justification (not recognised).
- Allows methods not considered to be reasonable at local level to be rejected at Shoreline Management Plan stage, well before economic appraisal (MAFF, 2000b).

Other factors

- There is confusion over what Managed Realignment is and whether it can always be distinguished from Non Intervention (although this is addressed through new SMP guidance).
- Present practice tends to separate the consideration of rivers, estuaries and coastlines in strategic studies. Coastal strategies tend to be more advanced, but estuaries tend to provide the greatest opportunities for Managed Realignment.
- Existing funding arrangements encourage operating authorities to develop schemes that attract grant aid from central government, rather than methods involving the mitigation of the effects of flooding (i.e. living with flooding).

9 Economic Valuation

9.1 Introduction

Better flood and coastal defence is often the primary goal of Managed Realignment. Although results from the questionnaire analysis within this project show that economic aspects are not necessarily the primary driver for management realignment schemes (Halcrow, 2002), results from regional workshops and case studies suggest that it is often the first consideration when comparing hold the line or realignment options. Furthermore, consultation with a wide range of stakeholders indicated that there can be other categories of benefits which are not necessarily included within DEFRA benefit/cost guidelines, and these should always be compared to costs when assessing Managed Realignment with respect to other options. Reviewing not only flood and coastal defence benefits but also more general costs and benefits associated with Managed Realignment is an important step in any strategic flood and coastal defence policy.

A distinction must be made between economic and financial analysis. In financial analysis, costs and benefits are evaluated in terms of the expenditures and earnings directly associated with the implementation of the scheme (i.e. a financial cost-benefit analysis is equivalent to a cash-flow analysis). Economic analysis, on the other hand, looks at costs and benefits for society as a whole, taking into account effects at a national level (this is considered appropriate because flood and coastal defence is funded by central government). For example, if there is a loss of tourism revenues in one area, but tourists switch to a recreational area elsewhere in the country, then there will be no net economic loss as the revenues in the new location will offset the lost revenues in the original site. "Extended" cost-benefit analysis takes into account non-priced external effects, such as the impacts on environmental resources. Coastal and river margin habitats provide a variety of services to humans. From an economic valuation point of view, the difficulty is that many of them take place outside the market. They are public goods, and cannot be evaluated through a market price. Economists have developed methods to place a value on these services, so that they can be included in cost-benefit analysis and environmental costs or benefits are taken into account in economic valuations of projects.

Section 9.2 focuses on an economic analysis of Managed Realignment. A review of costs and benefit categories associated with Managed Realignment options is first presented, in comparison with other options such as Non Intervention (equivalent to unmanaged realignment) or hold the line. Since the Habitats Directive requires that lost Nature 2000 habitats are recreated either on site or elsewhere, Section 9.3 focuses specifically on habitat replacement costs, as these are often likely to be part of the cost of Managed Realignment schemes.

Appendix F presents a discussion on the economic valuation methods for non-market goods, including the pros and cons of benefit transfer (i.e. how existing valuation studies can provide value estimates that can be transferred to similar cases in other geographical areas). Section 9.4 provides an overview of existing studies having produced estimates that can provide useful insights in the context of Managed Realignment. Appendix G summarises all the relevant valuation studies of which we are aware.

9.2 *Review of categories of costs and benefits of Managed Realignment*

Realistic options generally open to decision-makers can be summarised as: Non Intervention (i.e. do nothing or unmanaged realignment), Managed Realignment, or Hold the Line. Whether Non Intervention or Hold the Line is the most realistic alternative to Managed Realignment will usually depend on the value of assets protected. Managed Realignment will often be considered for sites with low asset values, in which case the most appropriate comparison may be with the Non Intervention option. However, where there is sufficient benefit to justified continued maintenance of existing defences, the realistic comparison may be with Hold the Line. Depending on the circumstances, the costs and benefits of Managed Realignment therefore need to be considered in reference to each of the two other options.

9.2.1 *Managed Realignment compared to Non Intervention*

Managed realignment differs to Non Intervention in a number of aspects:

- There is generally a controlled breach rather than leaving the breach to take place through erosion of the existing defence over time;
- There might be construction of a new defence further inland;
- There may be detailed studies such as modelling of the effects of the realignment;

- There is likely to be a requirement for specific consents such as planning permission; and
- There may be some engineering works in the area to control the type of habitat to be recreated and the rate of succession.

Compared to Non Intervention, the costs of Managed Realignment might therefore include capital and maintenance costs of a new defence inland and design and engineering costs for habitat creation. The benefits might include a higher value of habitat created and/or benefits from the recreated habitat occurring earlier because of engineering. They might also include costs linked to accidental damage, as opposed to a planned loss of land (e.g. loss of life), although it is unlikely that unmanaged realignment would take place in areas at risk without proper warning and planning.

Whether new defences need to be set up inland or not will depend on whether the topography of the site requires it, on the value of the assets to be protected, and on the costs of building the defence. This is a straightforward cost-benefit analysis of flood and coastal defence.

9.2.2 *Managed Realignment compared to Hold the Line.*

Our experience indicates that this is often the main choice of decision-makers and is therefore analysed in more detail. Where defences exist, the default option is often to carry on maintaining them, where it is economic to do so. The net benefits of Managed Realignment can be considered as the opportunity cost of Hold the Line and vice versa.

The main economic cost of Managed Realignment is the opportunity cost of the land that was originally protected by the existing defence (this is equivalent to saying that the benefits of holding the line are the avoided damage costs of flooding). This can have several components, depending on what type of asset is protected by the existing defence:

- Value of property assets in built up areas.

- Value of agricultural land. In the existing cases of Managed Realignment where landowners have been compensated, this financial compensation was negotiated above the market price, to take into account possible decrease in farm profitability,

and emotional value of the land. These are real economic costs in this context, and the whole amount should be included in the cost-benefit analysis. However, the current agricultural price subsidy system should also be taken into account, as noted by Dickie and Pilcher (2001), and the current market prices are likely to be higher than the true social value of agricultural land.

- Value of natural ecosystems. These can have a range of values, as described in Section 9.4. If they have high ecological value for wildlife, they are likely to have been designated in the context of the Habitats Directive (Section 11). If creation of replacement habitat is required by the Regulations then it is an integral part of the scheme, and its costs and benefits must be included in the analysis. There exists a relatively small literature on habitat replacement costs, which is reviewed in Section 9.3.

Other costs may include:

- Construction of a second line of defences further inland, both capital and defence maintenance costs;

- Design and engineering costs for creating new habitats; and

- Maintenance and monitoring costs of new habitat.

Finally, a point for consideration is that Managed Realignment options can take longer to implement than traditional options such as Hold the Line owing to the complexity of the planning process. This was found to be the situation at the case studies (Section 6). This may lead to increased flooding risks during that delay, which should theoretically be included in a cost-benefit analysis, though their extent cannot be readily predicted at the outset.

9.2.3 *Benefits of Managed Realignment*

Compared to Holding the Line: Capital and maintenance costs of the secondary line are usually lower, resulting in net benefits in terms of direct defence costs. Average mainline replacement defence costs used by DEFRA (2001) in the National Appraisal of Assets at Risk from Flooding and Coastal erosion were as follows. It should be noted that these varied dramatically between regions and depending on defence

structure and type and may not be representative of defence costs for agricultural and amenity land which is most likely to be considered for Managed Realignment.

- Fluvial defences: £8,400 km/yr
- Tidal: £10,300 km/yr
- Coastal: £32,300 km/yr

Because there was uncertainty over future investment needs, maintenance costs were estimated indirectly. A value of 38% of the annualised capital costs was estimated to provide a reasonable estimate of actual costs required (i.e. average annual expenditure for each defence equivalent to 38% of 1/50th of the capital cost of providing a defence with a 50 year life). These average estimates to compare capital and maintenance costs of realigned defences to classical defence costs. In practice, however, site-specific figures are likely to vary significantly.

Additional economic benefits of Managed Realignment were identified by Bryan *et al* (1994) in the context of the East Anglian coast:

- Potential market goods and services from recreated inter-tidal habitats, e.g. shellfish, samphire, wildfowl, mooring etc. (examples of revenues from Essex sites which will be included in the final report).

- As described in Section 9.4, ecosystems provide goods and services, which might not be sold on the market, but nevertheless represent important economic values. Such values might include wildlife habitat, pollution assimilation (nutrient and contaminant recycling), recreational and amenity value, option and existence value.

In the case where a Managed Realignment scheme impacts on a designated site, the benefits of the recreated site (as well as the costs, as seen above) should also be taken into account.

The economic review of costs and benefits of Managed Realignment has so far focused on the coastal context. There is no major difference, however, with Managed Realignment in rivers. The only noticeable difference is that in the context of rivers, climate change is likely to increase the need for flood storage, but only during extreme events. This means that the loss of land use might not be complete, but seasonal.

While occasional or seasonal freshwater flooding might not be compatible with all land uses, in certain situations it might be sufficient to compensate owners for loss of revenues, for example for certain forms of agriculture. In that case, the opportunity cost of land in the cost-benefit analysis should be replaced by the loss of revenues summed and discounted over the lifetime of scheme.

Other costs and benefits of coastal Managed Realignment can be directly translated to the river situation. The components of the value of habitats lost or recreated, as river margin habitats goods and services might vary slightly, but are comparable (e.g. storm protection compared to flood protection, etc.).

9.3 Habitat replacement costs

Habitat creation (establishing a wetland where previously none existed) and re-creation or restoration (re-establishment of an historical wetland that has subsequently been destroyed) can be important drivers in Managed Realignment. With a more strategic approach to Managed Realignment, and the need to compensate for habitat losses through development (both for coastal and river margin habitats) and through coastal squeeze, it is likely to become one of the major drivers in some circumstances. It is therefore useful to look more closely at costs and benefits of habitat restoration. Measuring the values of recreated habitat will be addressed in Section 9.4. This section therefore focuses on costs of habitat recreation or restoration.

Restoration can be regarded as the reinstatement of a previously existing ecological condition. Creation or recreation refers here to the actual re-establishment of a wetland where previously none existed.

The likelihood of success can be seen as a function of all the characteristics previously described (extent of damage, surrounding ecosystems, etc.), and the invested cost of restoration. There is a fundamental relationship between the costs and performance of ecological restoration projects (King, 1991). For a given site, the likelihood of success will increase with the restoration expenditure. The equivalent of saying that a site has 0 probability of being restored is to say that the cost of restoration is infinite. There is also substitution, to an extent, between investment on the restoration project, and the period of time for restoration to be deemed successful.

There have not been many studies on economics of restoration in the literature. One of the most interesting pieces of research is that by King and Bohlen (1990), who looked at nine types of wetland restoration, basing their analysis on a wide range of case studies which also included wetland creation and wetland enhancement projects (Table 9.1). They find that costs can be explained by grouping restoration projects according to structural characteristics that affect costs, and by adjusting these baseline cost estimates for each grouping to account for certain site-specific and project-specific conditions (e.g. dry or wet, hilly or flat...). As a general rule, the authors also found that wetland restoration undertaken as part of voluntary programmes in which agricultural lands are converted to wetlands are substantially less costly, on average, than mitigation projects. These projects are generally fairly simple operations, and usually involve restoring original site hydrology (e.g. by breaking drainage tiles or filling ditches), which is inexpensive and often highly successful. Agricultural conversion projects also involve fewer restoration tasks than restoring structurally and biologically more complex wetlands, and therefore are much less expensive. In contrast, for the rest of the categories, the authors found that differences in wetland type had a surprisingly small effect on average restoration costs once site specific and project-specific factors were accounted for. In fact, project costs varied more widely within wetland categories than between wetland categories. It is interesting to note, however, that coastal ecosystems such as salt marshes and other estuarine wetlands are among the lower cost restoration projects.

In a preliminary paper, Söderqvist, (1998) reports on a project in Sweden, where the costs involved in the creation of 53 created wetlands were analysed. The principal factors explaining the variation of costs were area and construction efforts, in particular the need for excavation. The wetlands were created in the context of a programme aimed at encouraging creation of wetland for nitrogen reduction, so costs involved are probably a lower estimate to wetland creation costs since other aspects such as recreation and biodiversity were not considered.

Table 9.1 Average cost per acre for different wetland types

Wetland type	Project Average cost (thousands of US$)	Sample size
Aquatic beds - tidal or non-tidal communities of permanently or nearly permanently submerged plants	9.5	3
Complex projects incorporating three or more wetland types in a single project	56.7	8
Freshwater mixed projects, consisting of non-tidal projects in which both forested and emergent vegetation is produced	25.3	10
Freshwater, non-tidal projects establishing forested wetlands	77.9	19
Freshwater, non-tidal projects establishing emergent wetlands	48.7	28
Projects producing tidal freshwater wetlands	42	3
Projects establishing salt marshes and other marine or estuarine wetlands dominated by emergent vegetation	18.1	9
Projects establishing mangrove communities	18	4
Agricultural conversions	1	494

Source: King and Bohlen, 1994

In the UK, an English Nature report (Shepherd *et al*, 1999) focused specifically on the issue, of habitat replacement, including both restoration of existing degraded habitat and the creation of entirely new habitat. The authors reviewed the costs of recreating three types of habitats: coastal and floodplain grazing marsh (3 sites), reedbed (4 sites), and coastal lagoon (2 sites). Land purchase costs were the single largest cost element for coastal grazing marsh schemes, accounting for 80-85% of the overall costs. For reedbeds and lagoons, however, they were significantly lower, accounting for a maximum of 45% in the case of reedbeds, and as low as 4% in the case of a lagoon. A comparison of costs per ha excluding land purchase costs revealed a range of £890/ha to £1,241/ha for grazing marsh schemes, £2,800/ha to £5,045/ha for reedbeds, and £4,200/ha to £57,000/ha for coastal lagoons. The large discrepancy for the latter type of habitat stems from a variety of factors: in the more costly case, the lagoon was

created from scratch and a specific objective was to enhance invertebrate populations and a population of rare beetle. The highest differences were reflected in the excavating and disposing of soil costs, the site supervision costs arising from the work being undertaken in an industrial complex, and the project management costs. The authors underlined that all of the case studies considered in the report attempted to achieve relatively simple replacement objectives. For schemes with more complex environmental objectives, the cost is likely to be higher than those in the ranges presented.

In conclusion, costs of restoration will depend broadly on:

- type of habitat to be restored
- extent of damage; and
- how quickly the restoration needs to be achieved, how permanent repairs need to be, and whether the site is to be self sustained or not.

Construction efforts are likely to be an important determinant of cost in most cases, and are likely to depend on the geomorphology of the site. Depending on natural relief, excavation may be required, or construction of dams on one or several sides.

The few existing studies therefore show that the costs of wetland creation vary widely depending on the objectives of the restoration or recreation schemes. Schemes aiming towards supporting particular species of birds, as in the context of the Habitats Directive, are likely to be more expensive than some of the simple wetland creation experiments. The English Nature report provides examples of costs in the UK, which can be useful for broad-brushed estimations, bearing in mind the above-mentioned limitation.

9.4 Existing wetland valuation studies

Appendix F summarises the methodological issues of valuing non-market goods. One of the key problems in evaluating costs and benefits of Managed Realignment is that many of the values concerned are related to ecosystem services, which are not exchanged in the market. Although economists have developed and refined tools to evaluate these goods and services in monetary terms, there are still significant methodological issues that need to be taken into account.

There has been a range of valuation studies on wetlands over the years, although few have focused on British sites. The functions of a wetland depend on its particular biological and physical characteristics. Few wetlands possess all of the potential functions, but will usually have a range of different functions (Skinner and Zalewski, 1995; Barbier *et al*, 1997). River margin wetlands are likely to have slightly different services from coastal wetlands, as underlined in the review of types of costs and benefits of Managed Realignment. Freshwater wetland services are likely to include: flood control, groundwater recharge, nutrient and contaminant sinks, recreation (inc. wildfowling and angling). Coastal wetland services might include flood and storm protection, nutrient and sediment sinks, and sediment trapping, recreation, nursery grounds for coastal fisheries, etc.

Appendix G summarises existing valuation studies which can be useful in the context of Managed Realignment, i.e. on coastal ecosystems (river margin ecosystems to be added). Mangrove systems and coral reefs were excluded, as results are unlikely to be transferable to the UK context.

Some studies attempt to estimate global values of wetlands, as in the case of valuation of the Norfolk Broads, in the UK (Bateman *et al*, 1995). Others look at more specific values, or one subset of services, as noted by Whitehead (1993). The studies included in Appendix G, which are more relevant in the context of Managed Realignment are reported in more detail below.

One of the most easily monetisable values of coastal ecosystems is the property protection function against flood and storm damage. For example, early studies were carried out in the US from which Farber found a net present value of between $6.82 and $22.94/acre in 1987. Farber and Costanza (1989) later reviewed benefits of coastal wetlands in Louisiana and found a storm defence value of between $1915 and $7549/acre compared to $317-846/acre for commercial fisheries, $151 – 401/acre for fur trapping and $46-181/acre for recreation, showing the significance of defence services compared to other categories.

A more recent study, more useful for UK reference, is King and Lester (1995), which investigated the value of salt marshes as buffers outside sea walls. The authors found that as salt marsh width decreases, an almost linear increase in wall height is necessitated until loss of a final thin strip causes an exponential rise in maintenance

and construction costs. They estimate that an 80 m wide strip of salt marsh could result in cost savings of between £300 000 to £600 000/ha. In the same study, they quote examples of revenues for salt marsh and grazing marsh for wildfowling of £370/ha to £1096/ha. They also estimate a flood defence value of vegetated ronds in the Broads at £400-£600/m using a sheet piling cost of £800-£1000/m.

The role of inter-tidal habitats as fishery grounds is another service leading indirectly to marketable goods and has been investigated as early as 1981 in the US (Lynne *et al*, 1981), although the results showed a relatively low value ($3/acre), and the authors concluded that this was unlikely to be the most valuable service of the valued ecosystems. Subsequent studies such as Farber and Costanza's (1989) mentioned above later found higher numbers. A number of studies have also focused on mangroves, showing similarly higher values (not reported here). There has been one recent valuation study of inter-tidal habitats as nursery grounds in Scotland, which results are yet to be published. These values are likely to be difficult to transfer, however, as values would be likely to change with site-specific fisheries. They would nevertheless be useful in providing an estimate of the value relative to other types of services.

Studies in Sweden have also produced interesting results on the value of wetlands as nutrient sinks. Gren (1995), showed that the value of investing in recreating wetlands for nitrogen abatement was SEK 3.7 per SEK invested, compared to between SEK 0.4 and 1.1 for sewage treatment plants. This suggests that the value of a marginal investment in wetlands is four times as high as the value of marginal investment in sewage-treatment plant. These results were based on the assumption that the nitrogen abatement capacity of recreated wetlands are 215 kg N/ ha for the first year, then an increase of 10% for the following years, to reach a capacity of 500 kg N/ha/year after 10 years. In valuing wetlands, health improving benefits, as well as life support values of wetlands were accounted for. Bystrom (2000) compares total abatement costs for nitrogen reduction with and without wetlands and finds a potential savings in abatement costs of about SEK 210 million per year, assuming that the maximum area of wetlands that can be constructed in the region is 1/372 of total agricultural land. He also shows that if one more hectare of wetland could be constructed, total costs could be reduced by between 20-45 thousand SEK.

Finally, Brouwer *et al* (2001) undertook a meta-analysis of wetlands, investigating the main findings of 30 contingent valuation studies of wetlands in temperate climate zones in developing countries. Based on the various functions addressed in the reviewed studies, a simple distinction was made between four main wetland ecosystem functions: flood control, water generation, water quality support and wildlife habitat provision. These functions were found to have a statistically significant role in explaining variance in average willingness to pay (WTP). The size of the estimated parameters indicated that average WTP was highest for flood control, followed by water generation and water quality, and lowest for the wetland function of biodiversity supply, although the latter was in itself a significant value. This seems to confirm, for example, the Farber and Costanza (1989) estimate, which showed that the highest value for Louisiana marshes was for flood and coastal defence.

Although few studies have focused on UK ecosystems, they are useful in indicating the relative proportion of values.

9.5 Costs and Benefits at Case Study Sites

This section gives concrete examples of costs for two Managed Realignment schemes: Brancaster, on the North Norfolk coast, and Thorngumbald, in the Humber estuary. It also illustrates the decision process in the two cases, given that the benefits of the schemes in terms of habitat creation were not taken into account in monetary terms.

9.5.1 Brancaster

A summary of costs in the Brancaster scheme as estimated at the start of the scheme is given in Table 9.2. Design and supervision costs were estimated at 20% of the construction costs for options 1 and 3, and 10% of the construction costs for option 2 and 4. Maintenance costs for the hold the line option were estimated considering the increasing need to replace revetment over 50 years. For the Managed Realignment options (options 3 and 4), this was estimated as the cost of 2 staff for a week, every year, over 2 years.

Options 1 and 3 would involve the need for the creation of a replacement habitat to comply with the Habitats Regulations. This was costed as follows:

Purchase 38 ha at £5800/ha	£220,400
Staff costs	£10,000

Monitoring (1k/r years) 6%	£4,214
Conversion of 38 ha at £120/ha:	£4,560
Total:	£239,174

To this was added the salt marsh habitats payments, at £250 per ha per year minus European funding, resulting in a total of £70,000 for 38 ha.

Benefits, or damage avoided by the defence, were estimated at £15,000 (without taking into account the social value of habitats). However, the Environment Agency argued that damage avoided compared to the Non Intervention option should include costs incurred by complying with the Construction Design and Management Regulations and the Habitats Regulations, i.e. the total costs of the Non Intervention option, of £468k. When evaluated against this, the partial realignment option (option 4) is the only one with a positive net present value. It is also the least costly and was the one adopted, as the most cost-effective, but also the most environmentally acceptable and sustainable. The full realignment option was more expensive mainly due to the land purchase costs. It is not obvious, however, whether the net cost would have been higher when including the social value of recreated habitats.

Table 9.2
Summary of costs for Brancaster Managed Realignment Scheme
Source: Environment Agency, 2000

Option	Monitoring	Construction (£k)	Maintenance (£k)	Design and Supervision (£k)	Land purchase (£k)	Habitats Payment. (£k)	Total (£k)
Non Intervention	26	111		22	239	70	468
Hold the line	26	302	150	30			508
Realign 38 ha	26	127	11	25	320	70	579
Realign 7.5 ha	26	286	7	29	41		389

Table 9.3 shows the revised costs once the scheme had been implemented. The main rise in cost was in consultancy and staff costs due to more costly ecological surveys than foreseen, and also probably due to delays caused by the Habitats Directive.

Table 9.3
Revised costs for Brancaster Managed Realignment Scheme
(costs in parenthesis represent costs originally included in estimate)

	Monit (£k)	Const. (£k)	Consult. (£k)	Staff (£k)	Land (£k)	Tot. (£k)
Revised Costs	5 (5)	347 (286)	155 (28)	100 (29)	58 (53)	665 (401)

9.5.2 *Thorngumbald*

Table 9.4 (overleaf) shows the estimated costs of the different options considered. Benefits were also quantified in terms of damage avoided (Table 9.5). The reactive maintenance option has the highest benefit/cost ratio. However, the option is not viable technically. (The tidal defence would be repaired as and when required, but not before a part of the flood risk area had been inundated on each occasion. The frequency of breaching would increase with time as a result of sea level rise, making the defence performance inadequate). The improve options all have similar benefit/cost ratios (46 or 47), greater than the benefit/cost ratios of either do minimum or sustain. For each improve option, the incremental benefit/cost ratio is sufficiently robust to permit the adoption of the 1 in 200 year standard.

Therefore economically on a reach specific basis there is little to choose between the three improve options. However, the economic costs of the options do not include for land purchase. When including land purchase costs, the cost-benefit ratio was higher for option 4A2 (improve on-line to a 1 in 200 year standard). However, this option would have significant environmental impacts and lead to disruption to bird populations on the foreshore. English Nature suggested that this option was unsustainable and unacceptable with respect to the SPA due to the continued and possibly increased scour seaward of the bank. Option 6B1 (full retreat) was eventually recommended, taking into account the recreation of 80 ha of inter-tidal habitat, which would compensate for other tidal defence works in the Humber estuary which may have adverse effects on the integrity of the SPA through inter-tidal habitat loss.

Table 9.4 Summary of Estimated Costs of Options for the Thorngumbald scheme
Source: Halcrow, 2000

Option	Description	Standard 1 in X yrs	Economic Capital Cost £000	Land Cost £000	Total Option Cost £000	Maint-enance Cost (1) £000
1	*Non Intervention*	<10				
2A	*Reactive Maintenance* Repair of breaches as and when required, replacement clough	10 (reducing)	620	0	620	1,760
2B	*Do Minimum* Repair of breaches as and when required, ring bank gas distribution station, replacement clough	10 (reducing) 200 (for gas compound)	2,460	30	2,490	1,760
4A1	*Sustain* Rock armour, periodic earthworks, replacement clough	10	4,400(2)	14	4,414	860
4A2	*Improve on-line* Earthworks, rock armour, replacement clough	50 100 200	3,900 3,930 3,990	14 14 14	3,914 3,944 4,004	110 70 50
6B1	*Full Retreat 500m/250m* Earthworks, rock armour (part), new pumping station	50 100 200	3,780 3,830 3,870	1,130 1,130 1,130	4,910 4,960 5,000	210 170 150
6B2	*Partial Retreat 250m/250m* Earthworks, rock armour (part), new pumping station	50 100 200	3,720 3,770 3,810	800 800 800	4,520 4,570 4,610	210 170 150

Notes: *Price base is February 2000*

(1) *Maintenance costs are capitalised for a 50 year period. They reduce with increased standard as the residual breach risk reduces*

(2) *Includes capitalised cost of future defence raising*

(3) *Costs include for no importation of subsoil fill (apart from the embankment core in the case of the retreat options)*

Table 9.5 Economic Summary of Options for the Thorngumbald scheme

Option	1	2A	2B	4A1	4A2	4A2	4A2	6B1	6B1	6B1	6B2	6B2	6B2
Description	Non Intervention £000	Reactive Maintenance £000	Do Minimum £000	Sustain £000	Improve On-line £000	Improve On-line £000	Improve On-line £000	Improve Full Retreat £000	Improve Full Retreat £000	Improve Full Retreat £000	Improve Partial Retreat £000	Improve Partial Retreat £000	Improve Partial Retreat £000
Standard (1 in X yrs)	<10	10	10 (200 for gas station)	10	50	100	200	50	100	200	50	100	200
Capital cost		620	2,460	[2]4,400	3,900	3,930	3,990	3,780	3,830	3,870	3,720	3,770	3,810
Maintenance Capitalised		1,670	1,670	860	100	60	40	210	170	150	210	170	150
Option Economic Cost		2,290	4,130	5,260	4,000	3,990	4,030	3,990	4,000	4,020	3,930	3,940	3,960
Damage	185,290	11,470	560	8,510	710	290	200	710	290	200	710	290	200
Damage Avoided		173,820	184,730	176,780	184,580	185,000	185,090	184,580	185,000	185,090	184,580	185,000	185,090
Benefit/Cost Ratio		76	45	34	46	46	46	46	46	46	47	47	47
Incremental Ratio		75.8	5.9	1.0	-6.2	-61.2	2.3	6.3	47.6	6.9	6.6	47.6	6.9
Net Present Value		171,530	180,600	171,530	180,580	181,000	181,050	181,590	180,990	181,070	180,650	181,060	181,130
Land Cost		0	30	10	10	10	10	1,130	1,130	1,130	800	800	800
Total Option Cost		620	2,490	4,410	3,910	3,940	4,000	4,910	4,960	5,000	4,520	4,570	4,610

Notes

1. Option economic cost does not include purchase cost of retreated land
2. Includes capitalised cost of future defence raising
3. Total option cost is the sum of the option capital cost and the land cost
4. Option capital costs assume no importation of subsoil fill (apart from the embankment core in the case of the retreat options)
5. Negative incremental ratio values are caused by the increase in capital cost being less than the decrease in maintenance cost resulting in an overall decrease in economic cost for a higher standard.
6. Price base date February 1999.

9.6 *Conclusions*

There are potentially significant net benefits from Managed Realignment. Existing reviews of defence costs (Frankhauser, 1995; Turner *et al*, 1995; Dickie *et al*, 1995) have shown that the main benefits of holding the line come from the protection of assets at risk of flooding. Conversely, the main cost of Managed Realignment is the loss of land to flooding, and it is unlikely for Managed Realignment to be the best economic option in built up areas. The situations where Managed Realignment is likely to have the higher net benefits include:

- areas with low value agricultural land;
- sites where the topography allows shorter defences inland or no additional defences where retreat is to higher grounds; and
- sites where the topography is such that only minor or no engineering works are necessary to ensure natural succession to the desired type of ecosystem.

Experience shows that engineering works costs are likely to be minor compared to defence land opportunity costs.

The main economic benefits are reduced defence costs, due to both shorter defences and the role of inter-tidal habitats in wave energy reduction. These are accounted for in current DEFRA appraisal methods, assuming that there is enough knowledge to predict how much lower defences realigned inland can be. However, inter-tidal habitats also provide other important goods and services that, even though they are often not marketed, have significant economic value, as emphasised in the few valuation studies that have been carried out in a context relevant to Managed Realignment. A meta-analysis of wetland values showed that the function with highest value is flood control, followed by water generation (surface and groundwater recharge, which might not be significant in the context of Managed Realignment), water quality improvement, and finally biodiversity support.

In some cases, Managed Realignment leads both to the loss of freshwater or brackish habitats, and to the creation of salt marshes or mudflats. Theoretically, the value of both types of habitats could be estimated to investigate whether it is a net cost or a net benefit. However, valuation methodologies can lead to significant uncertainties about the value estimates, unless one type of habitat is clearly providing higher value goods or services. In the Brancaster realignment scheme, for example, the local population

did not want to lose resources provided by the existing habitats and used under common rights. English Nature also wished to retain some of the existing habitat. This led to a reduced Managed Realignment scheme, protecting a significant proportion of existing habitats. In such a valuation study, one would need to take into account marginal values rather than average values, which leads to further difficulties. In other situations, habitats are not altogether lost, but undergo a change in functional value due to the impact of the scheme (e.g. Thorngumbald). Again, an economic valuation of such subtle changes by the general public would be difficult, and in practice it is down to conservation organisations to agree on suitable compensatory habitat measures. At Thorngumbald, it was estimated that part of the new habitats recreated by the scheme was sufficient to compensate for the change in value of the existing SPA, without judging explicitly whether the change was negative or positive.

When Managed Realignment involves the loss of a designated site, the costs and benefits of the replacement site should be included in the analyses. The net benefits might be positive, resulting in increased benefits, or negative, in which case the decision is sub-optimal, and this acts as an additional cost to the scheme.

These environmental costs should be included explicitly in economic appraisals of schemes. Quantified environmental costs should also be taken into consideration by the current revision of the scheme prioritisation system. Current advice in the Flood and Coastal Defence Project Appraisal Guidance is to use habitat replacement costs as a proxy for the value of habitat loss. However, these are likely to be a significant underestimate, as the total economic value of an ecosystem is likely to be higher than the costs of recreating it. A more thorough review of the relative importance of services provided by inter-tidal habitats would provide insights into which services should be valued in priority. There have been very few, if any, valuation studies done in the context of Managed Realignment, which could help towards suggesting values to be used in appraisal schemes. Some original valuation studies would be useful to have an estimate of the values involved, especially given the uncertainties with regards to timing and scale of ecological benefits of Managed Realignment sites. Given the high cost of these studies, and the unfeasibility of carrying out a contingent valuation study for each scheme, new valuation studies should be designed with benefit transfer in mind to avoid the need for further costly studies in the future. Such studies of existing realignment sites could be conducted as part of the proposed second phase of the present project.

There is still some uncertainty regarding costs of Managed Realignment. Results from case studies show that they can be higher than expected, as it is difficult to predict the success of habitat recreation, what further works might be necessary to improve or accelerate habitat succession, and what the cost of maintenance will be. There can also be costly delays in the process of Managed Realignment due to planning complexities which were not foreseen (e.g. the Habitats Regulations). Existing and future schemes should be monitored over time to estimate capital and maintenance real costs.

The benefits of managed versus unmanaged realignment are not always clear. There is no clear consensus amongst ecologists about whether managed retreat sites lead to higher quality habitats than unmanaged ones. Furthermore, the potential costs of unmanaged realignment are likely to depend on risk communication and accompanying safety measures. There should be a review of benefits from unmanaged sites, and compare scale and timing of ecological benefits with managed sites.

Finally, it is worth noting that with climate change and sea level rise, holding the line options are likely to become increasingly costly. Managed realignment schemes are therefore likely to become increasingly preferable on economic grounds both along the coast and rivers.

10 Financial Compensation

10.1 Introduction

The questionnaire responses (Halcrow, 2002), regional workshops (Section 5) and case studies (Section 6) all underline the importance of financial compensation as a key issue and potential constraint to the implementation of Managed Realignment. In this context, we include land purchase as a form of financial compensation (in both cases, money is paid to the landowner for the loss of use of land, whether or not title is acquired to the land). This Section summarises existing policies with respect to financial compensation and its implications.

10.2 Existing Policy

10.2.1 General

DEFRA issued a consultation paper on land purchase, compensation and payment for alternative beneficial land use in October 2001. (DEFRA, 2001a). This confirms that existing policy on financial compensation is as follows:

"Except in limited circumstances, outlined below, no compensation is payable to those affected by flooding or erosion, including cases where it is decided not to defend a particular area, or to undertake Managed Realignment. This approach, adopted by successive governments, is justified by current legislation, which provides operating authorities with permissive powers to undertake flood and coastal defence works. Save for the specific requirement of the Habitats Directive, there is no general obligation to build or maintain defences either at all, or to a particular standard. Consonant with this approach, the legislation also makes no provision for compensation from public funds to persons whose property is affected by erosion or flooding.

"Payment is, however, possible where beneficial use arises. Thus land may be acquired for the construction or maintenance of defences, and compensation paid for damage arising expressly from such operations. Also, in some circumstances where land seaward of justifiable new defences can be shown to contribute to effective defence, whether locally or remotely, landowners may be eligible for depreciation or loss of land. Finally, if a defence is realigned landward, land currently in agricultural use may be considered for payments under agri-environmental schemes if a long-term return to inter-tidal habitat fulfils the relevant objectives."

10.2.2 *Financial compensation from flood and coastal defence budgets*

DEFRA (2001a) notes three situations in which payments may be made for acquisition or use of land subject to Managed Realignment (as opposed to land actually used for the construction of the new defence itself, e.g. under the footprint of an embankment). These are:

- Where the new inter-tidal area forms part of the new defence. This could, for example, be the case where the realigned land will become salt marsh and the new embankment to the landward is designed to a standard that reflects the reduction in wave action achieved about by the presence of salt marsh.

- Where realignment is implemented to create a more sustainable regime within an estuary or river, such as improving discharge capacity or reducing flood levels, it may be reasonable to purchase the land. In essence, this is recognises that the whole area within the flood banks is part of the defence works. In "exceptional circumstances" it may also be appropriate for operating authorities to purchase areas allocated for fluvial flood storage, where it is deemed necessary to allow for full control.

- A further situation in which compensation might be paid is where a realignment scheme is being constructed specifically to create compensatory habitat for the effects of another scheme elsewhere (including loss of habitat as a result of "coastal squeeze" from holding the line). In such cases, the new habitat creation would be an integral part of the requirements of the other scheme, and acquisition of the land using public funds may be justified.

10.2.3 *Countryside Stewardship*

Countryside Stewardship Schemes are governed by the Countryside Stewardship Regulations 1998, as amended, made under Section 98 of the Environment Act 1995. The scheme forms part of the England Rural Development Programme, part-funded by European Union funds, and is therefore subject to Council Regulation 1257/1999, Commission Regulation 1750/1999 and Commission Regulation 2075/2000. The scheme is administered by DEFRA in consultation with DETR, Countryside Agency, English Heritage and English Nature. It offers payments to farmers and landowners to improve the natural beauty, habitats and wildlife of the countryside. The area entered into the scheme will be managed as per a 10 year legally binding agreement,

which is the maximum period "normally" permitted under Regulation 1257/1999 "except in the case of specific undertakings where a longer period is deemed to be indispensable".

From January 2000, the Stewardship scheme has included an inter-tidal habitat creation option, and payments for capital work where appropriate. This replaced the salt marsh option of the Habitat Scheme (which started in 1994 and allowed payments for up to 20 years) and also introduced raised water level supplements for waterside habitats. The objective is to target important and vulnerable Biodiversity Action Plan habitats such as salt marsh and to help facilitate the recreation of wet grassland. Both national and local (county) targets have been set for work that can be funded under the scheme.

The specific national objectives for coastal areas include:

- re-create flower-rich pasture on cultivated land along the coastal fringe or cliff-top;
- re-create inter-tidal habitats on agricultural land;
- manage coastal grazing marshes and sand-dunes by traditional grazing patterns to sustain both their wild character and the plants and animals they support;
- manage inter-tidal habitats such as salt marsh and shingle ridges where changes or active management are required (all existing inter-tidal habitats must be protected from damaging activities); and
- improve access to the coast by new footpaths, including links to coast paths, or provide picnic sites and viewpoints.

The specific national objectives for waterside land include:

- conserve the landscape and wildlife of meadow, marshes and wet pasture by grazing and hay cutting and stopping fertiliser and pesticide use;
- restore and create waterside features such as ponds, pollarded willows, fens and reedbeds;

- manage water levels in spring and/or winter to create splash flooding conditions suitable for winter feeding wildfowl and breeding waders;

- restore and manage ditches and dykes by rotational cutting and raised water levels;

- improve habitats for wildlife, both in the water and alongside rivers and streams, by restoring waterside vegetation, where necessary protecting banks from erosion by livestock, or by buffering them from the effects of herbicide, pesticide and fertiliser applications;

- provide opportunities for people to enjoy watersides by creating riverside footpaths, or open areas for picnics and bird watching.

Payments under the Countryside Stewardship scheme are generally for ten years, during which period a management agreement is entered into. Rates for coastal and wetland habitats are as follows:

• Managing fen	£100/ha/year
• Managing reedbed	£100/ha/year
• Recreating grassland on former cultivated land	£280/ha/year
• Supplement for raised water levels	£60/ha/year
• Managing inter-tidal habitats	£20/ha/year
• Creating inter-tidal habitats on grassland	£250/ha/year
• Creating inter-tidal habitats on cultivated land	£525/ha/year
• Managing vegetated sand dune	£50/ha/year
• Coastal supplement	£60/ha/year
• Inter-tidal habitats creation and management plan	no set agreement

These payments can provide a mechanism for compensating landowners for change of use of agricultural land as a result of Managed Realignment. They are intended to offset income foregone by taking land out of cultivation or pasture. The creation and management plan option can also fund work by private landowners involved in setting up a Managed Realignment scheme, including obtaining consents. The scheme is not intended to provide financial compensation for the loss in the value of land as a result of conversion to inter-tidal. However, the limiting of agreements to a ten-year period is seen as a serious constraint, particularly because of the long-term and essentially

irreversible nature of land use changes brought about by realignment of defences. Whilst it is recognised that in cases where the alternative to Managed Realignment is non-intervention (leading to failure of the defences and no payment), it is believed that the incentives would be more effective if management agreements could run for significantly longer periods than ten years.

10.3 Application of Present Policy

The case studies examined as part of this project (Section 6) found that in each case some form of financial compensation is being made available to landowners:

(a) At Thorngumbald, land involved in realignment is being acquired, with DEFRA funding, for the creation of inter-tidal mudflat and salt marsh. This is on the basis that the new inter-tidal area will itself form part of the new, realigned defence and will also provide compensatory habitat for losses due to other tidal defence works in the Humber Estuary.

(b) At Brancaster, land involved in realignment is being acquired, with DEFRA funding, for the creation of salt marsh which will itself form part of the new, realigned defence.

(c) At Halvergate, the proposed realignment areas include existing agricultural land within the Environmentally Sensitive Areas (ESA) scheme (Section 11.3.4). It is proposed that Broadland Environmental Services Ltd will pay landowners at the ESA rate for the areas of land affected by the works that will no longer attract ESA payments. The landowners will therefore not notice a difference in financial terms. On completion of the works, ESA payments will then be re-calculated by DEFRA and the change in payment as a direct result of the improvement works will be compensated by BESL. The suggestion has also been made that on Broadland flood defence schemes, compensation could in theory be paid outside of DEFRA guidelines. Although the situation with financial compensation at Halvergate has yet to be finalised, it was interesting that BESL stated that there is more flexibility to disburse funds in this way as the public-private partnership has more discretion over expenditure to deliver the flood management service to be provided with DEFRA funding.

The approach adopted at Thorngumbald is consistent with that outlined in a consultation document issued by the Environment Agency in June 2002 on managed

realignment elsewhere within the Humber Estuary (Environment Agency 2002). This document identifies 2,208 ha of land short-listed for possible managed realignment on which comment is invited and states: "*The set-back sites we select will fall into one or other of these categories* [delivering flood defence benefits or compensatory habitat] *so we expect to be able to buy the land needed to deliver our proposals*". The document also indicates that if owners wish to retain their present interest in the land, alternatives available would include financial compensation for change of use or purchase of easements to flood. It is understood that DEFRA has agreed the approach taken in this document to managed realignment on the Humber as according with present policy described in DEFRA 2001. However, DEFRA considers that it may be less applicable elsewhere (David Richardson, personal communication). This is because the Humber has very large flood cells, so that where realignment is adopted a set-back line of defence will generally be required and hence saltmarsh can form part of that defence. In situations where realignment is to higher ground, there would not be the same case for creating saltmarsh to form part of the defence and therefore realignment may fall outside of this criterion for land acquisition. Land may, however, still be required for habitat creation, either as mitigation or compensation for other schemes or on an anticipatory basis (Section 11) and could be acquired for this purpose. It is, however, notable that the Environment Agency consultation document for the Humber breaks new ground in terms of encouraging open participation in strategic decisions on Managed Realignment. If land acquisition or other financial compensation were not included in the package, it is unlikely that the proposals contained within it would be perceived as realistic or politically acceptable. Depending on the outcome of the cponsultation proces on the Humber, there may be a case for adopting similar approaches to consultation and public participation elsewhere.

10.4 Conclusions

The existing situation arises from the position in law that flood and coastal defence is permissive and, with few exceptions, there is no right to protection from erosion and flooding. It therefore follows that in general there is no right to financial compensation when such protection is not provided. However, as the discussion of existing policy demonstrates, the present situation does give rise to apparent anomalies, where one party may get financial compensation and another is denied it, when, on the face of it, both are similar cases but the precise justification for the realignment is slightly different. In practice, most realignment schemes will provide a range of benefits (for example better flood defence, habitat creation and lower maintenance

costs) and under present legislation, some of these gains may be delivered at a cost to the individual landowner (public gain versus private loss). This is likely to be perceived as inequitable, particularly within local communities. It was notable that one reason why the communities at Thorngumbald and Brancaster were broadly supportive of the realignment schemes is that the landowners directly affected were perceived to have been dealt with fairly, in that their land had been acquired by agreement.

A number of potential objections is likely to arise to any proposal for wider eligibility for financial compensation:

- Potential expense to public funds. However, as compensation costs would be included in financial and economic analyses of projects, Managed Realignment would only go ahead if it is the most economic option, even after allowing for financial compensation.

- It may be difficult to draw a clear boundary between Managed Realignment (with financial compensation) and unmanaged realignment (i.e. Non Intervention). In other words, a new set of potential anomalies could be opened up, depending on whether a sea defence breach was planned (intentional) or unplanned (simply the result of natural processes) and a suitable distinction would need to be made.

- It could replace the present problem of potential land blight with a new one of potential land speculation, where land likely to be considered for Managed Realignment is acquired by entrepreneurs hoping to sell it to the state at a higher price.

Careful consideration would need to be given to how these issues could be addressed as part of any change to procedures on compensation.

Despite the potential objections, it could be very difficult to bring forward significant numbers of Managed Realignment schemes to implementation in the absence of more general provisions for financial compensation. Operating authorities are susceptible to political pressures, and these will almost always be very strong where individuals stand to lose an asset (e.g. agricultural land), whatever the wider benefits which may accrue to society (see Section 6). It could be argued that the choice is between low-cost Managed Realignment or non-intervention (without financial compensation) and more

expensive Managed Realignment (with financial compensation), and that the former is preferable from the point of view of the public purse. However, the authors of this Review would argue that in practice the choice is more often between Managed Realignment with financial compensation and a (politically driven) option to hold the line, even where the latter would be less economic. Rather than being perceived as a cost to the public purse, such targeted compensation could be regarded as a way of unlocking wider benefits in the public interest.

11 Nature Conservation

11.1 Introduction

There is an extensive body of nature conservation legislation relevant to flood and coastal defence, which has been amplified by non-statutory plans, policies and guidance. The purpose of this section is to summarise the bearing that these instruments have as constraints and drivers for Managed Realignment.

11.2 Legislation

There are general duties on flood and coastal defence operating authorities to contribute to the conservation of nature when carrying out their functions. These are contained in the Environment Act 1995, the Land Drainage Act 1991 (as amended) and the Wildlife and Countryside Act 1981 (as amended by the Countryside and Rights of Way Act 2000).

The most specific requirements arise from the Conservation (Natural Habitats &c) Regulations 1994 ("The Habitats Regulations"). These transpose into UK law the provisions of the European Union Habitats Directive (Directive 92/43/EEC). During consultation for this study (Sections 3, 5 and 6), stakeholders often referred to "Habitats Directive" and "Habitats Regulations" interchangeably or as if synonymous. In fact, it is only the Regulations that are directly applicable in the UK. In this Section, we have where necessary distinguished between the Directive, the Regulations and the way in which they have been interpreted/implemented.

The Habitats Directive and Regulations principally deal with Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), together termed "European sites" and forming a network of protected areas called "Natura 2000". The duties of particular relevance to flood and coastal defence schemes are:

(a) Regulation 3(4): "Every competent authority in the exercise of any of their functions shall have regard to the requirements of the Habitats Directive so far as they may be affected by the exercise of those functions".

(b) Regulation 48: "A Competent Authority, before deciding to undertake or give any consent, permission or other authorisation for a plan or project which:

- is likely to have a significant effect on a European site in Great Britain (either alone or in combination with other plans or projects); and
- is not directly connected with or necessary to the management of the site;

shall make an appropriate assessment of the implications for the site in view of that site's conservation objectives…..

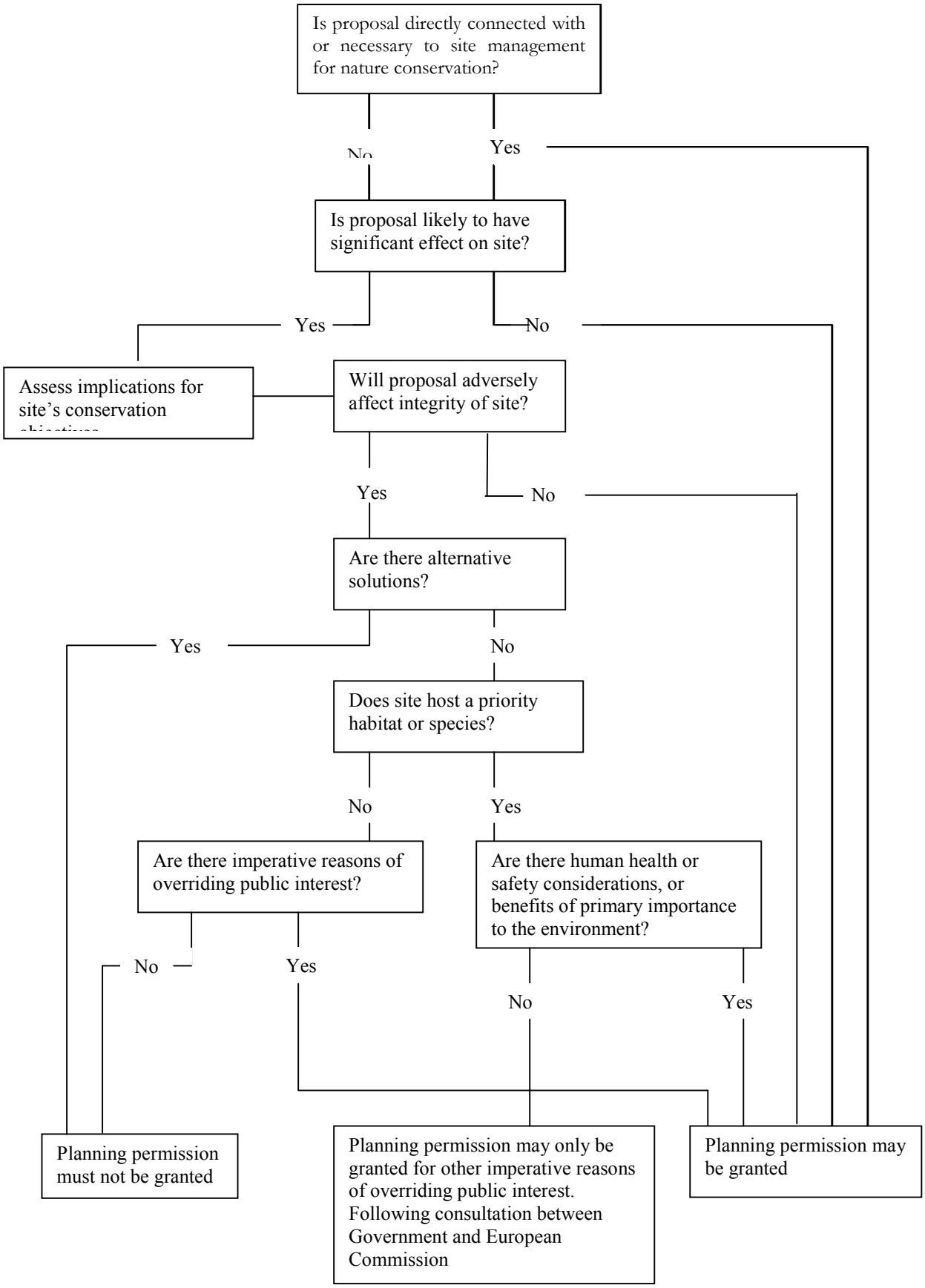
In the light of the conclusions of the assessment, and subject to Regulation 49, the authority shall agree to the plan or project only after having ascertained that it will not adversely the integrity of the European site."

(c) Regulation 49 goes on to state that a plan or project may be agreed notwithstanding a negative assessment for the site only if there are no alternatives and there are imperative reasons of over-riding public interest. In such a case, Regulation 53 requires that necessary compensatory measures are taken to ensure that the overall coherence of Natura 2000 is protected.

The route through Regulations 48 and 49 of the Habitats Regulations for projects subject to planning permission is summarised as a flowchart in Figure 11.1.

The requirements of the Habitats Regulations appear to act both as a driver and a constraint to Managed Realignment. Regulation 3(4) and Regulation 53 are both being interpreted by English Nature and the Environment Agency as requiring measures which maintain the extent of qualifying habitats (in SACs) and habitats supporting qualifying species (in SPAs). In the case of many European sites, this includes inter-tidal habitats such as salt marsh. Often, compliance with Regulation 3(4) and Regulation 53 can most readily be achieved by Managed Realignment to create new or replacement inter-tidal habitat on land previously protected by flood defences. This was cited as a significant driver to Managed Realignment by many consultees.

Figure 11.1 Consideration of development proposals affecting SPAs and SACs



However, there is another sense in which the Habitats Regulations may be a constraint to Managed Realignment. This is that Regulations 48 and 49 create a strong presumption that habitats be preserved in their present location. Only where "no alternatives" and "imperative reasons of over-riding public interest" are demonstrated can provision of compensatory habitat be an acceptable alternative to *in situ* conservation. Whilst "over-riding public interest" is often straightforward to demonstrate in the case of flood defences protecting life and property, there are often a number of alternative ways of achieving this objective, particularly since the cost of alternatives is not an explicit factor in the Regulations. This can constrain Managed Realignment because many freshwater habitats, such as grazing marsh, are also protected by the Regulations, and would be transformed into salt marsh if Managed Realignment were implemented. It further acts as a constraint because sustainable management of, for example, an estuary may benefit from relocating areas of salt marsh from one site to another, but this runs counter to the presumption of *in situ* preservation.

The three Managed Realignment case studies examined during this research project have each taken a different route through the Habitats Regulations:

(a) An Appropriate Assessment carried out on the Thorngumbald scheme concluded that it may have an adverse effect on the integrity of the Humber Estuary SPA. The scheme was subsequently approved on the basis of over-riding public interest and that none of the technically viable alternatives were more environmentally acceptable. Significant new inter-tidal habitat is being created at Thorngumbald, not only to mitigate the local adverse effects on the SPA, but also as compensatory habitat for other tidal defence works in the estuary where adverse effects on the integrity of the SPA have been identified.

(b) The Brancaster scheme was approved on the basis that it would not adversely affect the integrity of the Norfolk Coast SPA, the North Norfolk Coast and Gibraltar Point Dunes cSAC or the Wash and North Norfolk Coast Marine cSAC.

(c) The Halvergate scheme has not yet received consent, but following meetings with English Nature, RSPB and DEFRA, BESL is seeking to take the scheme forward on the basis that it is necessary for the conservation management of the Broads cSAC and Broadland SPA. This approach has been agreed in principle although, additional information is required to understand the level of flood protection the designated site should procure. Furthermore, as a direct result of this decision, the project

does not require an Appropriate Assessment to be undertaken to determine whether it may have an adverse effect on site integrity.

English Nature has produced a set of Habitats Regulations Guidance Notes, endorsed by DEFRA and other agencies, of which numbers 1 to 4 have been published and more are in preparation. There are at least three respects in which present practice in implementing the Regulations appears to run counter to the need for flexible application within an essentially dynamic environment such as the coast. On the basis of English Nature guidance and case law (but not explicit within the Directive or the Regulations):

- In many cases, a very strict definition of what constitutes "adverse effect on integrity" is being promoted. For example, we are aware of flood defence projects where loss of the order of 1% of a dynamic and potentially re-creatable habitat from a site is being treated as having an adverse effect on site integrity. In many cases, this is a much smaller area than would be affected by natural processes of change over a period of a few years.
- Re-creation of a habitat outside European site boundaries is not allowed as mitigation for the purpose of determining adverse effect on integrity, so the requirements of Regulation 49 must first be met. It may be questioned whether a strong presumption for *in situ* preservation is appropriate in relation to dynamic coastal habitats, particularly when they can be readily re-created as an alternative means of maintaining the area of habitat locally. Murby (2002), citing Cley/Salthouse as an example, argues that the present presumption that habitats be preserved *in situ* not only runs counter to natural processes, but leads to schemes being brought forward that are actively damaging to nature conservation interests.
- Very few projects have been progressed under the criterion that they are "directly necessary for and connected with the management of the site". Arguably, projects that enhance sustainable management of an estuary or river and therefore the habitats within it could fall into this category.

Some of these issues are being examined in a current study "Options for maintaining features of European Importance in dynamic coastal situations" being undertaken as part of English Nature's *Living with the Sea* project. This is considering issues such as whether we should aim to conserve or preserve habitats, whether site boundaries should be flexible or tightly defined, how habitats should be accounted for, how favourable conservation status relates to site integrity and how to involve the community in decision-making. (Source: www.english-

nature.org.uk/livingwiththesea/project_details/framework.asp). Practice in other European countries is being examined as part of the study, which is due to report at the end of 2002.

11.3 Existing Policy Guidance

Non-statutory instruments relating to nature conservation include:

- Biodiversity Action Plans (BAPs), produced both at UK and local level;
- DEFRA High Level Targets;
- Coastal Habitat Management Plans (CHaMPs) being prepared for certain complexes of European sites on the coast;
- DEFRA's agri-environmental schemes (countryside stewardship and environmentally sensitive areas); and
- DEFRA's funding criteria for flood and coastal defence.

DEFRA produced a consultation note (2001c) on the role of flood and coastal defence in nature conservation in England. The purpose is to address uncertainty on what is legitimate expenditure on nature conservation in flood defence.

11.3.1 Biodiversity Action Plans

BAPs have been prepared for both habitats and species at both national and local level. An England Biodiversity Strategy is due to be produced in Autumn 2002. Of particular relevance to Managed Realignment is the national Habitat Action Plan for coastal salt marsh, which sets the following targets (Source: www.ukbap.org.uk):

- To offset the current losses due to coastal squeeze and erosion, to maintain the existing extent of salt marsh habitat of approximately 45,500 ha, and to restore the area of salt marsh to 1992 levels (the year of adoption of the Habitats Directive, which included salt marsh as a habitat type of community interest). There is a need to identify realistic and achievable targets for creation. The results of individual estuary evaluations during the first five years of this 15 year plan will allow the headline targets set out below to be reviewed and refined. Such studies will also identify potential locations for salt marsh creation. There will be a presumption against any further net loss of salt marsh

to land claim or other anthropogenic factors. The best available information has been used to establish the targets below.

- There should be no further net loss (currently estimated at 100 ha/year). This will involve the creation of 100 ha/year during the period of this plan (total 1,500 ha). However, local losses and gains are to be expected in this essentially dynamic system.

- Create a further 40 ha of salt marsh in each year of the plan to replace the 600 ha lost between 1992 and 1998, based on current estimates.

- Maintain the quality of the existing resource in terms of community and species diversity and, where necessary, restore the nature conservation interest through appropriate management. It will be desirable for some Managed Realignment sites to develop the full range of salt marsh zonation.

There are also national Habitat Action Plans for coastal and floodplain grazing marsh (much of which is protected by existing flood defences) and fen, marsh and swamp (no targets set yet, but these habitats can potentially be created by fluvial defence realignment). A number of Local Biodiversity Action plans have adopted targets for their areas to contribute to meeting national targets. These are likely to be seen as increasingly important drivers to Managed Realignment.

11.3.2 *Coastal Habitat Management Plans*

CHaMPs are being prepared under the auspices of English Nature's "Living with the Sea" project, supported by European funding, for complexes of European sites in six different parts of eastern and southern England. They provide a mechanism for delivering commitments under the Habitats Directive for European sites and addressing conflicts between sustainable management of dynamic coasts and the protection of European sites. This is particularly relevant to Managed Realignment in instances such as where retreat is needed to maintain SAC inter-tidal habitats suffering coastal squeeze, but retreat would entail the loss of SPA freshwater habitats landward of the existing defence line. There is a presumption within CHaMPs that sustainable coastline management through working with natural processes should be the preferred course of action. This implies that Managed Realignment is likely to be a preferred policy response to rising sea levels, with habitats re-created in other sites to maintain the principle of "no net loss".

The CHaMPs are still in preparation and the approach that will be taken to resolving these conflicts is not yet clear. However, at the time of preparing this report, a copy of the draft CHaMP for the Essex Coast and Estuaries (Posford Haskoning, 2002) was available. This includes an inventory of cSAC and SPA features, a review of the geological and geomorphological context, historic habitat gains and losses, predicted shoreline changes and their impact and discussion of management options. The draft CHaMP predicts that 1,616 ha of salt marsh will be lost from the Essex estuaries over the next 50 years if the present flood defence regime is continued, and that Managed Realignment of some 3,000 ha of presently protected land would be required to replace this loss.

11.3.3 *High Level Targets*

The main instrument of DEFRA policy on incorporating nature conservation objectives into flood and coastal defence schemes is the High Level Targets issued in November 1999 (MAFF, 1999b). These provide a framework for operating authorities and define what conservation work can legitimately be undertaken using flood and coastal defence funding.

High Level Target 9A states that when carrying out flood and coastal defence work, operating authorities shall aim:

- to avoid damage to environmental interest;
- to ensure no net loss to habitats covered by Biodiversity Action Plans; and
- to seek opportunities for environmental enhancement.

The objective of "no net loss" is therefore extended from habitats protected by the Habitats Regulations to all those that are covered by BAPs (both UK and local). The third objective goes beyond this and indicates that creation of new habitat may also be a legitimate use of funds. DEFRA (2001c) states that enhancements are acceptable as part of a flood and coastal defence scheme provided they are appropriate in scale (incidental to the main works), directly linked to the main works, their costs and benefits are taken into account and opportunities are sought for partnerships to deliver them. In many cases, the objectives for High Level Target 9A appear to favour the adoption of Managed Realignment over other policy options, particularly where inter-tidal habitats are would be adversely affected by coastal squeeze if a "Hold the Line" policy were adopted.

High Level Target 10A states that operating authorities are to provide an outline timetable for preparing a programme for implementing and reviewing Water Level

Management Plans, which provide another mechanism for delivering statutory nature conservation duties and targets contained in Biodiversity Action Plans.

High Level Target 11A states that operating authorities shall identify sites where a CHaMP is needed and produce a programme for their completion.

11.3.4 *Agri-environmental Schemes*

DEFRA operates two principle schemes: Countryside Stewardship and Environmentally Sensitive Areas (ESAs). A review is currently underway to examine their future (Source: www.defra.gov.uk/erdp/schemes/landbased/review/aedraftnew. htm).

The waterside and inter-tidal options of the Countryside Stewardship scheme operated by DEFRA provide a mechanism for delivering BAP targets through financial compensation to farmers, and are discussed in Section 10.

The ESA scheme aims to maintain and often to enhance the conservation, landscape and historical value of the key environmental features of an area, and, where possible, improve public access to these areas. There are currently 22 ESAs in England and each has a series of tiers identifying operations for which payments can be made to farmers. Some ESAs (for example, Broads, Suffolk River Valleys, North Kent Marshes and Somerset Levels) have tiers relating to raising water levels and maintaining wet grassland, which are relevant to fluvial flood defence realignment. It has been suggested (Rees, personal communication) that the presence of an ESA may be a constraint to coastal Managed Realignment, particularly where significant public investment had been made in existing agricultural land uses. Radley (personal communication) indicated that DEFRA would not see this as a major factor constraining an application for conversion of an area within an ESA to inter-tidal.

11.3.5 *Coastal and Flood Defence Funding Criteria*

The priority scoring system announced by DEFRA in March 2002 will run from 1 April 2003 until 2006. There are three elements: economics, people and environment, which are weighted in the proportion 20:12:12 respectively. The environment score is designed to give additional priority to schemes that provide direct benefit to nationally and locally designated sites and also where a scheme would contribute to achieving national BAP targets or the protection of built heritage sites.

Current guidance confirms the position, first announced in July 1998, that flood and coastal defence funding is available to protect European sites irrespective of priority score or traditional economic valuation criteria. This recognises the requirement of the Habitats Directive to protect such sites. In practice, this provision is perhaps more likely to result in holding the line to protect freshwater sites, rather than Managed Realignment to allow landward migration of inter-tidal sites. It may, however, be used to justify partial setback by building a new, retreated line of defence to protect part of a designated site, rather than realignment to high ground. This has occurred at Brancaster (Section 6) and also at Cley/Salthouse, though in the latter case the proposed realigned bank was found to have an adverse effect on the integrity of the site requiring compensatory habitat.

DEFRA's Flood and Coastal Defence Project Appraisal Guidance Note 3 (MAFF, 2000b) gives indicative standards for different land use bands, which includes the protection of nature conservation sites. These suggest that environmental assets of international importance requiring protection should be defended to a 1:25 to 1:100 year standard, environmental assets of national significance requiring protection to a 1:5 to 1:50 year standard and environmental assets of local significance to a 1:1.25 to 1:10 year standard. This approach does not take account of how robust different habitats may be to occasional inundation. In some cases (e.g. Cley/Salthouse), an approach may be developed where a front line defence protecting habitats is maintained to a lower standard than a secondary line protecting property, in essence a hybrid between Managed Realignment and holding the line.

11.4 Conclusions

Nature conservation legislation and objectives, in particular the Habitats Regulations, are important drivers to Managed Realignment, but also in many cases a constraint. The ways in which the Regulations themselves act as a constraint include:

- The complexities that the Habitats Regulations have introduced to the planning process are one of the major causes of protracted delays in bringing realignment (and other) schemes forward for implementation. Delays arise from the Appropriate Assessment process and, if projects may adversely affect the integrity of European sites, from the need for consent from the Secretary of State before consent can be granted.

- The requirement to show "no alternatives" before a project that may adversely affect the integrity of a European site can be consented.

The ways in which the interpretation of the Regulations (i.e. how they are applied) can act as a constraint to Managed Realignment include:

- The application of strict tests of "necessary for site management" and "adverse effect on site integrity" makes it more likely that the "no alternatives" test will be triggered.

- A strong presumption of *in situ* habitat preservation within tightly drawn, fixed site boundaries makes it difficult to adopt Managed Realignment as an approach to achieving sustainable coastal management through allowing natural habitat migration and by artificial habitat re-creation.

The result is that Managed Realignment will often be found to have an adverse effect on the integrity of adjacent European sites, and it can only then proceed if there are no alternatives. In many cases, there is more than one alternative approach available to achieve flood and coastal defence objectives, and hence under these criteria then an alternative approach would have to be followed.

12 Planning and Consents

There was a consensus at the regional and case study workshops that the planning process is complex and, in the case of several Managed Realignment schemes, has caused long delays in implementation. This topic was not explored in detail at the workshops, partly because, although several representatives of the planning community were invited, few were present. A brief review of some issues identified from the study team's experience is provided here.

12.1 Consents

For flood and coastal defence schemes generally, there is a number of consents that are required. Typically, these include:

- Planning permission from the local authority under the Town and Country Planning Act 1990;
- Department of Transport, Local Government and the Regions (DTLR) under Section 34 of the Coast Protection Act (1949) with regard to safety of shipping;
- Department of Environment, Food and Rural Affairs (DEFRA) under Food & Environmental Protection Act (1985) with regard to fisheries, ecology and other similar interests;
- Environment Agency (EA) under Environment Act (1995), Land Drainage Act (1991), Water Resources Act (1991), Flood Defence (Land Drainage) Bylaws / Sea Defence Bylaws and Highways Act (1980); and
- Crown Estate, with respect to groyne construction and shingle placement below the level of mean high water.

Where improvements to existing flood defence schemes are brought forward by the Environment Agency, planning permission is not normally required. However, Managed Realignment schemes often entail constructing a set-back defence on a new alignment and/or a change of land use in the retreated area, and schemes of this type generally do require planning permission. The Habitats Regulations (Section 11) also introduce a requirement for planning consent in respect of schemes that may adversely affect the integrity of a European site. Such consents are subject to approval by the Secretary of State, which can incur delays of the order of a year over and above the normal planning process.

12.2 *Plans and Policies*

Flood and coastal defence schemes are subject to a range of statutory and non-statutory plans and policies.

12.2.1 *Statutory Plans and Policies*

National Guidance is provided in a series of Planning Policy Guidance (PPG) Notes produced by the Department of Transport, Local Government and the Regions. Of particular interest are the following:

- PPG7: The Countryside – Environmental Quality and Economic and Social Development. Paragraphs 2.16 to 2.20 (of which 2.17 and 2.18 were modified in March 2001), are of particular relevance to Managed Realignment in cases where good quality agricultural land would be affected. These paragraphs are quoted as follows:

  "2.16 In preparing development plans and considering planning applications, local planning authorities should take account of the quality of any agricultural land that would be lost through development proposals. Annex B explains the grading of agricultural land according to its quality, and gives detailed advice on development affecting it.

  "2.17 Development of greenfield land, including the best and most versatile agricultural land (defined as land in grades 1, 2 and 3a of the Agricultural Land Classification), should not be permitted unless opportunities have been assessed for accommodating development on previously-developed sites and on land within the boundaries of existing urban areas (see PPG3 in respect of housing development). Where development of agricultural land is unavoidable, local planning authorities should seek to use areas of poorer quality land in preference to that of a higher quality, except where other sustainability considerations suggest otherwise. These might include, for example, its importance for biodiversity, the quality and character of the landscape, its amenity value or heritage interest, accessibility to infrastructure, workforce and markets, and the protection of natural resources, including soil quality. Some of these qualities may be recognised by a statutory wildlife, landscape, historic or archaeological designation, such as a National Park or Site of Special Scientific Interest.

  "2.18 Local authorities planning to allow the development of greenfield land, where soil or agricultural quality is a consideration, should seek advice from MAFF and from other relevant bodies such as English Nature, the Countryside

Agency, the Environment Agency or English Heritage, as appropriate. They may also be required to consult one or more of these agencies of any intention to allow development under the Town and Country Planning (General Development Procedure) Order 1995, and in respect of development plan proposals as described in Annex C to PPG12. The decision whether to utilise BMV land for development is for each local planning authority, having carefully weighed the options in the light of competent advice.

"2.19 Agricultural land in grades 3b, 4 and 5 is of moderate or poor quality and is less significant in terms of the national agricultural interest. In making the assessment set out in paragraph 2.8, little weight in agricultural terms should be given to the loss of this land, except in areas such as hills and uplands where particular agricultural practices themselves contribute in some special way to the quality of the environment or the local economy. The policies set out elsewhere in this PPG for protecting the countryside for environmental and other non-agricultural reasons apply equally to agricultural land, including land in lower grades.

"2.20 Structure, local and unitary development plans should include policies for the protection of the best and most versatile agricultural land, and make clear the approach adopted to the protection of the different grades of agricultural land within the area. Regional Planning Guidance should address these issues where necessary. If undeveloped land needs to be developed, any adverse effects on the environment should be minimised. Once land is built on, the restoration of semi-natural and natural habitats and landscape features is rarely possible and usually expensive and archaeological and historic features cannot be replaced. Minerals Planning Guidance notes advise on minerals underlying agricultural land."

- PPG 9: Nature Conservation. The implications of nature conservation policy for Managed Realignment are discussed in Section 11.

- PPG 15: The Historic Environment. This PPG sets out policies for protecting listed buildings, Conservation Areas, historic parks and gardens and the wider historic landscape. Special consideration needs to be given to any Managed Realignment proposal that would entail the loss of buildings or features in these categories. Existing flood defence embankments may be considered part of the historic environment and arrangements may have to be made for preservation or recording where it is proposed to remove them.

- PPG 16: Archaeology and Planning. This PPG provides advice on handling archaeological matters in the development process. The main relevance to Managed Realignment proposals is that archaeological investigation may be required in areas of high archaeological potential that are proposed to be converted to inter-tidal.

- PPG 20: Coastal Planning. PPG 20 sets out guidance on the types of uses appropriate to the developed and undeveloped coast, including approaches to environmental protection and enhancement. Managed realignment is not specifically addressed.

- PPG 25: Development and Flood Risk. PPG 25 was published in July 2001 and provides guidance in England on how flood risk should be considered at all stages of the planning and development process in order to reduce future damage to property and loss of life. It requires a precautionary approach to ensure that any development is safe and not exposed unnecessarily to flooding.

Structure and Local Plans are the statutory documents of most immediate relevance to planning applications for coastal and flood defence schemes, including Managed Realignment proposals. Many Local Plans contain policies for the protection of good quality agricultural land, in line with PPG 7. Such policies could be used by local planning authorities as a basis for refusing consent for Managed Realignment schemes that would convert such land to inter-tidal. Policies for the protection of landscape may also be a constraint, particularly in Areas of Outstanding Natural Beauty and Heritage Coasts, where a Managed Realignment scheme involves constructing a new defence embankment inland of the previous line of defence (as at Cley/Salthouse). Some Local Plans do contain policies that proposals for coastal defence will be evaluated against the relevant Shoreline Management Plan, but this is by no means universal.

12.2.2 *Non-statutory Plans and Policies*

The non-statutory plans of most relevance to Managed Realignment are Shoreline Management Plans in the case of the coast (see Section 2.2 and Section 7) and the emerging Catchment Flood Management Plans in the case of rivers (see Section 2.3). There are, however, many other non-statutory documents concerned with planning and guiding the use of the coastline and rivers. These include Coastal Zone Management Plans, Estuary Management Plans, Local Environment Agency Plans, Water Level Management Plans and Heritage Coast Management Plans. What these documents have in common is that they set out to promote a strategic

approach to decision-making for rivers and the coast, including flood and coastal defence issues. Potential weaknesses include:

- the number of different plans and policies with overlapping interests;
- the lack (in the case of some types of non-statutory plans) of clear mechanisms or procedures for implementation;
- initiatives are frequently pursued independently of the plan-led process (e.g. many Managed Realignment schemes have come forward which were not identified in Shoreline Management Plans (Section 2.2); and
- the incorporation of Managed Realignment proposals into plans is often dependent on political pressures on operating authorities such as District Councils, which are usually major stakeholders in plan preparation. We are aware of cases where proposals for managed realignment to create intertidal habitat have been produced separately from SMPs or CHaMPs for the respective area and treated as "confidential", because of their sensitivity where landowners are concerned.

Criticism of SMPs must take into account that these were first generation documents fulfilling a role that had previously not been addressed. It is anticipated that many of the lessons learned will be incorporated into the second round of SMPs.

12.3 Conclusions

The planning process is necessarily complex as it seeks to reconcile many potentially conflicting interests and priorities. However, there is a perception on the part of many stakeholders that the protracted delays experienced in implementing some Managed Realignment schemes have not been in the public interest. This is principally because of the costs of obtaining consents and the flood risk to which communities may be exposed during the planning process. Indeed, there is a possibility that these costs and risks may act as a deterrent to promoting Managed Realignment schemes.

There is also a risk that some existing policies may work against the implementation of Managed Realignment. The role of the Habitats Regulations as a potential constraint is examined in Section 11. Another particular case is policies in statutory Local Plans for protecting agricultural land of Grade 1, 2 and 3a

derived from PPG7 and policies for protecting undeveloped coastal landscape. These are legitimate concerns that need to be weighed against the potential benefits of Managed Realignment when schemes are considered. However, it is worth noting that in the planning process, protection of agricultural land and landscape generally has statutory backing, as authorities are obliged to regard national and local planning policies as material considerations when determining planning applications. On the other hand, proposals for Managed Realignment derived from SMPs, for example for reasons of coastal processes and sustainable shoreline management, may not carry the same weight in planning terms.

There is a perception that the benefits of the strategic approach offered by SMPs have not always been realised in bringing forward Managed Realignment schemes. Evidence for this may be found in the number of Managed Realignment proposals that have been developed independently of SMPs and the number of Managed Realignment schemes proposed in SMPs that have not been progressed towards implementation. The political sensitivity of Managed Realignment, arising from the perception that land may be lost without financial compensation, appears to be one factor discouraging equal consideration in the shoreline planning process with other approaches to coastal defence. We consider that full and open consideration of Managed Realignment within Shoreline Management Plans and other coastal plans is the preferred approach to delivering the benefits of strategic decision making.

13 Recommendations

13.1 Policy Recommendations

13.1.1 General

The issues identified during the Research Project as representing significant barriers to Managed Realignment are addressed in this Section. Recommendations have been made for possible direction of shifts in policy to address these areas. These would be developed further in Phase 2 of the project, and specific proposals for this are outlined in Section 13.2.

An overriding conclusion of the consultation was that there is no simple way of carrying out Managed Realignment. Experience to date suggests that Managed Realignment projects are always likely to be more complex and time consuming than "classical" defence schemes. However, it also seems from the review of case studies (and other sites such as Cley/Salthouse, which was not selected as a case study because of the sensitive stage of the scheme), that they are becoming increasingly costly and taking longer to implement. To some extent this is common to experience of all kinds of major projects in the planning process. However, participants to workshops were broadly unanimous in stating that the current situation is not satisfactory. If Managed Realignment is to be undertaken on a larger scale and become a central plank in coastal and fluvial flood defence strategy, the current approach has to be streamlined.

It was also notable from the questionnaire consultation that the stated views of respondents within DEFRA tend to diverge from those of other stakeholders on several issues. This suggests that successful shifts in policy towards the implementation of cost-effective and environmentally beneficial realignment schemes may require targeting of policy instruments with regard to the views expressed by most stakeholders. The following points suggest ways of integrating these concerns into current policy to allow a more strategic approach to Managed Realignment.

13.1.2 Compensation

The desirability of increased provision of financial compensation to individual stakeholders, such as landowners who are adversely affected by Managed Realignment, has been a strong theme of this research. Financial compensation may comprise either acquisition of land or payments for specific use (or loss of

use) of land, without title being transferred. The Countryside Stewardship scheme offers an example of a possible way forward, where payments to landowners are linked to delivery of societal benefits. We propose:

(a) Closer integration between the rural development and the flood and coastal defence functions of DEFRA, in terms of planning, delivery and funding. It is suggested that the salt marsh and wetland creation options of the present Countryside Stewardship schemes might in future be jointly administered by these two functions.

(b) Options for lengthening the period of management agreements under Countryside Stewardship or its successor scheme(s). Use could possibly be made of the clause in Regulation 1257/1999 that permits agreements over more than ten years "in the case of specific undertakings where a longer period is deemed to be indispensable".

(c) Review of the levels of payment for the relevant inter-tidal and wetland options, so that in combination with the period of agreements, they more fully reflect the loss in value of land brought in to inter-tidal use, and provide adequate incentive to landowners.

(d) Review the scheme so that it is better adapted to deal with multiple landowners.

(e) Possible targeting of scheme resources on land identified as strategically suitable for Managed Realignment;

(f) Making available additional funds from a number of sources, including flood and coastal defence budgets, to complement the present funding from the England Rural Development Programme. This would recognise that benefits from Managed Realignment can include more sustainable coastal management as well as habitat creation and wider socio-economic benefits.

(g) Assessing what changes to the design and management of the schemes would most likely lead to long term anticipatory habitat creation for Managed Realignment.

(h) Incorporating the economics of using agri-environment payments for sustainable coastal redesign into revised cost benefit guidelines.

(i) Examining the scope for enabling landowners to enter into a series of possible management schemes in areas currently proposed for future Managed Realignment treatment.

Many of these ideas could be taken forward through the present review of agri-environmental schemes underway in DEFRA.

We also recommend adopting a wider range of circumstances in which land acquisition is recognised as appropriate when implementing Managed Realignment. Compulsory purchase powers have not been seen as necessary or appropriate, but the option for landowners to sell land to a public agency could be made available as an alternative to use-related payments, where a Managed Realignment scheme is implemented in the public interest. This would essentially be an extension of the existing DEFRA philosophy, which recognises that land can be acquired for specific beneficial uses, but does not currently recognise that Managed Realignment or associated habitat creation *per se* represents a beneficial use.

13.1.3 *Habitats Regulations*

The Habitats Regulations could act as less of a constraint to Managed Realignment if a more flexible interpretation were adopted to their application. In particular, there is an argument for recognising that works "directly connected with or necessary to the management of the site" includes measures to achieve long-term sustainable management of the coast (i.e. working with natural processes), provided that the overall mosaic of habitat types is maintained. This would allow Managed Realignment schemes that change habitat (e.g. from grazing marsh to salt marsh on the coast or grazing marsh to reedbed on rivers) to go ahead without Appropriate Assessment and demonstration of "no alternatives" and "imperative reasons of over-riding public interest", provided the changed habitat were re-established elsewhere. Given that concerns may be raised that habitat creation may not be successful or that the recreated habitats might not deliver similar benefits within a short time period, there is a case for taking a proactive approach to habitat creation, for example through CHaMPs or by anticipatory habitat creation.

We would also argue for a less onerous interpretation of "adverse effect on site integrity". We do not consider that the original directive intended this test to apply to changes in the habitat character (e.g. grazing marsh to salt marsh) of small areas (e.g. a few percent) of a total site. The key test is that the ability of the whole site to support the qualifying habitats and populations of species should not be seriously reduced. Coastal habitats are naturally dynamic, and a degree of change (whether natural or man-made) should be acceptable within their framework for management. Linked to this is the idea that site boundaries should be drawn in such a way that habitats can be allowed to migrate (or be re-created) in accordance with the dynamic nature of the coastal environment.

A number of these issues is being considered as part of English Nature's *Living with the Sea* programme, due to report by the end of 2003. The review of practice in implementing the Directive in other EU countries currently under way is likely to assist in this process. Changes to the Directive or Regulations themselves would not necessarily be required, as many of the constraints appear to arise from the way in which they are currently being implemented. It is proposed that a position should be agreed with DEFRA, Environment Agency and English Nature and incorporated in future editions of the Habitats Regulations Guidance Notes and, in due course, in a revised version of PPG9.

13.1.4 *Planning and Consents*

The planning process is complex and often causes long delays, both in terms of technical details and obtaining consents. Many of the issues seem to be due to the relatively novel nature of Managed Realignment. Experience from these early cases should be documented to provide useful information for future cases and accelerate the process. There is a case for Managed Realignment issues to feed into broader land-use planning at an earlier stage. Although some Local Plans make reference to SMPs, it seems that a mechanism for Managed Realignment proposals to fit into Local Plan policies is often lacking.

Creating a stronger link between the strategic approach provided by SMPs, CFMPs and associated strategies is seen as a key way to reduce the planning difficulties encountered in bringing Managed Realignment forward. In other words, we suggest moving to a situation that there is a presumption in statutory Local Plans in favour of Managed Realignment in locations where it has been adopted as the preferred approach by the relevant SMP, CFMP or strategy, even where other policies may conflict.

Reducing the political sensitivity of Managed Realignment would contribute to enabling more balanced consideration with other coastal defence options and therefore better integration into the strategic planning process. Mechanisms for this could include public education about benefits of Managed Realignment and financial compensation to landowners, so as to reduce the perception that such benefits are achieved at the expense of private loss.

13.1.5 *Consultation and Pubic Participation*

Appropriate consultation and public participation are important in developing any scheme. Involving stakeholders is not easy. It is time consuming, intensive in management time and can lead to outcomes that are not in the best interests of

strategic flood management. Managed realignment is a complex issue, which needs to be explained and expectations need to be managed. The review of case studies has shown that it is essential to start consultation in early stages, and find a way of "selling" the scheme to local communities to avoid delays in later stages. Keeping communities involved in the post-scheme phase is also important. Constructive ways to inform and involve the local communities need to be explored, such as the steering groups and local fora that were set up at case study sites. These should have a role both in designing the scheme and in monitoring its success.

13.1.6 *Investigation of project risks in Managed Realignment*

Phase One of the study focussed on identifying the constraints and drivers for Managed Realignment. One of the themes of the constraints identified was the higher degree of (perceived and real) uncertainty faced when developing Managed Realignment compared to a hold the line scheme.

This uncertainty may be inherent in the lack of ability to predict physical processes, in the anticipation of longer periods required to obtain consents and licences, in the estimation of long-term maintenance costs or in other similar factors. Such uncertainties may stem partly from the lack of previous examples of similar schemes. From experience, flood and coast defence decision-makers tend to be risk averse. Lack of guidance information in an up-to-date well-recognised form may contribute to the perception of uncertainty. Equally, the perception of "higher risk" of Managed Realignment may arise from an unrealistically low assessment of the risks faced when holding the line.

Many of the coastal and estuarine schemes that have been carried out to date and studied in the course of Phase One have been developed either before or outside the Shoreline Management Planning process. Effective strategic planning requires that future schemes, whether coastal, estuarine or riverine, be developed within the established strategic framework. This has implications for the development of future schemes. In particular, it has been identified in the course of the review of the development of schemes (Chapter 2) that once Managed Realignment has been identified in a Shoreline Management Plan (SMP), there has been a 44% uptake in terms of the number of schemes brought forward. Planning for the second round of SMPs and first round of Catchment Flood Management Plans should therefore include the feasibility of including further Managed Realignment proposals. If the decision of whether to develop Managed Realignment or not is to be taken at the policy stage, a more efficient way of identifying the risks needs to be established.

13.1.7 *Economic Valuation*

Environmental benefits and costs should be included explicitly in economic appraisals of schemes and be taken into account by the scheme prioritisation system, while taking care that there is no overlap between the economic and environmental criteria. Current advice in the Flood and Coastal Defence Project Appraisal Guidance is to use habitat replacement costs as a proxy for the value of habitat loss. However, these are likely to be a significant underestimate, as the total economic value of an ecosystem is likely to be higher than the costs of recreating it. A more thorough review of the relative importance of services provided by inter-tidal habitats would provide insights into which services should be valued in priority. New valuation studies should be designed with benefit transfer in mind to avoid the need for further costly studies in the future.

To get the full benefits of Managed Realignment, there needs to be a strategic approach, integrating traditional benefit-cost measures with wider environmental, nature conservation and socio-economic consequences. The new DEFRA priority scoring system, which includes elements for economics, people and environment, represents a move towards recognising the inter-dependence of these issues.

13.1.8 *Natural Processes*

The review of the scientific aspects of natural coastal processes as a 'driver' or 'constraint' to Managed Realignment implementation (Chapter 7) clearly points to a range of issues that require further investigation:

(a) The review has shown the need to recognise the close links between political, social, economic and technical issues on the one hand and the availability and use of scientific knowledge of the role of natural processes on the other. These links are important as they may either prevent existing natural process knowledge being used fully (e.g. where it contradicts a powerful political aim) or limit the extent to which a case could be put forward for/against Managed Realignment (e.g. if there is a lack of appropriate natural process knowledge).

(b) A general lack of coastal process information has been identified. This lack of information is particularly strong in the case of longer term (>5 years) and site-specific studies.

(c) Better integration of scientific knowledge of natural coastal processes, including knowledge relating to restoration and reconstitution into

Managed Realignment discussion / scheme planning is necessary. In particular, it was surprising to find that existing process knowledge was often not considered in detail for the purpose of addressing the principal 'physical'/'natural' sustainability of any Managed Realignment scheme. As the natural sustainability of a scheme has to be guaranteed, however, before any economic or social sustainability assessment can be carried out, this provides a key area that needs to be addressed in future.

(d) Lastly, and related to the previous point, it has become clear that Managed Realignment planning or implementation currently does not take natural process knowledge into account in a quantitative way. It is now, for example, possible to quantify the degree of wave attenuation over vegetated and non-vegetated inter-tidal surfaces (Möller *et al.*, 2001), yet the economic benefits of this new scientific knowledge have not been quantified. There is clearly a need to:

(i) Help practitioners/planners decide which natural process data are relevant to the assessment of a particular scheme; and

(ii) Develop mechanisms (e.g. decision support systems) through which practitioners can use this existing scientific knowledge to aid economic and environmental assessments and decision making and/or decide what other scientific knowledge (or data) needs to be collected in order to improve the decision making process.

13.1.9 *Overseas Review*

The review of Managed Realignment as a coastal management option overseas has indicated that, while some similarities exist as regards drivers and constraints to Managed Realignment implementation, the detailed political, economic, social, and scientific/technical factors involved in the implementation of individual schemes differ considerably. The investigation into financial compensation as a possible funding mechanism overseas has highlighted the importance of differences in the structure of the public sector and the level of public awareness in the different countries. Due to these differences, it would be impracticable to transfer experience directly from overseas to the UK situation. However, if Managed Realignment implementation in the UK is to be promoted as a viable and realistic coastal management option, some elements of the experience in implementing Managed Realignment overseas (such as developing ways of increasing its political acceptability) are worth investigating in more detail.

The review carried out as part of this project has shown that Managed Realignment approaches to coastal defence are being discussed widely within Europe and the US. We would thus recommend that these discussions should be followed closely, in particular with respect to more generally applicable issues, such as:

(a) building public awareness and attempts to increase levels of political acceptability of (and, in particular, financial compensation mechanisms as part of) Managed Realignment as a coastal defence option;
(b) degrees to which the natural sea-defence capacity of re-created inter-tidal areas is being either taken into account and/or quantified (see also 'process uncertainty' recommendations in Section 13.1.7).

13.2 Proposals for Phase Two of Study Project

During the course of the study, we identified that a number of studies and policy reviews that have a bearing on Managed Realignment are already underway. Rather than duplicating such work, we propose that Phase 2 should concentrate on working with these projects to ensure that their outputs reflect the needs identified to overcome barriers to achieving benefits from Managed Realignment. In other cases, we have proposed separate activities arising directly from Phase 1 of this project.

13.2.1 Financial Compensation

Phase Two of the research project should include participation in DEFRA's agri-environmental review team. The objective will be to ensure that proposed revisions to the scheme will deliver the proposed integration with flood and coastal defence requirements and be structured in such a way as to provide adequate incentives for landowners to participate in Managed Realignment. This input will need to take place during 2002.

Further work should take place with DEFRA's flood and coastal defence staff to develop guidelines on land acquisition for Managed Realignment. This should include defining circumstances where land can be acquired and guidance on valuation, and distinguishing between Managed Realignment as opposed to Non Intervention. It will build on results of DEFRA's recent consultation exercise on financial compensation issues.

We have identified that funding from Managed Realignment should come from a wider range of sources, over and beyond the necessary integration with agri-

environmental schemes, to increase the overall budget and recognise the variety of benefits from Managed Realignment. OXERA (2001) has undertaken a review of funding options for flood and coastal defence, recommending innovative instruments such as a flood plain levy, or development charges. There needs to be a similar investigation of funding options for Managed Realignment, taking into account not only flood defence benefits, but wider environmental and socio-economic impacts, taking a constructive and innovative to Managed Realignment funding in the form of multiple source funding "packages".

13.2.2 *Habitats Regulations*

Phase Two of the project should include participation in English Nature's Living with the Sea programme *Options for maintaining features of European Importance in dynamic coastal situations.* The objective will be to ensure that the specific needs relating to Managed Realignment are reflected in an approach that will achieve sustainable coastline and fluvial management whilst complying with obligations under the Habitats Directive. This input will need to take place during 2002. Specific outputs will be a report describing how the role of the Regulations will be adapted to bring about a more proactive approach to Managed Realignment and specifying proposed revisions to PPG 9 (Nature Conservation) and the Habitat Regulations Guidance Notes.

13.2.3 *Planning*

We propose to prepare a guide to proposed revisions of PPG 7 (Countryside), PPG 20 (Coastal Planning) and PPG 25 (Development and Flood Risk), providing links between coastal and fluvial redesign, planning and stakeholder involvement. The aim here would be to integrate the principles of sustainable development into planning and coastal/flood defence economics, so that Managed Realignment becomes a process for creating sustainable futures for coastal and riparian communities and their visitors. A key objective will be to improve the links between SMPs and CFMPs on the one hand and the statutory planning process on the other, so as to reduce conflicts during the scheme planning and implementation process. The role of public education and other initiatives in reducing the political sensitivity of Managed Realignment would also be included. Revisions could also look at fresh approaches to managing planning between those parts of the coast and flood plains where future development will be possible and those where it will not.

13.2.4 *Economic Valuation*

This report has identified the need for better integration of social costs and benefits in Managed Realignment project appraisals. We recommend that these should be investigated in further detail to come up with a range of estimates for expected non-market values, with the aim of revising the relevant sections of FCDPAG3. For this, it is proposed that a benefit transfer study should be carried out. At its simplest, this would involve a meta-analysis of existing studies directly targeted towards Managed Realignment benefits. However, we have identified that there is a lack of suitable valuation studies, especially ones carried out in the UK. A more suitable approach would be a new valuation study aimed specifically towards identifying a benefit transfer function for Managed Realignment schemes. A contingent ranking study would be particularly suited to this objective, with a survey of people's preferences for different aspects and functions of wetlands. This could focus on a real wetland displaying a variety of functions, or a hypothetical wetland displaying all possible functions. Virtual reality is likely to be a useful tool in this exercise, as it has already shown to be a useful tool in coastal zone management consultation. Such a study, when complete, would not need to be repeated for individual schemes as it would provide values that could be used for future scheme planning.

13.2.5 *Practical Implementation of Anticipatory Habitat Creation*

Anticipatory Habitat Creation, whereby a large area of habitat is created ahead of displacement or loss, could alleviate some of the difficulties encountered relating to habitat creation. This includes a number of issues raised during consultation, such as the complexity of the planning system and delays associated with the Habitats Directive, the uncertainties about what type of habitat the schemes would provide, and the increase of transaction costs. A recent informal workshop between a number of government agencies and non-governmental organisations concluded that strategic land acquisition would be a more acceptable approach than the formal system of "habitat banking" adopted in the United States. Although land banking is widely advocated as a better alternative to site by site mitigation under the US wetland federal law, it is reported to lead to a decline in habitat quality and quantity. There are some specific issues regarding the practical implementation of anticipatory habitat creation in this country that need to be investigated in detail, with widespread consultation of interested parties. We recommend a review of these issues, with a view to providing guidelines for implementation as a tool to improve flood and coastal defence management. This would be undertaken in close consultation with English Nature, which will need to

be persuaded of the benefits of this approach before it could be implemented on a wide scale (e.g. through a national habitat accounting system).

13.2.6 *Risk Assessment*

We propose to systematically identify the risks involved in developing, constructing and maintaining schemes where both Managed Realignment and Hold the Line are realistic options. In Phase One, a broad knowledge of the uncertainties that were (and are being) faced was identified through the regional workshops and case studies. However, the complexities of risks faced at detailed design and construction stage would also benefit from examination.

By comparing the probability and consequences of each risk, the key differences between these two policies would be isolated. Based, where possible, on sample schemes, this would allow some guidance as to the generic risks inherent in Managed Realignment and allow a better overall understanding of the actual risk. In addition, consideration of specific risks that have not yet occurred in the course of the projects undertaken to date, but have potential to occur in future schemes will be included. This analysis will also identify where high uncertainties do not translate into high risks, because the consequences of the event are small in the context of the overall scheme.

Having established a more extensive understanding of where the risks of Managed Realignment lie, the ability to control or mitigate the risks of Managed Realignment will be reviewed. Guidance to practitioners on the identification, control and mitigation will be compiled. In many cases, control measures may involve the effective communication of information known about the site from the client to designer or contractor. The availability of a register of generic risks will improve the ability of client organisations to identify relevant information and/or encourage the systematic collection of data prior development of specific schemes.

At present, relevant information such as Project Appraisal Reports, Environmental Statements, Monitoring Reports and Computer Modelling reports has been gathered in the course of Phase 1 for schemes such as Abbot's Hall, Brancaster, Thorngumbald and Orplands. In addition the present and imminent development by Halcrow of flood defence strategies for estuaries such as the Roach, Crouch Blackwater, Colne, Stour and Orwell provides the opportunity to monitor the identification, assessment and occurrence of risks where Managed Realignment is a possibility. Consultation with contractors as well as the designers and promoters of schemes will provide further information relating to example schemes.

13.2.7 *Natural Processes*

It is crucial to the success of future policy and planning development towards sustainable coastal management that uncertainties regarding natural processes should be addressed. To achieve this, Phase 2 of the project should:

- Identify a prioritised set of physical parameters / data required for the assessment of the natural/physical sustainability of Managed Realignment schemes over a series of time horizons. Although the Futurecoast project has highlighted specific shortcomings in the current scientific knowledge of coastal processes, a separate assessment should be made with regard to the information required for the planning / implementation of Managed Realignment schemes. Such an assessment should take into account and learn from any experience of Managed Realignment overseas.

- Carry out a review of existing scientific information on the ecological, geomorphological, and hydrodynamic functioning of inter-tidal and, in particular, Managed Realignment areas. The review should distinguish between general principles and process rules that can be identified and site-specific variability in the natural functioning of inter-tidal (Managed Realignment) areas. Furthermore, the degree of knowledge of the *variability* (both spatial and temporal) of natural processes should be determined.

- Develop methodologies for converting existing scientific knowledge into qualitative and, most importantly, **quantitative** guidelines on how both:
  (i) general natural principles; and
  (ii) knowledge on variability (and possible measures for reducing such variability)

  can be used to assess the future evolution (and thus the sustainability) of particular Managed Realignment schemes.

Further develop specific quantitative guidelines in the form of user-friendly decision support systems (PC-based or in the form of accessible 'look-up table' style) for the assessment of the natural sea-defence value of existing or potential future inter-tidal areas.

13.2.8 *Overseas Review*

To achieve maximum benefit from an extended study of the Managed Realignment discussions taking place in Europe, a focus on the southern North Sea countries of The Netherlands, Belgium and Germany is recommended. These three countries

are characterised by similar rates of sea-level rise storm-surge histories and soft coastal environments to the south-east of the UK.

The extended review should include:

(a) an in-depth review of any literature published by the government, the media, and scientists in the respective countries (this should include especially literature published in the national languages, i.e. should not be focused only on literature that has been translated into English);
(b) (semi-)structured interviews with members of the central, regional, and local government authorities that deal with coastal defence funding, planning, and implementation;
(c) (semi-)structured interviews with members of nature conservation organisations and/or other (potential) stakeholders who are involved with implementing Managed Realignment schemes and more generally in the implementation of the Habitats Directive in their respective countries.

The purpose of this investigation is to examine, from political insiders and policy advisors, just what are the successful components of Managed Realignment implementation. In addition, knowledge of how barriers have been overcome would also be of great value in the UK.

13.2.9 *Further Case Studies*

We feel that the addition of additional case studies would consolidate the experience acquired in this project. The sites chosen for this study were selected because they were fairly advanced and the major potential obstacles have been resolved, which means on the whole that they were relatively "easy" schemes. Investigating another three case studies, selected to address additional issues and possibly more controversial schemes, would provide insights into how to identify a mix of solutions that would deliver Managed Realignment expeditiously, effectively, and in a sustainable manner.

13.2.10 *Managed Realignment Manual*

English Nature produced "Managed Realignment: A Practical Guide" in 1995, which focuses on process and nature conservation issues. This has been found to be useful by many practitioners. However, there is a need to update it in the light of experience gained and policy changes since its publication and also to expand the scope of guidance to address a broader range of issues. It is understood that this may be addressed through English Nature's maritime strategy. It is proposed

that a major focus of Phase 2 should be to document the recommendations of the present Study in the form of a new guidance manual, aimed at operating authorities and other practitioners. Key issues for inclusion would include navigating the consent process, mechanisms for stakeholder participation, design and technical guidelines, and dealing with risks and uncertainty. It would also cover the need for monitoring, modelling and visualisation of possible future states of the coast. Documentation of lessons from the case studies addressed in this Report would be another feature that would be valuable to future scheme implementation.

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15 Glossary

Anticipatory habitat creation
Creation of ***compensatory habitat*** ahead of displacement or loss of the habitat to be replaced.

Catchment Flood Management Plan (CFMP)
Strategic plan setting out flood defence policies for a river catchment.

Coastal Squeeze
Loss of intertidal habitat between rising sea levels and a fixed line of coastal defence.

Compensatory Habitat
Creation of a new area of habitat specifically to replace habitat lost as a result of implementing a plan or project, in order to comply with the requirements of the ***Habitats Regulations***.

(Financial) Compensation
Payments to land owners or land occupiers either for land acquisition or for specific use (or loss of use) of land. Such payments may relate to land that is affected by ***Managed Realignment***.

Habitats Regulations
The Conservation (Natural Habitats, & c.) Regulations 1994 implement the European Union Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. The Regulations introduce stringent requirements for the conservation of Special Protection Areas and Special Areas of Conservation.

Hold the Line
Maintaining an existing line of coastal or flood defmce in its existing position.

Land Banking
A form of ***anticipatory habitat creation*** based on a gain and loss accounting system, under which habitat creation can be traded for development.

Land Blight

Loss in value of land and/or inability to sell or deal with land as a result of the publication of proposals affecting that land (for example change in flooding regime resulting from ***Managed Realignment***).

Land Speculation

Increase in value of land as a result of the publication of proposals that would entail ***financial compensation***, possibly at rates that reflect a higher value than would have been obtained in the absence of the proposals.

Managed Realignment

Deliberate, planned process of realigning an existing river or coastal defence to landward, either constructing a new line of defence or utilising higher ground.

Opportunity Costs

The return on investment that might otherwise be achieved by alternative employment of that capital.

Shoreline Management Plan (SMP)

Strategic plan setting out broad policies for flood and coastal defence along a length of coastline (which may include estuaries) that is relatively self-contained in terms of coastal processes.

Appendix A
Coastal Managed Retreat Sites identified in SMPs

Name of Plan	Reference code	Who Produced	Date	number of MR units	Management unit code	Location Name	Existing type of defence	Coast protection/ Flood defence?	Reason	Suggested Method	Length of Coast	Potential Retreat Area	Operating Authority	Managed Retreat or Realignment
Huntcliffe to Flamborough Head	**1d**	**Mouchel Consulting Ltd**	**Sep-97**	**11**	MU1b	Huntcliffe Cottages to Jackdaw Crag	Rock Platform	Coast Protection	1b/2	Reduce toe erosion Reduce groundwater impacts	1.2km		Redcar and Cleveland Borough council	Retreat
					MU6b	Port Mulgrave	Two Breakwaters Rock platforms Cliffs	Coast Protection	6b/2	Further studies necessary	.8km		Scarborough Borough Council	Retreat
					MU13a	Whitby	High Cliffs Rock Platform	Coast Protection	13a/2	Detailed study required	0.3km		Scarborough Borough Council	Retreat
					MU23	Scarborough / Wheatcroft	Cliffs Rock Platform	Coast Protection	23/2	Detailed scheme + cost benefit appraisal Sensitive engineering	3.6km		Scarborough Borough Council	Retreat
					MU24a	Cayton Bay	Soft Cliffs Wide sandy beach	Coast Protection	24a/2	Detailed scheme + cost benefit appraisal	0.6km		Scarborough Borough Council	Retreat
					MU27	Filey Brigg	Brigg Cliffs	Coast Protection	27/1	Detailed scheme + cost benefit appraisal	3.5km		Scarborough Borough Council	Retreat
					MU29a	Filey Bay	Cliffs	Coast Protection	29a/2	No hard works Allow maximum flexibility	0.9km		Scarborough Borough Council	Retreat
					MU29b	Amtree Park	Clay Cliffs	Coast Protection	29b/2	No hard works Development of a specific scheme	1.4km		Scarborough Borough Council	Retreat
					MU29c	Hunmanby gap	Clay Cliff Stone Gabions	Coast Protection	29c/2	No hard works Development of a specific scheme	1.3km		Scarborough Borough Council	Retreat
					MU30a	Reighton Sands	Clay Cliffs	Coast Protection	30a/1	No hard works Development of a specific scheme	1.2km		Scarborough Borough Council	Retreat
					MU31d	North Landing	Concrete revetment Tall Cliffs	Coast Protection	31d/3	Detailed scheme	0.4km		East Riding of Yorkshire	Retreat
Humber Estuary	**2a + 2b**	**Posford Duvivier**	**Apr-98**	**1**	MU12	Easington / Kilnsea	Clay embankment Flood embankment Groynes	Flood Defence	104	Produce strategy study Monitor cliff retreat			N.E. Lincolnshire council	Retreat local flood defences
North Norfolk	**3a**	**Mouchel**	**Jul-96**	**8**	MU1	Sheringham to Kelling Quag	Cliffs Shingle bank Breastwork Palisade	Coast Protection	12/7	Slow down, arrest the recession	4.25km +		North Norfolk DC	Long term Retreat Limited Intervention
					MU2	Kelling Quag to Cley Coastguards	Cliffs Shingle ridge Flood banks Sea Wall	Coast Protection / Flood Defence	12/18	Retreat to new defences			North Norfolk DC	retreat 1*
					MU3	Cley Coastguards to Stiffkey Marshes	Sand dunes Shingle ridge	Coast Protection / Flood Defence	12/32	Limited intervention			North Norfolk DC	Retreat in long teerm
					MU7a	Brancaster Staithe to Beach access road	Sheet piled walls Concrete promenade Sea wall Gabion revetment Rock armouring	Flood Defence	12/77	Ring embankment defence			North Norfolk DC	1*
					MU7b	Beach access road to Thornham	Timber toeboards Flood banks	Flood Defence	12/77	Ring embankment defence Allow existing defences to breach If old defences unsustainable			North Norfolk DC	Long term 1*
					MU8	Thornham to Hunstanton Golf Course	Flood bank Rock groynes	Flood Defence	12/88	Detailed study initiated Soft measures at first			North Norfolk DC	Retreat in the long term 1*

							Sand dunes			If old defences unsustainable					
					MU9	Hunstanton Golf Course	Sand dunes Gabion revetments Groynes	Coast Protection / Flood Defence	12/93	If old defences unsustainable Continued maintenance of dunes Construction of new defence point			North Norfolk DC	Long term 1*
					MU10	Hunstanton Cliffs	Cliffs	Coast Protection	12/98	Ongoing monitoring and rock berms or groynes/beach recharge Only when erosion threatens properties			North Norfolk DC	Long term 1*
Sheringham to Lowestoft	**3B**	**Halcrow**	**May-96**	**5**	Run 2	Beeston Regis Hills to Cromer, Bernard Road	Timber Revetment Groynes Short stretches of masonry wall Cliffs	Coast Protection	1.2.4	Maintenance of existing constructions until these can no longer be sustained Remove timber defences for safety reasons	4.5km	0.2km^2	North Norfolk District Council	Retreat
					Tri 5	Trimingham, Beacon Hill to Mundesley, Seaview Road	Timber revetment in poor condition Timber groyne field Cliffs	Coast Protection	2.5.4	Maintenance of ramp New construction when this can no longer be maintained	1.6km	0.16km^2	North Norfolk District Council	Retreat
					Sea 1	Walcott, Ostend Cottages to Happisburgh, Caravan park	Timber Revetment Timber Groynes (damaged) Low Cliffs	Coast Protection	4.1.4	Remove existing timber defences	1.4km	0.21km^2	North Norfolk District Council	Retreat
					Cor 2	Gorleston, Links Road to Hopton, Cliff Cottages	Timber revetment well in front of Cliffs Groynes Cliffs + high beach	Coast Protection	8.2.4	Continued maintenance	1.2km	0.01km^2	Great Yarmouth Borough council	Retreat
					Cor 4	Hopton Playing Field to Corton Caravan Site	Concrete seawall Permeable timber revetment Exposed Groynes Cliffs	Coast Protection	8.4.4	Specific protection to the cliff base Maintenance of beach levels	1.8km	0.18km^2	Great Yarmouth Borough council Waveney district council	Retreat

Name of Plan	Reference code	Who Produced	Date	number of MR units	Management unit code	Location Name	Existing type of defence	Coast protection/ Flood defence?	Reason	Suggested Method	Length of Coast	Potential Retreat Area	Operating Authority	Managed Retreat or Realignment
Lowestoft to Harwich	**3c**	**Halcrow**	**May-98**	**5**	Ben 3	Pakefield Cliffs to The Red House, Kessingland	Cliffs	Coast Protection	4.1.17	Use soft measures which do not block sediment movements Undertake Leachate Monitoring	2.5km	0.25km^2	Waveney district council	Retreat
					Ben 5	Benacre Pumping Station to Easton Marshes, Southwold	Cliffs	Coast Protection	4.1.28	Maintain shingle banks Monitor	7.7km	4.62km^2	Waveney district council	Retreat
					Min 1	Walberswick to Dunwich village	Shingle berm Beach Flood Wall	Flood Defence	4.2.8	Maintain + re-profile Berm Allow occasional breaches Monitor	4.0km	0.8km^2	Suffolk Coastal District Council Environment Agency	Retreat
					Min 2	Dunwich village to Dunwich Heath	Cliffs	Coast Protection	4.2.15	Soft measures to limit erosion Beach feeding after detailed study	2.1km	0.3km^2	Suffolk Coastal District Council Environment Agency	Retreat
					Min 3	Dunwich Heath to North Sizewell	Some Cliffs Natural Barrier system Shingle beach Sand dune system Clay embankment	Coast Protection / Flood Defence	4.2.21	Maintenance of banks 2nd line flood defence Remove obstructions to natural processes	4.0km	- - - -	Suffolk Coastal District Council Environment Agency	Retreat
Essex	**3d**	**Mouchel**	**Jun-96**	**9**	7e	The Naze	Soft Cliffs Improvement works	Coast Protection	31	Use Hardpoints	1.3km		Tendring District Council	Retreat

					9c	Carless Refinery to Lawford	Cliff Walls Embankments	Coast Protection	39	Monitoring and Numerical studies	2.2km		Tendring District Council	Retreat just the cliff area
					2a + 2b	Maplin Sands	Beach ridge Concrete walls Revetment Embankment with concrete revetment	Flood Defence	7	Monitoring and Numerical studies	2.3km		Tendring District Council	Retreat in the long term - after 10yrs!
					3	The Roach and the Crouch	Clay Embankments Revetments Wall Salt Marshes	Flood Defence	13	Monitoring and Numerical studies			Tendring District Council	Retreat in the long term - after 10yrs!
					4a + 4b	The Dengie Peninsula	Clay Embankment Concrete Revetment	Coast Protection / Flood Defence	17	Monitoring and Numerical studies			Tendring District Council	Retreat in the long term - after 10yrs!
					5	The Blackwater	Clay Embankment Revetments Groynes	Coast Protection / Flood Defence	21	Monitoring and Numerical studies Only when only sustainable policy			Tendring District Council	Retreat in the long term - after 10yrs! MANAGED SETBACK
					6a + 6c	The Colne	Reinforced natural banks Clay embankment Walls Revetments Barrier Flood wall Timber Groynes	Flood Defence	27	Monitoring and Numerical studies Only when only sustainable policy			Tendring District Council	Retreat in the long term - after 10yrs! MANAGED SETBACK
					8	Hamford Water	Clay embankment Timber Wall Concrete revetment Earth Walls	Flood Defence	34	Monitoring and Numerical studies Only when only sustainable policy			Tendring District Council	Retreat in the long term - after 10yrs! MANAGED SETBACK
					9a	Little Oakley to Dover court	Concrete walls + revetments Breakwater	Flood Defence	39	Based on result of Sediment model study			Tendring District Council	Retreat in the long term - after 10yrs! MANAGED SETBACK
Isle of Grain to Dover Harbour	**4a and 4b**	**Halcrow**	**Aug-96**	**2**	6c	Palm Bay to White Ness	Chalk Cliffs Concrete Seawalls Apron Embankment Beaches	Coast Protection	6c.6	Maintain selected defences	3.1km	- - - -	Thanet District Council	Retreat
					7a	White Ness to North Foreland	Cliffs Concrete seawalls Beaches Toe Protection of Cliffs	Coast Protection	7a.6	Relocate road Selective defence Defences to base of Cliffs Beach control structures Maintain existing structures	1.4km	- - - -	Thanet District Council	Retreat
East Solent Volume 2	**5a + 5b**	**HR Wallingford and High point Rendel**	**Jul-97**	**2**	11	Fort Gilkicker to Browndown Ranges	Concrete wave return wall Timber Groynes	Flood Defence	11-3	Re-site road Monitor	4.1km	- - - -	Gosport Borough Council	Selectively Retreat
					7	Inn on the Beach to Langstone Harbour	Recurved seawall Timber revetment Concrete wals Concrete groynes and gabions Sheet pile	Coast Protection	07-4	Re-allign golf course Resite inn if necessary	2.7km		Havent Borough Council	Selectivley retreat

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Western Solent and Southampton water	**5c**	**Halcrow**	**Apr-98**	**4**	Lym 5	Elmers Court Country club to Pitts Deep	Embankment Wall Groynes Banks Gabions	Flood Defence	lym 5	Soft engineering methods Saltmarsh management Regeneration techniques	4.5km	- - - -	Southampton city council	Retreat
					Faw 6	Fawley Oil Refinery to Hythe Sailing Club	Low lying beach	Flood Defence	faw6	Defences in front of railway Saltmarsh management	0.9km	- - - -	Southampton city council	Retreat
					Net 4	Cliff House to Ensign Industrial Park	Wall Low Cliffs	Coast Protection	net 4	Soft defence scheme Reduce cliff toe erosion	1km	- - - -	Southampton city council	Retreat
					Ham 2	Satchell Marshes to Badnam Creek	Marsh Breastwork Wall Piling Revetment	Flood Defence	ham2	Soft measures Saltmarsh management	1.3km	- - - -	Southampton city council	Retreat
Isle of Wight Coast	**5d and 5e**	**Halcrow**	**-**	**7**	Ryd 2	West Woodside to Chapelcorner Copse	Beach	Coast Protection	7	Soft defence along retreated line	- - - -	- - - -	Isle of Wight Council	Retreat
					Ryd 4	Fishbourne to Pelhamfields	Cliffs	Coast Protection	7	Soft defences	- - - -	- - - -	Isle of Wight Council	Retreat
					Ryd 9	Horestone Point to St Helens Tower	Beach	Coast Protection	8	Soft defences	- - - -	- - - -	Isle of Wight Council	Retreat
					Ven 1	Horse Ledge to Monks Bay	Cliffs	Coast Protection	11	Drainage techniques to improve stability	- - - -	- - - -	Isle of Wight Council	Retreat
					Ven 3	Steephill Cove to East of Binnel Bay	Cliffs Beach	Coast Protection	13	Allow Landslide debris apron to build up	- - - -	- - - -	Isle of Wight Council	Retreat
					Ven 4	East Binnel Bay to Puckaster Point	Cliffs	Coast Protection	13	Control instability with Drainage techniques	- - - -	- - - -	Isle of Wight Council	Retreat
					New 14	Cowes Harbour	Beach	Coast Protection	16	Structural strategy to protect from erosion Land Reclamation	- - - -	- - - -	Isle of Wight Council	Advancement
Hurst Spit to Durlston Head	**5f**	**Halcrow**	**-**	**3**	Phb 4	South Haven Point to Hydes Quay	Revetment Wall Marshland	Flood Defence	1 - D113	Strategy Study required Management of Saltmarsh	5.7km		Poole Harbour	Selective Retreat
					Phb 5	Hydes Quay to Holton Point	River Defences Small section of Cliff	Flood Defence	1 - D120	Dredged material set further inland Allow sea inundation	2.8km		Poole Harbour	Selective Retreat
					Phb 6	Lychett Bay	Saltmarsh	Flood Defence	1 - D127	Strategy Study required	0.3km		Poole Harbour	Selective Retreat

					Pby 3	Warren Hill to Hengistbury Long Groyne	Cliffs Beach	Coast Protection	14	Limit Erosion of headland Beach nourishment to limit cliff toe attack	- - - -	- - - -	Borough of Poole	Retreat
					Cby 1a	Hengistbury Long Groyne to Tip of Mudeford Sandbank	Cliff	Coast Protection	15	Limit threats to harbour	- - - -	- - - -	Christchurch borough council	Retreat
					Cby 3	Chewton Bunny to Barton on Sea	Cliffs (30m)	Coast Protection	15	Maintain scientific value	- - - -	- - - -	Christchurch borough council	Retreat
Durlston Head to Portland Bill	**5g**	**Mouchel Consulting Limited**	**Oct-98**	**11**	MU1c	Church Ope Cove	Cliffs	Coast Protection	6.1c/2	Further feasibility studies	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU1e	Grove Point Rifle Ranges (Disused)	Cliffs	Coast Protection	6.1e/2	Further feasibility studies	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU1f	Rifle Ranges (Disused) to Portland Breakwater	Cliffs	Coast Protection	6.1f/2	Further feasibility studies Relocation of assets	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU2e	Fleet Opening (North) to North Breakwater	Cliffs Shingle Beach	Coast Protection	6.2e/2	Further feasibility studies	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU5c	Overcombe to Bowleaze Cove (West)	Cliffs Shingle Beach	Coast Protection	6.5c/2	Further feasibility studies	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU5d	Bowleaze Coast (West) and Bowleaze Cove (East)	Beach	Coast Protection	6.5d/2	Further feasibility studies	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU6b	Osmington Bay Holiday Centre	Narrow Beach	Coast Protection	6.6b/2	Further feasibility studies	- - - -	- - - -	Weymouth and Portland Borough Council	Retreat
					MU6d	Goggin's Barrow to Osmington Mills (East)	Cliffs Rock Platforms	Coast Protection	6.6d/2	Further feasibility studies	- - - -	- - - -	West Dorset District Council	Retreat
					MU8b	Lulworth Cove (West) to Lulworth Cove (East)	Cliffs	Coast Protection	6.8b/2	Further feasibility studies Protect Assets	- - - -	- - - -	Purbeck District Council	Retreat
					MU12b	Kimmeridge Bay (West) to White House	Cliffs Small beach	Coast Protection	6.12b\2	Further feasibility studies Soft defence measures	- - - -	- - - -	Purbeck District Council	Retreat
					MU12c	White House to Clavel Tower	Clay Cliffs Man made defences	Coast Protection	6.12c/2	Further feasibility studies	- - - -	- - - -	Purbeck District Council	Retreat

Name of Plan	Reference code	Who Produced	Date	number of MR units	Management unit code	Location Name	Existing type of defence	Coast protection/ Flood defence?	Reason	Suggested Method	Length of Coast	Potential Retreat Area	Operating Authority	Managed Retreat or Realignment
Rame Head to Lizard Point	**6d**	**Halcrow**	**Apr-99**	**1**	Pentewan 2	Harbour to Caravan Park	Old breakwater Timber piles and rubble erosion control Clay embankment Wide Beach	Coast Protection Fluvial Flooding Defence	6d - 2.48	Maintain river mouth alignment	0.1km	- - - -	Cornwall county council	Retreat
Land's end to Hartland Point	**7a and 7b**	**Halcrow**	**Apr-99**	**3**	7A-2	Common, Phillack and Upton Towans	Sand dunes	Coast Protection	7A - 2.36	Dune Management	2.3km	0.345km^2	Cornwall County Council Penwith District council	Retreat
					7B -1	Pentonwarra Headland	Masonry Seawall Rock Revetment Cliffs	Coast Protection	7B - 1.21	Continued Maintenance Extension if necessary	0.3km	- - - -	North Cornwall District Council	Retreat
					7B - 2	Low Cliffs fronting river	Masonry wall	Coast Protection	7B - 2.32	Halt sand extraction Regular monitoring suitable structure along the line of the road	0.1km	- - - -	North Cornwall District Council	Retreat

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Bridgewater Bay to Bideford Bay	**7C and 7D**	**Halcrow**	**Jun-98**	**5**	West 2	Pebble Ridge	Pebble ridge Rock armour	Flood Defence	WEST.10	Continue replenishment of ridge More rock armour Observe and monitor	3.75km	- - - -	Torridge district council	Retreat
					West 3	Skern Saltmarsh	Artificial Embankment	Flood Defence	WEST.12	Breach embankment Sand dune management approaches	1.3km	- - - -	Torridge district council	Retreat
					West 4	West of Appledore	Mudflats	Flood Defence	WEST.14	Observe and monitor	0.8km	- - - -	Torridge district council	Retreat
					Inst 4	Home Farm Marsh	Cobble embankment Ridge of higher ground	Flood Defence	INST.15	Observe and monitor	3.5km	- - - -	North Devon district council	
					Port 3	Porlock Bay	Shingle ridge Some Groynes	Flood Defence	INST.12	Remove existing Groynes Observe and monitor shingle ridge	3.7km	- - - -	West Somerset district council	Retreat
Lavernock Point to Worms Head	**8b**	**SMP**	**Nov-00**	**6**	7.6	Ball Rock To Lavernock Point	Cliffs Beach	Coast Protection	336	Avoid Ad-hoc private intervention	1.5km		Vale of Glamorgan Council	Long term Retreat (+5 yrs)
					7.4	West Side Sully to Swanbridge West	Shingle Beach Cliffs	Coast Protection	319	Depend on Risk assessment	1.7km		Vale of Glamorgan Council	Long term Retreat (+5 yrs)
					6.3	Cwm Col Huw to Limpert Bay	Cliffs	Coast Protection	255	Depend on erosion mechanism Depend on sea level rise	5.1km		Vale of Glamorgan Council	Long term Retreat (+5 yrs)
					5.2	Dunraven Bay to Trwyn y Witch	Cobble/ boulder Embankment	Coast Protection	224	Construct alternative access Maintain Beach	0.8km		Vale of Glamorgan Council	Retreat
					4.7	Newton to Ogmore River	Shingle storm Beach Sand Dunes	Coast Protection	208	Record and Monitor	3.2km		Bridgend county Borough Council	Long term Retreat (+5 yrs)
					4.3	Afon Cynfig to Sker Point	Shingle storm Beach Sand Dunes	Coast Protection	175	Monitor	3.8km		Bridgend county Borough Council	Long term Retreat (+5 yrs)
Worms Head to St Govans Head	**8c**	**SMP**	**Mar-00**	**6**	1.8	Freshwater East	Clay shore Sea Wall Sand Dunes	Coast Protection	78	Monitor erosion Dune Management	1.7km		Pembrokeshire County Council	Long term Retreat (+5 yrs)
					1.12	Lydstep Haven	Apron Revetment Sea Wall	Coast Protection	101	Depend on sea level rise Depend on integrity of existing structures	1.2km		Pembrokeshire County Council	Long term Retreat (+5 yrs)
					4.7	Carmarthen Holiday Park	Clay silt shore	Coast Protection	238	Depend on river bank and channel movements	1.2km		Carmarthenshire County Council	Long term Retreat (+5 yrs)
					5.1	Pembrey Sands	Sand Dunes Beach	Coast Protection	254	Remove or re-work trial breakwater	105km ??		Carmarthenshire County Council	Retreat
					7.2	Cwm Ivy Marsh to Burry Holms	Sand dunes Sea Wall Rock shore	Coast Protection	325	Depend on sea level rise	3.5km		City and County of Swansea	Long term Retreat (+5 yrs)
					7.3	Llangenneth Burrows to Worm's Head	Sand Dunes Hard Rock Shore	Coast Protection	331	Dune Management Monitor Sea Level	9km		City and County of Swansea	Long term Retreat (+5 yrs)

Central Cardigan Bay	**9a**	**Posford Duvivier**	**Jan-00**	**11**	4.3	Tresaith	Rock Revetment Sea Wall Beach	Coast Protection	5.60	Maintain existing Defences			Ceredigion County council	Retreat
					7.3	Traeth Gwyn	Beach Cliffs	Coast Protection	5.95	Stabilisation works if necessary	1.6km		Ceredigion County council	Retreat
					8.1	The Bay	Cliffs Beach Stone Revetment Groynes	Coast Protection	5.100	Maintain existing works Refurbishment if necessary	0.4km		Ceredigion County council	Retreat
					11.2	Aberarth	Cliff Beach Timber Groynes and breastwork Concrete wall Steel crib and rock training works	Coast Protection	5.131	Maintain defences	1km	0.02km^2	Ceredigion County council	Retreat
					11.3	Morfa Mawr	Cliff Beach	Coast Protection	5.135	Stabilise Road when necessary	3.2km		Ceredigion County council	Retreat
					11.5	Llanrhystud Bay	Sandy Beach Clay Cliffs	Coast Protection	5.143	Allow breaches Maintain beach Monitor	2km		Ceredigion County council	Retreat
					15.2	Clarach	Beach Clay ridge Concrete and timber breastwork Rock revetment	Coast Protection	5.184	Reinforce defences Close off flood area	0.7km		Ceredigion County council	Retreat
					16.1	Borth Cliffs	Hard Cliffs Rock Platform Sand/shingle Beach	Coast Protection	5.198	Monitoring cliff erosion Take action when assets are at risk	0.75km		Ceredigion County council	Retreat
					16.4	Ynyslas	Wide Beach Shingle Ridge Timber Breastwork Groynes	Flood Defence	5.209	Create natural defences Maintain existing defences in South	0.2km		Ceredigion County council	Retreat
					17.1	Ynyslas Dunes	Shingle Ridge Sand Dunes	Coast Protection	5.225	Dune Management Monitoring	1.8km		Ceredigion County council	Retreat
					17.2	Twyni Bach	Beach Sand Dunes	Coast Protection	5.228	Manage dunes Manage Estuary	1.3km		Ceredigion County council	Retreat
Formby Point to Rossall Point	**11b**	**SMP**	**Nov-98**	**1**	8/2	Dale Slack Gutter to Formby Coastguard station	Beach Dunes	Coast Protection	165	Monitoring Liaison with appropriate parties Dune management	3.5km	- - - -	Blackpool Borough Council	Natural defence Management / Managed retreat
St Bees Head to Earnse Point	**11d**	**Bullen Consultants**	**Nov-98**	**1**	MU 7 unit 14	Eskmeal Dunes	Sand Dunes Gabions Shingle Ridge	Coast Protection	Apendix B	Evaluate Management Method Evaluate Beach management Monitor foreshore condition	6.5km		Copeland Borough Council	Managed Retreat
The Humber Estuary		**EA**	**Sep-00**	**4**	unit 3	North Ferriby to Trent Falls	Natural Bank Clay embankments Rock Revetment	Flood Defence	43	Further studies	12km		EA (anglian)	Set back at certain sites
					unit 4a + b	Trent Falls to Boothferry bridge	Earth and clay embankments Concrete and Masonry retaining walls Steel sheet piling Rock revetments	Flood Defence	45	Further studies	37.6km		EA (anglian)	Set back at certain sites and if sea levels rise
					unit 4c + d	Trent falls to Keadby bridge	Earth and clay embankments Concrete walls Steel sheet piling Rock revetments	Flood Defence	47	Further studies	35.4km		EA (anglian)	Set back at certain sites and if sea levels rise

			Training revetments						
	unit 5	Whitton to South Ferriby Cliff	Walls Clay embankments	Flood Defence	49	Further studies	10.6km	EA (anglian)	Set back at certain sites and if sea levels rise

Sites identified from General Questionnaire responses	A	Aldcliffe Marsh - Lune Estuary	Possible compensation for damage to the integrity of a SPA caused by coastal defence works at Morecambe						
	B	Hesketh outer Marsh - Ribble Estuary	Possible purchase of land by RSPB from Farmers - Reallignment / controlled inundation						
	C	Bridgewater Bay – Parrett Estuary	Feasibility Stage						
	D	Lilstock, Bristol Channel	Estuarine scheme						
	E	Camel Estuary (Padstow)	Planned						
	F	River Tamar	National Trust						
	G	Exe Estuary	Planned						
	H	Selsey Bill	EA abandonment of shingle ridge management?						
	I	Shoreham Port, West Sussex	The scheme advanced the defences to create an additional 3 Ha of cargo terminal, the sea defences were improved and public access and the beaches also improved. A subsequent scheme to realign the coast to create an additional 29 Ha of cargo terminal is at an early planning stage.						
	J	Seaford Bay, East Sussex	Planned						
	K	Trimley Marsh, Felixstowe	4 sites Yr 2000 succesful habitat creation						
	L	Freiston Shore, Lincolnshire	To be breached next year, should be successful - 70 hectares of IT habitat; involved a partnership of organisations, attracted considerable funding and publicity.						
	M	Chichester Harbour	Includes Thorney Island and Hayling Island						
	N	Thames Estuary	No details available						
	O	River Torridge, Bideford, Devon	No details available						
	P	River Taw, Braunton Marshes, Devon	No details available						
	Q	River Torridge, Devon	No details available						
	R	River Camel, Cornwall	No details available						

Appendix B
Questionnaire, Letter and List of Recipients

QUESTIONNAIRE ON MANAGED REALIGNMENT

Section A: You and your organisation

1. What organisation do you represent?

2. What are your name and position in the organisation?

3. Are you personally associated with any other organisation? If so, which one(s)?

4. What is your level of interest in flood and coastal defence issues generally? Please tick one box only.

   ❑ very high
   ❑ moderately high
   ❑ not very high
   ❑ don't know/no opinion

5. Do you think managed realignment affects, or will affect you or your organisation directly?

   ❑ yes please go to question 6
   ❑ no please go directly to question 7

6. How much does or will managed realignment affect you?

   ❑ very much
   ❑ moderately
   ❑ not very much
   ❑ don't know yet, insufficient information to say
   ❑ no opinion

7. Would you say that you and your organisation have an influence on flood and coastal defence decisions?

   ❑ yes please go to question 8
   ❑ no please go directly to question 9

8. How much do you think that you and your organisation can influence flood and coastal defence options?

   ❑ very much
   ❑ moderately
   ❑ not very much
   ❑ don't know/no opinion

8.a Please indicate how you might have this level of influence:

9. Do you see a case for managed realignment? ❑ yes please go directly to question 11
❑ no please go to question 10

10. Why do you not see a case for managed realignment?

11. Under what circumstances do you see a case for managed realignment?

12. Do you have any specific interests in ensuring that managed realignment does or does not occur?

❑ yes please go to question 13
❑ no please go directly to section B

13. What are your or your organisation's specific interests?

Section B: your views on drivers and constraints to managed realignment

The points listed below describe possible drivers (incentives) and constraints (obstacles) to managed realignment. For each of these points, we are interested in your opinion on how significant they are ***in general (at a national level)***: please circle the number that best describes your point of view, from not important (1) to very important (5).

	Not important				Very important	Don't know
DRIVERS						
Technical/environmental						
14. Providing sustainable and effective flood and coastal defence	1	2	3	4	5	□
15. Controlled breach better than dealing with an accidental breach	1	2	3	4	5	□
16. Providing environmental benefits in terms of habitat creation	1	2	3	4	5	□
17. Other (please specify):	1	2	3	4	5	□
Economic						
18. Reducing costs of flood and coastal defence	1	2	3	4	5	□
19. Low cost means of recreating natural habitats	1	2	3	4	5	□
20. Other (please specify):	1	2	3	4	5	□
Policy and legislation						
21. Habitats Regulations (means of compensating for habitats lost elsewhere through reclamation or coastal squeeze)	1	2	3	4	5	□
22. Essential for a long term strategy of coping with sea level rise	1	2	3	4	5	□
23. DEFRA funding not available for holding the line	1	2	3	4	5	□
24. Other (please specify):	1	2	3	4	5	□

	Not important				Very important	Don't know
CONSTRAINTS						
Technical and environmental						
25. Insufficient robustness of flood and coastal defence	1	2	3	4	5	☐
26. Potential loss of terrestrial and freshwater habitats	1	2	3	4	5	☐
27. Difficulty of recreating an environmentally diverse habitat	1	2	3	4	5	☐
28. Other (please specify):	1	2	3	4	5	☐
Economic and financial						
29. Potential high cost of managed realignment	1	2	3	4	5	☐
30. Potential loss of land with high property value	1	2	3	4	5	☐
31. Lack of access to or information about suitable funding	1	2	3	4	5	☐
32. Other (please specify):	1	2	3	4	5	☐
Policy and legislation						
33. Habitats Regulations (need to compensate on site or elsewhere for habitats lost through managed realignment)	1	2	3	4	5	☐
34. Managed realignment is ineffective if carried out on a piecemeal basis	1	2	3	4	5	☐
35. Other (please specify):	1	2	3	4	5	☐
Political and cultural						
36. Lack of support from public opinion	1	2	3	4	5	☐
37. Insufficient compensation to land owners for land or property lost	1	2	3	4	5	☐
38. Insufficient consultation with interested parties	1	2	3	4	5	☐
39. Other (please specify):	1	2	3	4	5	☐

Section C. Your experience of managed realignment

40. Have you, or your organisation, had any ***practical experience*** of planning and/or implementing managed realignment of coastal or flood defences?

    ❑ yes please go to question 41
    ❑ no please go directly to Section D

41. Please give more details of your experience of managed realignment, including schemes that might have been planned but not implemented. If you have experience of more than one scheme of managed realignment, please provide details of additional schemes on a separate sheet of paper, answering the same questions as below:

41a. Where did the managed realignment scheme take place?

41b. When?

41c. To what extent would you say the managed realignment scheme was successful or unsuccessful? Please explain why it was successful, or why not.

Section D: follow-up to this questionnaire

42. What are your feelings on how far and how seriously your opinions on managed realignment will be taken into account by flood and coastal defence decision makers?

43. We are interested in hearing more about your views on managed realignment. We are planning to organise regional workshops in the near future to investigate further the issues described above. Would you, or regional representatives from your organisation, be willing to participate in these regional workshops, to share your views further and contribute to shape flood and coastal defence policy? Please give details of whom we might contact in different regions.

44. Please write down your contact details so that we can get in touch regarding the follow-up of this questionnaire:

Name:

Address:

Telephone number:

Fax number:

Email address:

45. Please find enclosed a list of people to whom this questionnaire has been sent. If you think anybody else should be consulted on the above issues, please write below their name and contact details:

Please return this questionnaire to Laure Ledoux, CSERGE, University of East Anglia, Norwich, NR4 7TJ. Tel: 01603 593747. Fax: 01603 593739. L.Ledoux@uea.ac.uk., before 31 October 2001. Thank you for your contribution in filling out this questionnaire. Please do not hesitate to contact me if you have any further comments or queries.

<addressee>

15 October 2001

Dear <addressee>,

DEFRA/EA MANAGED REALIGNMENT RESEARCH

The Department of Environment, Food and Rural Affairs (DEFRA) and the Environment Agency are seeking to identify why managed realignment of flood and coastal defences is not more widely implemented. As part of an ongoing research programme on Flood and Coastal Defence policy, ways of increasing the uptake of managed realignment are being investigated. Your views will be invaluable in understanding the incentives and the constraints to carrying out managed realignment.

Whilst managed realignment has been a topical issue for many years now, there have been few examples of actual implementation. There is an urgent need for a better understanding of issues associated with managed realignment, and how it could be better delivered through future flood and coastal defence planning. The study seeks to understand the political and social aspects of managed realignment in addition to the environmental, technical and economic aspects that are more commonly investigated.

For this purpose, a questionnaire has been produced by the project team comprising Halcrow, CSERGE (Centre for Social and Economic Research on the Global Environment) at the University of East Anglia, and CCRU (Cambridge Coastal Research Unit).

Throughout this questionnaire, managed realignment refers to the deliberate process of realigning river, estuary and/or coastal defences. Managed realignment can take several forms, for example a retreat of defences to higher ground or a realignment of coastal cliff frontages. The purpose of managed realignment schemes might be to:

- reduce defence costs by shortening the overall length of defences to be maintained;
- increase the efficiency and long term sustainability of flood and coastal defences by recreating river, estuary or coastal habitats and using their flood and storm buffering capacity;
- provide other environmental benefits through re-creation of natural habitats;
- (under the Habitats Regulations) provide replacement habitats in or adjacent to a European site, to compensate for habitat loss as a result of reclamation or coastal squeeze .

We understand that you may have an interest in coastal or flood defence and that managed realignment may be of interest or may affect you in some way. We would be most grateful, therefore, if you would spend a few minutes in completing and returning the attached questionnaire.

In completing the questionnaire, please do not try to give a formal statement on behalf of your organisation, but give your personal, professional view as a member of your organisation. Sections A and B deal with your views on managed realignment in general, and Section C deals with specific practical experience of managed realignment you might have had. We look forward to receiving your response, and would be grateful if you were able to reply by 31 October 2001.

Yours sincerely,

Laure Ledoux
Senior Research Associate
CSERGE

Implementing Managed Realignment as a Strategic Flood and Coastal Defence Option

List of consultees

Name	Organisation	Returned
Central Government		
Mr R. Purnell	DEFRA	
Mr D. Collins	DEFRA	X
Mr D. Richardson	DEFRA	
Dr D. Brook	DEFRA	
Mr V. Bodnar	DTLR	
Mr P. Jones	National Assembly For Wales	
Mr A. J. Burdekin	Scottish Executive	X
Mr P. Webster	Government Office for the North West	X
Local Government		
Mr M. Ashley	Local Government Association	
Mr S. Blair	Welsh Local Government Association	
Ms E. Wilson	National Association of Local Councils	
Mr M. Price	National Association of Local Councils	
Mr R. Wallis	Canterbury County Council	X
Mr P. Bredsford	Denbighshire County Coucil	X
Mr D. Lowsley	Chichester District Council	
Mr B. Bond	Conwy County Borough Council	X
Environment Agency		
Mr S. Wheatley	Regional Flood Defence Manager Anglia	X
Mr J. Adams	Regional Environment Manager Anglia	X
Mr K. Barton	Regional Flood Defence Manager NE	
Mr S. Bailey	Regional Environment Manager NE	X
Mr P. Wynn	Principal project Manager NE	X
Mr J. Pygott	Fisheries, Ecology and Recreation Manager NE	X
Mr P. Stainer	Regional Flood Defence Manager NW	X
Mr M. Diamond	Regional Environment Manager NW	X
Mr J. Fitzsimons	Regional Flood Defence Manager Midlands	
Mr M. Stark	Regional Environment Manager Midlands	X
Ms A. Baptiste	Regional Flood Defence Manager Southern	X
Mr I. Johnson	Regional Environment Manager Southern	X
Ms P. Harrisson	Environment Manager Kent area	X
Ms C. Drummond	Regional Flood Defence Manager SW	X
Mr S. Bray	Regional Environment Manager SW	
Mr P. Borrows	Regional Flood Defence Manager Thames	X
Mr A. Driver	Regional Environment Manager Thames	X
Mr J. Redmond	Regional Environment Manager	
Mr G. Bayliss	Regional Flood Defence Manager	
Mr M. Evans	Regional Environment Manager	
Mr B. Utteridge	Head of Flood Defence	
Mr G. Manse	Director of Water Management	
Mr M. Dixon	Environment Agency	X

Regional Development Agencies

Ms R. Philipps	OneNorthEast	
Mr R. Keffler	North West Development Agency	
Mr J. Haynes	Yorkshire Forward	
	Advantage West Midlands	
Ms S. Thackery	East Midlands Development Agency	
Mr J. Megginson	East of England Development Agency	
Ms C. Gibbson	South West of England Development Agency	
Ms V. Carter	SEEDA Headquarters	
	LDA Headquarters	

Nature Conservation Bodies

Ms S. Collins	English Nature	X
Mr T. Collins	English Nature	
Dr R. Jones	Countryside Council for Wales	
Dr G. Lees	Scottish Natural Heritage	X
Dr T. Weighell	Joint Nature Conservancy Council	
Mr R. Pilcher	Royal Society for the Protection of Birds	X
Mr P. Murby	The Wildlife Trusts	X
Ms J. Brown	World Wide Fund for Nature	X
Ms M. Morton	Marine Conservation Society	X

Heritage Bodies

Mr R. Daniels	Association of Local Government Archaeological Officers	X
The Director	Council for British Archaeology	
Mr J. Burgon	National Trust Estates Dept	
Mr P. Begg	National Trust Policy and Planning	
Mr R. Jarman	National Trust	X
Mr M. Coupe	English Heritage	X

Other

Ms E. Teller	Council for the Preservation of Rural England	
Dr A. Woods	Country Landowners Association	X
Mr R. Woolmore	Countryside Agency	
Mr B. McLaughlin	National Farmers Union	X
Ms J. Milne	Association of British Insurers	
Mr J. Taverham	CIWEM	X
Mr A. Gilham	CIWEM	X
Mr K. Riddell	Institution of Civil Engineers	
Mr K. Bartlett	Royal Institution of Chartered Surveyors	X
Mr D. Noble	Association of Drainage Authorities	X
Mr D. Leggett	C I R I A	X
Mr N. Jacobson	The Crown Estate	
Mr R.J. Dickinson	Defence Estates	X
Mr R. Jackson	Confederation of British Industry	
Mr N. Cleeveley	Trade Union Congress	
Miss S. Thomas	English Tourism Council	

Coastal Defence Groups

Mr R. Walton	South East Coastal Group	
Mr D. Green	South Downs Coastal Group	X
Mr C. Budzynski	Northumbrian Coastal Group	
Mr P. Ferguson	Humber Estuary Coastal Authorities Group	
Mr R. McInnes	SCOPAC	X
Mr J. V. Calvert	Cornwall and Isles of Scilly Coast Protection Group	X

Mr R. Eckersley	North Western Coastal Group	
Mr D. Mulrenan	Severn Estuary Group	X
Mr J. Riby	North East Coastal Authorities Group	X
Mr A. Bell	North Devon, Somerset and South Avon Coastal Group	X
Mr P. Frew	North Norfolk District Council	
Mr K. Cole	Lyme Bay and South Devon Coastal Group	
Mr T. Smith	Liverpool Bay Coastal Group	X
Mr M. D. Alexander	Tidal Dee Users Group	
Mr H. Jones	Carmarthern and Swansea Bay Coastal Group	X
Mr M. Wright	Cardigan Bay Coastal Group	
Mr P. Jones	Ynys Enlli to Llandudno Coastal Group	
Mr K. Keirle	Welsh Coastal Groups Forum	

Regional and sub-regional Coastal Fora

Ms T. Hewett	Solent Forum	
Ms S.h Bleakley	North West Coastal Forum Officer	X
Mr D. Brunsden	Dorset Coastal Forum	

National Coastal Fora

Ms L. Thomas	English Coastal Forum	
c/o S. Rowbury	English Coastal Forum	
Mr C.r Morgan	Welsh Coastal Forum	
Mr M. Cox	Scottish Coastal Forum	

RFDC

Miss D. Clark	South West RFDC	
Mr G. Sturdy	Wessex RFDC	X
Mr B. Cutting	Southern RFDC	X
Mr P. Bye	Anglian RFDC	X
Ms J. Turnbull	Northumbrian RFDC	
Mrs J. Venables MBE	Thames RFDC	
Mr S. McLeod	North West RFDC	
Mr P. Watts	Severn Trent RFDC	
Prof R. Ward	Yorkshire RFDC	X
Mr G. Manning	Environment Agency	

Local Flood Defence committees

Mr H. Cator	Norfolk and Suffolk Flood Defence Committee	X
Mr T.K. Jagger	Essex Flood Defence Committee	X
Mr R. Gregory	Kent Flood Defence Committee	X
Mr A. Drinkwater	Hampshire and Isle of Wight Flood Defence Committee	
Mr P. Dorhan	Sussex Flood Defence Committee	X
c/o Ms J. Cornthwaite	North West Local Flood Defence Committees	

Port Authorities

Mr D. Whitehead	British Ports Association	
Capt. G. Wilson	UK Habour Masters Association	
Mr D. Allen OBE	Harwich Haven Authority	X
Mr T. Vaughn	Shoreham Port Authority	X
Mr P. Couchman	Chichester Harbour Conservancy	X
Mr P. Barham	Associated British Ports	X

Estuary / Management Scheme Project Officers

Ms C. Davis	Thames Estuary Partnership	
Dr. A. Jemmett	The Dee Estuary Strategy	
Mr R. Humphreys	Dart Estuary Officer	X

Steven Knowles	Severn Estuary Management Scheme Project Officer	
	Taw/Torridge Estuary Manager	
Ms Sally Porter	Poole Harbour Commissioners	X
Ms R. Arkle	Morecambe Bay Partnership	
Mr P. Couchman	Environmental Manager	
Ms E. Davey	Wash Implementation Officer	
Mr C. David	N Cornwall Heritage Coast Officer	
	Falmouth Bay & Estuaries Initiative	
Ms E. Giles	Humber Project Officer	
Ms J. Falton	Wear Estuary Project Officer	
Mr J. Stapley	Yealm Estuary Forum	X
Mr R. Hill	Exe Project	
Ms L. Hopkins	Mersey Estuary Officer	
Mr D. James	Tamar Estuaries Coastal Officer	
Mr A. Midlen	Colne Estuary Project Officer	
Mr P. Morrison	Coastal project Officer	X
Mr N. Mortimer	Salcombe-Kingsbridge Project Officer	X
Ms N. Baker	Teign Estuary Project Officer	
Ms S. Porter	Fowey project Officer	
Mr C. Shepherd	Tees Project Officer	
Ms K. Ansell	Solent Project Officer	X
Mr G. Smith	Blackwater Estuary Implementation Officer	
Miss J. Pennington	Isle of Wight Estuaries Officer	
	Medway/Swale Estuary Project Officer	
Mr D. Hortin	Ribble Estuary Project Co-ordinator	
Ms D. Mortimer	The Wash and North Norfolk Coast Management Scheme Project officer	
Ms A. Hinks	Stour and Orwell Estuaries Officer	X
Mr T. Child	North-East Kent Management Scheme Project Officer	X

European Management Site Officers

Mr M. Quigley	Berwickshire and North Northumberland, EMS Conservation officer	
Ms S. Coles	Northumbria Coast EMS Conservation Officer	X
Mr K. Evans	EMS Conservation Officer (N and E Yorkshire)	
Ms R. Warren	Humber Estuary Conservation Officer	X
Mr C. Donnelly	The Wash and North Norfolk Coast EMS Conservation Officer	X
Mr R. Leishman	Breydon Water EMS Conservation Officer	
Mr P. Lambley	Great Yarmouth EMS Conservation Officer	X
Ms A. Collins	EMS Conservation officer (Suffolk)	
Ms C. Reid	Essex Estuaries EMS Conservation officer	X
Mr I. Black	EMS Conservation officer (Essex)	
Mr L. Solly	EMS Conservation officer (Kent)	X
Mr J. Curson	Dungeness EMS Conservation Officer	X
Mr W. McKenzie	Solent Maritime EMS conservation Officer	
Mr V. Copley	Poole EMS conservation Officer	X
Mr J. Crix	EMS Conservation officer and Management Scheme project Officer (Devon)	
Mr R. Covey	EMS Conservation officer (Cornwall)	
Ms K. Pollock	Severn Estuary EMS Conservation officer	X
	EMS Conservation Officer- English Nature NW	

Ms H. Johnston	Morecambe Bay EMS Conservation Officer
Mr M. Camplin	Cardigan Bay Marine SAC Officer
Ms L. Kay	Llyn Peninsula Marine SAC Officer
Ms S. Burton	Pembrokeshire Marine SAC Officer

Appendix C
Questionnaire Respondents in England and Wales

Appendix C
Questionnaire Respondents in England and Wales

The consultees who responded to the questionnaire are listed in the table below.

No.	Type	Organisation	Position in organisation	Name
2	CG	DEFRA	Environmental Adviser, Flood Management	David Collins
7	CG	Scottish Executive Environment Group	Head of Engineering Team; Air, Climate Engineering Unit	Alan Burdekin
	LG	Denbighshire County Council	Head of Highways and Transportation	Philip S Brelsford
	LG	Conwy County Borough Council	Assistant Director of Environmental Services	Barry Bond
	LG	Canterbury City Council	Senior Engineer (sea defences)	Roland Wallis
12	IDB	Association of Drainage Authorities	Chief Executive	David Noble
13	EA	Environment Agency, Anglian Region	Regional Flood Defence Manager	Stephen Wheatley
14	EA	Environment Agency	Regional Fisheries, Recreation, Conservation and Navigation Manager	John Adams
16	EA	Environment Agency, North East Region	Fisheries, Ecology and Recreation Manager	John Pygott
	EA	Environment Agency	Regional FRCN Manager	Steve Bailey
17	EA	Environment Agency, North West Region	Regional Flood Defence Strategic Planning Engineer	Paul M Stainer
18	EA	Environment Agency	Regional FRCN Manager	Mark Dixon
20	EA	Environment Agency	Regional FRCN Manager	Martin Stark

21	EA	Environment Agency	Regional Flood Defence Manager	Alison Baptiste
22	EA	Environment Agency	Regional FRCN Manager	Ian Johnson
23	EA	Environment Agency, Southwest Region	Flood Defence Improvements Engineer	Carol Drummond
24	EA	Environment Agency	Team Leader Conservation and Recreation (Kent area)	Philippa Harrison
25	EA	Environment Agency	Regional Flood Defence Manager	Peter Borrows
26	EA	Environment Agency, Thames Region	Regional Conservation Manager	Alastair Driver
32	EA	Environment Agency	Flood Defence Improvements Engineer	Mark Dixon
	EA	Environment Agency	Principal Project Manager, NCPMS	Philip Winn
42	NC	English Nature	Head of Coastal Conservation	Tim Collins
45	NC	Government Nature Conservation Agency	Coastal Geomorphologist	George Lees
47	NC	Royal Society for the Protection of Birds	Senior Water Policy Officer	Robert Pilcher
48	NC	The Wildlife Trusts	Coastal Policy Officer	Paul Murby
49	NC	WWF-UK	Policy Officer (coastal and biodiversity); Marine and Coastal policy	Janet Brown
50	NC	Marine Conservation Society	Coastal and Marine Planning Officer	Melissa Morton, Coastal and Marine Planning Officer
51	CH	Association of Local Government Archaeological Offices	Convenor Maritime Working Policy	Robin Daniels

54	CH	National Trust	Head of Environmental Practices	Rob Jarman
55	CH	English Heritage	Head of Land Use Planning and Regeneration	Michael Coupe
57	O	Country Land and Business Association	Director of Strategy	Tanya Olmeda-Hodge
59	O	National Farmers Union	Head of Environment and Rural Affairs Department	Brian McLaughlin
61	O	Chartered Institution of Water and Environmental Management	Committee member - Rivers and Coastal Group	Andrew Gilham
61	O	Chartered Institution of Water and Environmental Management	Director of Policy	Justin Taberham
63	O	The Royal Institution of Chartered Surveyors	Executive, RICS Rural Faculty	Kenneth Bartlett
65	O	CIRIA	Head of Water Engineering Group	Daniel Leggett
67	O	Defence Estates	Head of Environmental Policy	R.J. Dickinson
73	CDG	Coast Groups, Arun District Council	Head of Infrastructure and Works	David Green
76	CDG	SCOPAC	Chairman of the Officers' Working Group	Robin McInnes
77	CDG	Cornwall & Isles of Scilly Coastal Group	Chair	J.V. Calvert
79	CDG	Severn Estuary Coastal Cell	Chair/Secretary	Diarmuid Mulrenan
80	CDG	North East Coastal Authorities Group	Chair	John Riby
81	CDG	North Devon Coast and Countryside Service	AONB & countryside Development Officer	Andrew Bell
84	CDG	Liverpool Bay Coastal Group	Secretary	Tony Smith

92	RCF	North West Coastal Forum	Project Officer	Susannah Bleakley
	RCF	North West Coastal Forum	Representative of GO-NW on NWCF steering group	Paul Webster
99	RFD	Wessex RFDC	Chairman, Wessex RFDC	Giles Sturdy
100	RFD	Southern Region Flood Defence Committee	Chair	William Cutting
101	RFD	Anglian RFDC	Chairman	Peter Bye
106	RFD	Yorkshire Regional Flood Defence Committee	Chairman	Roy Ward
108	LFD	Norfolk and Suffolk Local Flood Defence Committee	Chair	Henry Cator
109	LFD	Anglian RFDC	Member Anglia Region RFDC; Chair Essex LFDC	T.K. Jagger
110	LFD	Kent Local Flood Defence Committee	Chair	Ron Gregory
112	LFD	Sussex Flood Defence Committee	Chair	Peter Doran
116	PA	Harwich Haven Authority	Harbour Engineer	Richard S. Allen
117	PA	Shoreham Port Authority	Port Engineer/Deputy General Manager	Tony Vaughan
118	PA	Chichester Harbour Conservancy	Environmental Manager	Philip Couchman
119	PA	Associated British Ports	Environment Manager	Peter Barham
123	EO	Dart Estuary Environmental Management (NGO Estuary Management Partnership)	Estuary Officer	Ray Humphreys
134	EO	River Yealm Harbour Authority	Harbour Master	P.J. Stapley
139	EO	Northumberland County Council	Countryside Officer, Environment Division	Paul Morrison

140	EO	South Hams District Council; Salcombe Harbour Authority	Marine Conservation Officer	Nigel Mortimer
142	EO	Poole Harbour Commissioners	Environmental Adviser; Harbour Engineer	Richard N Appleton
144	EO	Solent Forum	Solent Forum Officer	Kate Ansell
150	MSC	English Nature - Northumbria	Conservation Officer Northumberland Coast (North)	Sarah Coles
152	MSC	English Nature	Conservation Officer, Humber	Ruth Warren
153	MSC	English Nature	Maritime Conservation Officer, East Midlands	Conor Donnelly
155	MSC	English Nature	Conservation Officer	Peter Lambley
157	MSC	English Nature	Conservation Officer	Carol Reid
159	MSC	English Nature	Conservation Officer, Kent Team	Lionel Solly
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162	MSC	English Nature	Conservation Officer	Victoria Copley
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174	MPO	Thanet Coastal Park Project	Coastal Park Project Officer	Tony Child

Organisational Types:

CG Central Government

LG Local Government

IDB IDBs

EA Environment Agency

RDA Regional Development Agencies

NC Nature Conservation Bodies

CH Heritage Bodies

O Other

CDG Coastal Defence Groups

RCF Regional and sub-regional coastal fora

NCF National Coastal Fora

RFD RFDC

LFD Local Flood Defence committees

PA Port Authorities

EO Estuary Officers

MSC Marine SAC officers

MPO Management Scheme project officers (not overlapping with estuary officers)

Appendix D
Regional Workshop Participants

Regional Workshop on Managed Realignment
Leeds United Football Club, 7 January 2002.
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Regional Workshop on Managed Realignment

Fitzwilliam College, Cambridge, 17 January 2002.

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Appendix E
Participants in Case Study Workshops

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Paul Murby	Yorkshire Wildlife Trust
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Brancaster Focus Group Meeting
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Appendix F
Methodological Issues for Valuing Environmental Assets

Appendix F
Methodological Issues for Valuing Environmental Assets

F.1 Concepts of economic valuation of environmental goods

In environmental economics, an individual preference-based value system operates in which the benefits of environmental gain (or the damages from environmental loss) are measured by social opportunity cost (i.e. cost of foregone options) or total economic value. The assumption is that the functioning of ecosystems provides society with a vast number of environmental goods and services that are of instrumental value to the extent that some individual is willing to pay for the satisfaction of a preference. It is taken as axiomatic that individuals almost always make choices (express their preferences), subject to an income budget constraint, which benefit (directly or indirectly) themselves or enhances their welfare. The social value of environmental resource committed to some use is then defined as the aggregation of private values. Nature conservation benefits should be valued and compared with the relevant costs. Conservation measures should only be adopted if it can be demonstrated that they generate net economic benefits.

The main problem when including the range of environmental services in economic choices is that many of these services are not valued in markets. There is a gap between market valuation and the economic value of environmental resources. To fill these gaps the non-marketed gaps must first be identified and then where possible monetised. The mainstream economic approach to valuation takes an instrumental (usage-based) approach (as opposed to an intrinsic value which resides in the object itself), and seeks to combine various components of value into an aggregate measure of resource value labelled total economic value (TEV). This total economic value (TEV) can be usefully broken down into a number of categories as shown in Figure F.1. The initial distinction is between use (direct and indirect) value and non-use value.

A use value is a value derived from the utilisation of a productive function of a natural system and has several subcomponents. Direct use value refers to the gain from the actual use which may be consumptive (e.g. fishing) or not (e.g. aesthetic enjoyment). Indirect use value refers to the benefits individuals derive from the various ecosystem functions (e.g. storm buffering, species nursery and breeding grounds.). Option value relates to the value an individual might place on perceived future benefits from the conservation of a resource or one of its components. A number of environmental economists include an additional sub-division of option value, the quasi-option value which is the value of information gained by delaying a decision to proceed with use of a resource which may result in an irreversible loss.

Non-use values, in essence, are associated with benefits derived simply from the knowledge that a resource, such as an individual species or an entire ecosystem, is maintained. It is, by definition, not associated with any use of the resource or any tangible benefit derived from it, although users of a resource might also attribute non-

use value to it. Such values will be motivated by a number of different ethical and other motivations. Non-use values can be sub-classified into three main components. Existence value is the satisfaction value an individual derives by simply knowing that a feature of the environment continues to exist, whether or not it brings benefits to others. Bequest value relates to the knowledge that a resource will be maintained for future generations so protecting the opportunity for them to enjoy it. Finally, philanthropic value is associated with the satisfaction an individual derives from ensuring that a resource is maintained and available for contemporaries of his or her generation.

Economists have developed a range of valuation methodologies that capture different components of the TEV, as described in Table F.1, using a wetland ecosystem as an example (see Pearce and Turner, 1990, and Turner *et al* 2001 for a more complete description). Which method should be used depends on the type of impact considered (Table F.2). As a general rule, any study whose objective is to measure total economic value must use Contingent Valuation, as this is the only method that can measure non-use value as well as use value. This is indeed often the preferred method of economists (e.g. Green et al, 1994, Penning-Rowsell, 1992).

Table F.1 **Valuation Methodologies Relating to Ecosystem Functions: e.g. wetlands**
Source: Turner et al, 2001

Valuation Method	Description	Direct Use Values	Indirect Use Values[1]	Non-use Values
Market Analysis	Where market prices of outputs (and inputs) are available. Marginal productivity net of human effort/cost. Could approximate with market price of close substitute. Requires shadow pricing	√	√	
(Productivity Losses)	Change in net return from marketed goods: a form of (does-response) market analysis.	√	√	
(Production Functions)	Wetland treated as one input into the production of other goods: based on ecological linkages and market analysis.		√	
(Public Pricing)	Public investment, for instance via land purchase or monetary incentives, as a surrogate for market transactions.	√	√	√[2]
Hedonic Price Method (HPM)	Derive an implicit price for an environmental good from analysis of goods for which markets exist and which incorporate particular environmental characteristics.	√	√	
Travel Cost Method (TCM)	Cost incurred in reaching a recreation site as a proxy for the value of recreation. Expenses differ between sites (or for the same site over time) with different environmental attributes.	√	√	
Contingent Valuation (CVM)	Construction of a hypothetical market by direct surveying of a sample of individuals and aggregation to encompass the relevant population. Problems of potential biases.	√	√	√
Damage Costs Avoided	The costs that would be incurred if the wetland function were not present; e.g. flood prevention.		√	
Defensive Expenditures	Costs incurred in mitigating the effects of reduced environmental quality. Represents a minimum value for the environmental function		√	
(Relocation Costs)	Expenditures involved in relocation of affected agents or facilities: a particular form of defensive expenditure.		√	
Replacement/ Substitute Costs	Potential expenditures incurred in replacing the function that is lost; for instance by the use of substitute facilities or 'shadow projects'.	√	√	√[3]
Restoration Costs	Costs of returning the degraded wetland to its original state. A total value approach; important ecological, temporal and cultural dimensions.	√	√	√[3]

Notes to Table F.1:

[1] Indirect use values associated with functions performed by a wetland will generally be associated with benefits derived off-site. Thus, methodologies such hedonic pricing and travel cost analysis, which necessarily involve direct contact with a feature of the environment, can be used to assess the value of indirect benefits downstream from the wetland.

[2] Investment by public bodies in conserving wetlands (most often for maintaining biodiversity) can be interpreted as the total value attributed to the wetland by society. This could therefore encapsulate potential non-use values, although such a valuation technique is an extremely rough approximation of the theoretically-correct economic measure of social value, which is the sum of individual willingnesses to pay.

[3] Perfect restoration of the wetland or creation of a perfectly substitutable 'shadow project' wetland, which maintains key features of the original, might have the potential to provide the same non-use benefits as the original. However, cultural and historical aspects as well as a desire for 'authenticity' may limit the extent to which non-use values can be 'transferred' in this manner to newer versions of the original. This is in addition to spatial and temporal complexities involved in the physical location of the new wetland or the time frame for restoration.

Table F.2 Environmental impacts of Managed Realignment and valuation methods

Source: adapted from Turner et al, 2001

Effects Categories	Valuation Method Options
PRODUCTIVITY	Market valuation via prices or surrogates
e.g. primary productivity, fisheries, agriculture, tourism, flood control, storm buffering and coastal protection	Preventive expenditure
	Replacement cost/shadow projects
	Defensive expenditure
HEALTH	Human capital or cost of illness
	Contingent valuation
	Preventive expenditure
	Defensive expenditure
AMENITY Coastal and freshwater wetlands, landscapes including cultural assets and structures	Contingent valuation/ranking
	Travel cost
	Hedonic pricing
EXISTENCE VALUES	Contingent valuation
Ecosystems; cultural assets	

F.2 Issues in valuation

F.2.1 Quantitative and qualitative approaches to valuation

Monetary economic valuation of the environment has been both supported and heavily criticised in the social science literature and by policy practitioners. The use of cost-benefit analysis (CBA) in environmental policy-making and contingent valuation (CV) as an extension of traditional CBA has stimulated an extensive debate. CV is a collective term for various survey-based environmental valuation methods. A lot of the debate about the use of CV in CBA is conditioned by ethical and implicit value judgements held by various protagonists (Turner, 1979). First, there is the question whether the utilitarian ethic underlying economic efficiency is considered an appropriate basis for dealing with the allocation of scarce resources, including the environment. It is argued that this approach is too restrictive because it disregards important issues like the distribution of resources and non-anthropocentric values. Secondly, and related to this first point is the question of whether environmental systems, including their intrinsic values can be meaningfully valued in monetary terms. Thirdly, there is the question of how environmental values should be elicited, either through CV or alternative approaches.

Environmental economists are accused of blind adherence to an outmoded neo-classical economic theory lacking empirical verification and political consensus. For some of the critics, the supposed biases and practical inconsistencies found in CV surveys further undermine the validity and modern relevance of neo-classical economic value theory.

The individual survey based approaches to environmental valuation and the deliberative stakeholder group approaches are rooted in different perspectives on how decision-making procedures are or should be organised. Different cultural views on social relations are assumed to give rise to different preferences towards decision-making procedures for different kinds of issues, including environmental ones (see for example Rayner, 1984, in the context of risk management). These cultural foundations can be found underpinning the different approaches to environmental valuation.

Burgess *et al.*, (1998) seriously question the role of CV in environmental decision-making by arguing that people come up with a monetary amount because of the coercive interview situation, or people's trust in the expertise held by those asking the questions. Burgess *et al.* conclude that decisions about the environment should be based on social consensus about appropriate standards and acceptable choices rather than on the individual WTP amounts elicited in CV surveys. Some of the force of this critique is in our view conditioned by the problems with the specific CV survey used as an exemplar. This was experimental in nature and therefore not established 'best practice' (Garrod, personal communication, 1998). Nevertheless, the in-depth group discussion offers CV researchers a different perspective on the elicitation of environmental values and is relevant to a comprehensive CV approach.

While CV research has been criticised as imposing a market construct and context on respondents, the recent use of focus groups linked to public decision-making may be equally suspect from a 'critical realism' point of view (Bhaskar, 1989). The group discussion may not be mere consultation or a mechanism to reproduce underlying social

relationships, but rather more of a 'transformational intervention', at once scientific and political. It is therefore just as open to manipulation and steering. The key message is that all the methods and approaches must be anchored to a proper testing protocol to yield information on the "reliability" and "validity" of the results.

A combination of quantitative and qualitative research methods can be advocated in order to generate a blend of different types of policy relevant information. This applies to both the biophysical assessment of management options, and the evaluation of the welfare gains and losses people perceive to be associated with the environmental changes and the management options that may be entailed.

Social research dependent on quantitative research methods and techniques is premised on the assumption that opinions, feelings, perceptions, beliefs, attitudes or behaviour can be expressed in meaningful numerical ways within a given context. It is most often criticised for its overly reductionist character in the face of real world complexity and diversity, i.e. social, cultural, economic, political and environmental. Its technical nature may also act as a shroud, obscuring its 'proper' interpretation by the public.

F.2.2 Discounting

Temporal scale, in combination with the rate of discount applied, will influence the value assigned to ecosystem functions. It is frequently necessary within cost-benefit analysis to choose between alternative projects which may have different intertemporal patterns of benefits and costs extending over varying durations. Costs and benefits which occur at different times need to be compared within a common matrix, and this is the rationale behind discounting effects which occur in the future. It is common practice in economic appraisal to convert the stream of future costs and benefits into 'present' values to allow them to be directly compared, the difference between total benefits and costs being referred to as 'net present value' (NPV). A project is only accepted if NPV is positive.

Discounting future values stems from the observation that costs and benefits in the future are not valued as highly as equivalent costs and benefits occurring now. The choice of discount rate can have significant influence on which projects pass the cost-benefit criterion. Options that involve high initial costs and a stream of benefits far into the future, such as the creation or restoration of wetlands, are less likely to be accepted when employing a higher rate of discount. Options for which the benefits are more immediate and the costs are not incurred until far into the future, will become more viable with a higher discount rate. For projects that produce hazardous wastes that must be stored for lengthy periods, such as nuclear power generation, the potentially disastrous costs can become insignificant when discounted to present value. A higher rate of discount is also more likely to encourage more rapid depletion of non-renewable natural resources and over-exploitation of renewable natural resources, thereby reducing the inheritance of natural capital for future generations. However, lower rates of discount will tend to encourage investments that might not otherwise have been viable and could conceivably result in more rapid depletion of resources. The link between the size of discount rate and the degree to which options will impinge upon the environment

is therefore ambiguous, and it is not clear that the traditional call for lower discount rates in order to incorporate environmental concerns is generally valid.

It is the social rate of discount that should be used when assessing developments that will influence intergenerational welfare. Maintaining future welfare could be regarded as a public good, if it is seen as an obligation of society as a whole, in which private individuals will tend to under-invest. As a result, the social discount rate – measured as either the social rate of time preference (SRTP) or the social opportunity cost of capital (SOC) – can be expected to be lower than the equivalent individual rate of discount. The rates currently recommended for project evaluation by the UK Treasury, for example, are 8% for commercial investments, 6% for public sector projects and 3% for the forestry sector. Pearce and Ulph (1995) in a recent study of the factors determining the social rate of discount in the UK, measured as the consumption rate of interest, argue that a rate of nearer 2% as more appropriate.

The discount rate does not take into account effects that developments might have which are irreversible, for instance the extinction of species or exhaustion of minerals. An approach to rectify this has been proposed in which future benefits forgone are treated as additional costs. These net benefits of preservation are likely to increase over time as demand for environmental services rise, with limited or declining supply, while net benefits from development projects are likely to decline relatively as alternative technologies improve. These temporal trends in benefits can be incorporated into the decision rule by applying adjustments to the social discount rate: in effect, decreasing the discount rate applied to preservation benefits while increasing the rate applied to development benefits.

F.2.3 Aggregation and double counting

If each output provided by an ecosystem is identified separately, and then attributed to underlying functions, there is the likelihood that benefits will be double counted. Benefits might therefore have to be explicitly allocated between functions. For instance, Barbier (1993) notes that if the nutrient retention function is integral to the maintenance of biodiversity, then if both functions are valued separately and aggregated this would double count the nutrient retention which is already 'captured' in the biodiversity value. Some functions might also be incompatible, such as water extraction and groundwater recharge, so that combining these values would overestimate the feasible benefits to be derived from the ecosystem. Double counting will be particularly important with partial analysis and total valuation of an ecosystem, although some approximations to total valuation do not encounter this problem.

F.2.4 Benefit transfer

Environmental value transfer is commonly defined as the transposition of monetary environmental values estimated at one site (study site) through market based or non-market based economic valuation techniques to another site (policy site). The most important reason for using previous research results in new policy contexts is cost-effectiveness. Applying previous research findings to similar decision situations is a very

attractive alternative to expensive and time consuming original research to quickly inform decision-making.

The criteria for selecting studies for environmental value transfer suggested in the literature focus on the environmental goods involved, the sites in which the goods are found, the stakeholders and the study quality (Desvousges *et al.* 1992). However, very little published evidence exists of studies that test the validity of environmental value transfer. Moreover, in the few studies that have been carried out, the transfer errors are substantial (Brouwer, 1998).

Bateman et al (2000) review approaches to benefit transfer in theory and practice, of which a summary of findings follow. The simplest approach to transferring benefits is to apply the unit value estimate of the site at which the original valuation study was conducted to the target site where benefit estimates are required. In practice, the assumption of identical unit values across sites may not hold for a variety of reasons, including differences in the socio-economic characteristics of the relevant population, differences in the physical characteristics of the study and policy site, difference in the proposed change in provision between the sites, differences in the market conditions applying to the sites. The extent to which these and other potential differences hold can be regarded as criteria for acceptability of unadjusted unit value transfer. Clearly, ideal conditions for this simple approach with rarely hold, and unit values should be adapted to the new site. Three adjustment strategies can be considered:

(a) Expert judgement – while there may be certain cases for which this is acceptable, more objective adjustment techniques are obviously preferable;

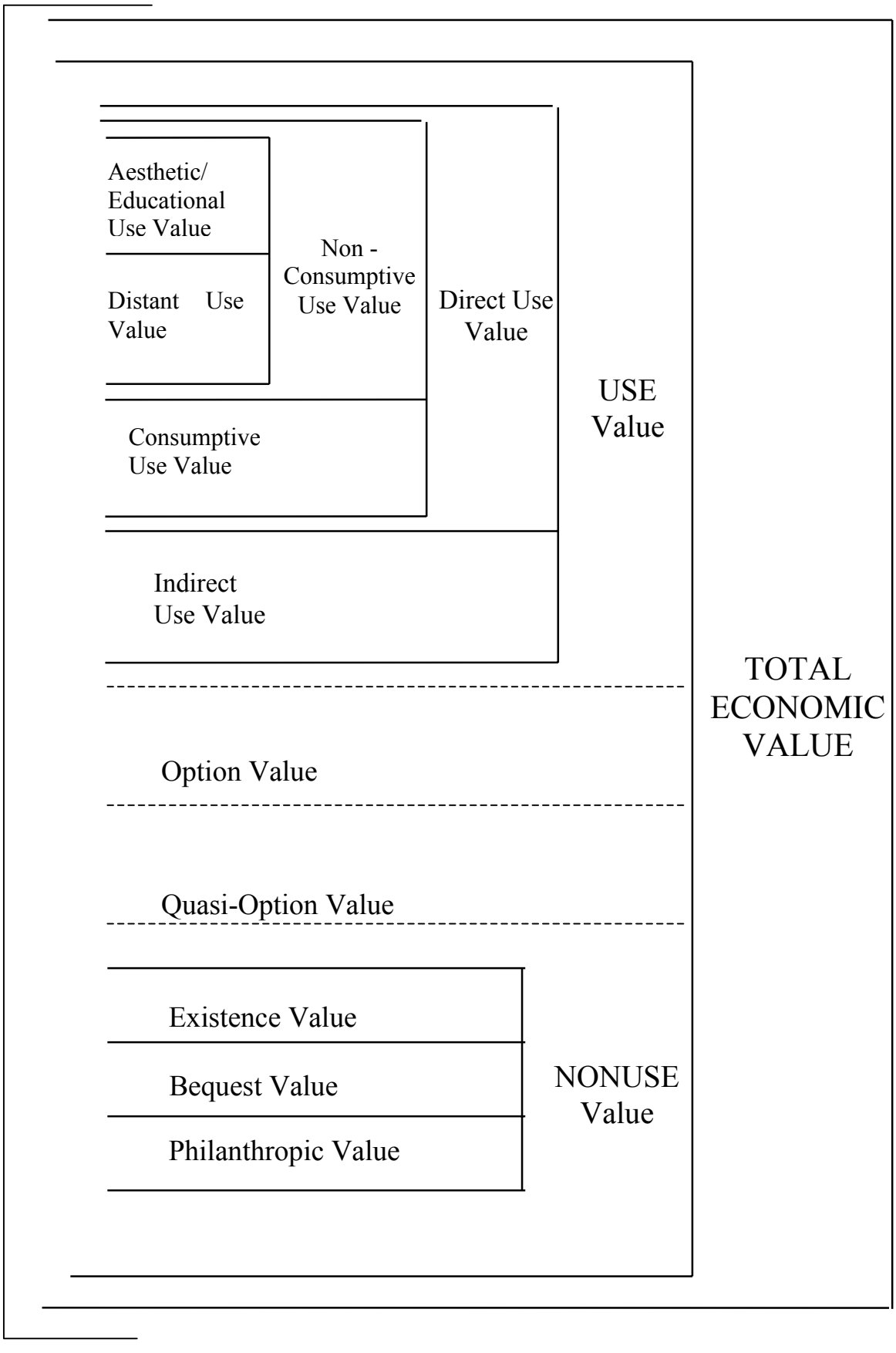
(b) Re-analyses of existing study samples to identify subsamples of data suitable for transferral – the extent to which this can be done depends crucially upon initial sample size, and this problem becomes exacerbated where sub-division is required across a number of variables; and

(c) Metanalysis, which is the statistical analysis of the summary findings of prior empirical studies for the purpose of integrating findings (Wolf, 1986). Meta-analysis assumes relatively standard designs and standard measurements. The further the raw data deviates from such specifications, the more it is difficult to rely on results from a cross-analysis. Another problem is that studies published in the available literature may over represent studies which produce "positive" or significant results if studies yielding "negative" or non-significant findings tend not to be published. Nevertheless, meta-analysis offers a transparent structure allowing the derivation of useful generalisations, and permitting extraction of information from large masses of data in a way that would be difficult with narrative or qualitative analysis only. There has been a number of applications of meta-analysis to the field of environmental economics in recent years, including one on wetland function values which is particularly useful in the context of Managed Realignment and which is reported in Section 6.

The last approach to benefit transfer is to transfer the entire benefit function from the study to policy site, instead of using unit values. Since benefit estimates are often a

complex function of the site and user characteristics, function transfer can directly account for these by using the relationship between characteristics and the benefit estimate. Bateman *et al* review practical examples of benefit function transfer, and conclude that in some cases the transferability of the benefit function transfer is rejected. Brouwer (1999) shows that the errors in transferring monetary value estimates for seemingly similar environmental goods over sites can be as large as 56% in the case of average unit value transfer and 475% in the case of benefit function transfer. Nevertheless, carefully designed benefit functions can yield useful results, and Bateman *et al* suggest that the application of GIS can substantially benefit function transfer through improved and systematised data access.

One of the main applications of benefit transfer in the UK has been the assessment of recreational and amenity benefits resulting from flood and coastal defence schemes (Spurgeon, 1998, Penning-Rowsell, 1992, Green *et al*, 1994). Several "standard values" have been derived for use at a feasibility level. However, the review summarised above underlines the danger of using these average values where more reliable estimates of costs and benefits are required. As argued by Green et al (1994), this is a case of cost-benefit analysis on cost-benefit analyses: "the value of collecting better information should be weighed against the cost of collecting data. Conversely, saving a few tens of thousands of pounds when a multi-million pound decision is at issue is usually penny wise and pound foolish."


Aesthetic/
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Philanthropic Value
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TOTAL
ECONOMIC
VALUE

Appendix G Summary overview of valuation studies on coastal and freshwater wetland ecosystems

Appendix G Summary overview of valuation studies on coastal and freshwater wetland ecosystems

Bibliographical characteristics				Details of Study						
Author(s)	Title	Bibliographical details	Year	Issue addressed in study/ General Function-Use Identification	Technique	Measurement unit	Mean / Total	System	Spatial scale	Country
Anderson, E.	"Economic Benefits of Habitat Restoration: Seagrass and the Virginia Hard-Shell Blue Crab Fishery,"	*North American Journal of Fisheries Management*, 9, 140-149.	1989	Aquatic vegetation (seagrass) used as habitat by Virginia hard-shell blue crabs. Function-Use: Fishing.	SM	$.	2438000.	Bay	Local	USA
Anderson, G.D. and S.F. Edwards.	"Protecting Rhode Island's Coastal Salt Ponds: An Economic Assessment of Downzoning,"	*Coastal Zone Management Journal*, 14 (1/2), 67-91.	1986	Economic benefits of coastal amenities (swimmable water). Function-Use: recreation (fishing, boating and wildlife viewing)	HP	US $ 1983 Per foot (frontage) and per house (view)	11.16	salt pond	local	USA
Barnard, J.R.	"Externalities from Urban Growth: The Case of Increased Storm Runoff and Flooding,"	*Land Economics*, 54 (3), 298-315.	1978	Increased frequency and magnitude of flooding due to urban growth, and its impact on urban residential property values. Function-Use: flood control	HP	$ 1973 per property for properties subject to flood hazard.	727	streams	local	USA

Bateman, I.J., I.H. Langford, R.K. Turner, K.G. Willis, and G.D. Garrod.	"Elicitation and Truncation Effects in Contingent Valuation Studies,"	*Ecological Economics,*12, 161-179.	1995	Analysis of methods of eliciting WTP in a CV study of flood protection of a UK wetland. Function-use : recreation, nature conservation	CV	English pounds/year	67.19	freshwater wetland	local	United Kingdom
Bergstrom, J.C., J.R. Stoll, J.P. Titre, and V.L. Wright.	"Economic Value of Wetlands-Based Recreation,"	*Ecological Economics,* 2, 129-147.	1990	Wetlands loss and recreational value. Function-Use: Hunting and fishing	CV	$ 1986 Per user.	360	freshwater and coastal wetlands	regional	USA
Boisson, J.M. and M.A. Rudolff.	"Second-Thoughts on Long Term and Supra Long Term Valuation of Natural Assets in a CVM Application to the Filling of a Coastal Lagoon,"	Montpellier: Faculté de Sciences Economiques, LAMETA (CNRS), Université de Montpellier I, France.	1998	Context of the filling of a natural lagoon. Test difference between valuation of two types of natural assets, with use and bequest values (30 years) and without (100 years). Function-Use: Habitat.	CV	FF.	a.) FF52,72 incl protest bids: FF47,52; b.) 46,02 inc. protest bids FF33,66.	Coastal lagoon	Local	France
Broadhead, C., J.P. Amigues, B. Desaigues, and J. Keith.	"Riparian Zone Protection: The Use of the Willingness to Accept Format (WTA) in a Contingent Valuation Study,"	paper presented at the World Congress of Environmental and Resource Economists in Venice, Italy.	1998	To evaluate the costs of preserving riparian habitat on the banks of the Garonne River. The CVM was used to study households that currently own land on the banks of the river. More precisely, a WTA was used to estimate the loss to owners for no longer being able to farm riverbank areas activity. Function-Use: agriculture	CV	1997 FF/ha/year	Mean WTA for program 1 is 1373FF/ha.	river	regional	France

Cooper, J.C.	"Using the Travel Cost Method to Link Waterfowl Hunting to Agricultural Activities,"	*Cahiers d'Economie et Sociologie Rurales*, 36, 5-26.	1995	impact of contaminated irrigation run-off on waterfowl hunting benefits. Function-Use : hunting, agriculture	TC	$ 1988 per hunter day and total for Kesterson	55.41	freshwater wetlands	regional	USA
Cooper, J. and J.B. Loomis.	"Testing whether Waterfowl Hunting Benefits Increase with Greater Water Deliveries to Wetlands,"	*Environmental and Resource Economics*, 3, 545-561.	1993	impact on recreational waterfowl hunting benefits of an increase in refuge water supplies to levels necessary for biologically optimal refuge management. Function-use: waterfowl hunting	TC	$ 1990 per acre-foot of additional water supply	0.93 -- 20.40 (OLS), 0.64 -- 14.05 (Poisson)	freshwater wetlands	regional	USA
Costanza, R., Farber, S.C., Maxwell, J.	"valuation and management of wetland ecosystems"	*Ecological Economics,* 1(4), 335-361	1989	Review of Louisiana coastal wetland values for commercial fisheries (a), trapping (b), recreation (c), storm protection (d)	CV, MV	1983 $/acre with both 8% and 3% discount rate	(a) 317 and 846; (b) 151 and 401; (c) 46 and 181; (d)1915 and 7549.	Coastal wetland	Regional	USA
Crandall, K.B., B.G. Colby, and K.A. Rait.	"Valuing Riparian Areas: A Southwestern Case Study,"	*Rivers*, 3 (2), 88-98.	1992	economic value of river preserve, in particular riparian areas	CV	$ 1990 per visitor, per year	65	river	regional	USA
Creel, M. and J.B. Loomis.	Recreation Value of Water to Wetlands in the San Joaquin Valley: Linked Multinomial Logit and Count Data Trip Frequency Models,	*Water Resources Research, 28 (10), 2597-2606*.	1992	recreation benefits from an increase in water quantity or quality. Function-Use: waterfowl hunting, fishing and wildlife-viewing	TC	$ 1989 per visitor, per year	126 -- 655	freshwater wetlands	regional	USA
Donnelly, W.A.	"Hedonic Price Analysis of the Effects of a Floodplain on Property Values,"	*Water Resources Bulletin*, 25 (3), 581-586.	1989	flood hazard potential reflected in land values. Function-use: property, flood-control	HP	$ 1985 per $ of property tax liability	5.53 per $ property tax liability	river	regional	USA

Driscoll, P., B. Dietz, and J. Alwang.	"Welfare Analysis When Budget Constrains are Nonlinear: The Case of Flood Hazard Reduction,"	*Journal of Environmental Economics and Management*, 26, 181-199.	1994	methodology (direct utility model) illustrated by case study. Function-Use: fishing, swimming	HP	$ 1990 per chance of flooding	204.29 -- 6,105.20	river	local	USA
Farber, S.	"The Value of Coastal Wetlands for Protection of Property Against Hurricane Wind Damage""	*Journal of Environmental Economics and Management,* 14(2), 143-51.	1987	Coastal wetland value for protection against hurricane damage (indirect use) Function-Use: Storm Protection	MV	$/acre	6.82-22.94	Coastal Wetland	Regional	USA
Farber, S.	"The Value of Coastal Wetlands for Recreation: An Application of Travel Cost and Contingent Valuation Methodologies,"	*Journal of Environmental Management*, 26, 299-312.	1988	To estimate wetlands recreational value. Function-use: swimming, commercial harvest, waste treatment	TC	$ 1984, per year, per visit and per household.	Mean PV of the linearization process (pop.growth =2.6%, i=8%): mean full wage (in $mil): $72.185; 0.6 mean full wage: $50.611; 0.3: $34.444; 0.1: $23.648. 650,000 acres of wetlands: depending on the time cost value used, the average capitalized value ranged from $36 to $111 per acre. Semilog and quadratic estimates: PV (pop.growth =2.6%, I=8%): $133.407 million. Mean response of the WTP-question: $103.48 per household annually. Mean WTP for semi-log demand function: $323.22 per household.	coastal wetland	regional	USA

Farber, S.	"Welfare Loss of Wetlands Disintegration: a Louisiana Study"	*Contemporary Economic Policy*, 14, 92-106.	1996	Total present value of coastal wetlands Function-Use: all	MV, CV, etc.	$/acre	8,437-15,763	Coastal wetland	Regional	USA
Grant, W.E. and W.L. Griffin.	"A Bioeconomic Model of the Gulf of Mexico Shrimp Fishery"	*Transactions of the American Fisheries Society*, 108(1), 1-13.	1979	Bioeconomic simulation model of the Gulf shrimp fishery, assessing the impact of alternative management strategies on the harvest of shrimp. Function-Use: Recreation.	SM	$Millions/ year.	4.2.	Gulf	Regional	Mexico
Green, C.H. and S.M. Tunstall.	"The Amenity and Environmental Value of River Corridors in Britain,"	in P.J. Boon, P.Calow, and G.E. Petts (eds.), *River Conservation and Management*, Chichester: John Wiley, 425-441.	1992	To evaluate three different potential benefits from water quality improvements: 1) the additional enjoyment to existing users; 2) the increase in amenity enjoyment to residents living near the river corridor; 3) the overall non-use value. Function-Use: swimming, boating, fishing.	CV	In UK pounds 1987, per visit or per lump sum.	Residents: water quality good enough for 1. water birds/ 2. to support fish, dragonflies and different types of plant 3. to be safe for children to swim: 546/562/ 582;. Visitors (in pence per visit): 1.: for town centre/local park/honeypot: 37/42/41; 2: 42/48/41; 3: 36/38/45. Remote sites survey: WTP for non-user/ users: 13.59/19.56 per year.	river	national	United Kingdom

Gren, I.M., C. Folke, R.K. Turner, and I.J. Bateman.	"Primary and Secondary Values of Wetland Ecosystems,"	*Environmental and Resource Economics*, 4, 55-74.	1994	To compare different approaches with respect to their ability to capture the primary and secondary values of wetlands. Two categories of methods are considered; biophysical methods, and methods based on behavioural models. Due to the fact that only one case study dealt entirely with this last type of model, only that case study will be investigated here. (Bateman et al. 1993). Function-use: agriculture, recreation	CV	British Pound 1991 per year	1a) 67; 1b) 75; 1c) 140; 2a) 12,45; 2b) 4,08.	freshwater wetland	local	United Kingdom
Holway, J.M. and R.J. Burby.	"The Effects of Floodplain Development Controls on Residential Land Values,"	*Land Economics*, 66 (3), 259-271.	1990	Considering the effects of the National Flood Insurance Program (NFIP). The purpose of this study is to determine the extent to which floodplain management programs are indeed reducing the value of vacant land in the floodplain. Function-use: housing, flood-control	HP	In thousand square feet and dollars.	Arvada: mean land value/mean parcels size (acre)/mean flood hazard (fifths in floodplain): 1,009/3.1/4.4; Cape Girar-deau: 200/1.8/3.5; Fargo: 706/1.9/4.6; Omaha: 499/ 9.6/3.0; Palatine: 1,248/ 0.4/3.5; Savannah: 348/ 9.7/4.3; Toledo: 387/ 4.5/2.3; Tulsa: 259/3.5/ 3.8; Wayne: 1,131/4.5/ 4.4; average: 782/3.7/3.7.	river	regional	USA

Kaoru, Y.	"Differential Use and Non Use Values for Coastal Pond Water Quality Improvements,"	*Environmental and Resource Economics*, 3, 487-494.	1993	As concerned over the deterioration of water quality grows, effective management of coastal pond water quality will require the evaluation of benefits derived from water quality improvements. This paper examines the distinct relationship between individual socio-economics characteristics and different components of the total value of water quality improvements. Function-use: shellfishing	CV	Dollars, years per option, use and existence value.	Total WTP for water qualilty improvements: $131.03; use value component of total WTP: $33.69; option value component of total WTP: $19.41; existence value component of total WTP: $77.59.	coastal pond	regional	USA
King, S.E., and Lester, J.	"The value of salt marsh as a sea defence"	*Marine Pollution Bulletin,* 30(3), 180-189.	1995	Value of salt marshes for sea defence	MV	£/m2	30-60 (capital savings), 0.6 (maintenance savings)	Saltmarsh	Regional	UK
Klein, R.J.T. and I.J. Bateman.	"The Recreation Value of Cley Marshes Nature Reserve: An Argument against Managed Retreat?,"	*Water and Environmental Management*, 12, 280-285.	1998	The main aim of this study is to provide an estimate of the recreational value of the Cley Reserve. Function-use: recreation and nature conservation	CV, TC	A: In UK pounds, per household, per year or per visit. B: In UK pounds, per party per annum.	WTPfee (incl. zero-bids, in UK pounds): 1.58; WTPfee (excl.): 2.22; WTPtax (incl.): 48.15; WTPtax (excl.): 62.08.	coastal frehswater marsh	regional	United Kingdom

Kosz, M.	"Valuing Riverside Wetlands: The Case of the "Donau-Auen" National Park,"	*Ecological Economics*, 16, 109-127.	1996	To review the main results of a cost-benefit analysis concerning all the variables that depend on direct anthropocentric use, including energy production with hydroelectric power stations, shipping, ground water protection, stabilisation of the river bed to stop channel erosion, visitors' benefits, forestry, farming, fishing, hunting, and the costs of establishing a national park.	CV	ATS 1993 a year	2a) 919,80; 2b) 329,25; 3a) 694,9; 3b) 122,21; 4a) 689,85; 4b) 69,63.	river	regional	Austria

Lant, C.L. and G.A. Tobin.	"The Economic Value of Riparian Corridors in Cornbelts Floodplains: A Research Framework,"	*Professional Geographer*, 41 (3), 337-349.	1989	This paper illustrates how an economically efficient mix of wetlands and cropland on Cornbelt floodplains can be estimated and suggests how such a mix of land uses can be encouraged through appropriate agricultural policies. This research framework was applied to three drainage basins in the agricultural Midwest. Edwards (1), near the city of Aledo, Wapsipinicon (2) near the city of Anamosa, and South Skunk (3), near the city of Ames. Furthermore, the drainage basins were confronted with three types of river quality improvements: (a) poor-fair, (b) fair-good, (c) good-excellent. Function-use: boating, fishing, swimming, observing	CV	$ 1989/ year	1a) 35,2 ; 1b) 40,5 ; 1c) 24,3 ; 2a) 32,7 ; 2b) 38,5 ; 2c) 28,7 ; 3a) 29,9 ; 3b) 34,9 ; 3c) 35,1.	floodplain	regional	USA
Lant, C.L. and R.S. Roberts.	"Greenbelts in the Cornbelt: Riparian Wetland, Intrinsic Values, and Market Failure,"	*Environment and Planning*, 22, 1375-1388.	1990	The purpose of this study is to investigate the recreational and intrinsic values that Cornbelt residents place upon local streams, rivers, and reservoirs. Function-use: boating, fishing, swimming	CV	$ 1987 / year	1A) $36,18; 1B) $48,65; 1C) $49,47; 2A) $43,29; 2B) $55,82; 2C) $53,86.	floodplain	regional	USA

Loomis, J.B., M. Hanemann, B. Kanninen, and T. Wegge.	"Willingness to Pay to Protect Wetlands and Reduce Wildlife Contamination from Agricultural Drainage,"	in A. Dinar and D. Zilberman (eds.), *The Economics and Management of Water and Drainage in Agriculture*, 411-429.	1991	To survey the WTP of the general population in California for alternative programs to protect and expand wetlands as well as reduce wildlife contamination. Function-use: wildlife habitat, agriculture	CV	$ 1988 per household, per year and in dollars.	Wetland maintenance: California; Valley: $152/123-188; $174/157-196; wetland improvements: $251/235-268; $286/255-325; contamination maintenance: $187/177-199; $197/179-216; contamination improvement: $308/289-331; $360/317-415; salmon improvement: $181/171-193; $202/180-231.Mean value per household: wetland maintenance: $154; wetland improvement: $254; contamination maintenance: $188; contamination improvement: $313: salmon improvement: $183.	wetland	regional	USA
Lynne,G.D., Conroy, P., Prochaska, F.J.	"Economic Valuation of Marsh Areas for Marine Production Processes"	*Journal of Environmental Economics and Management*, 8, 175-86.	1981	Indirect use of coastal wetland in the production of blue crab Function-Use: Fishing	MV	$/acre	3 (total present value)	Coastal wetland	Regional	USA

Mannesto, G. and J.B. Loomis.	"Evaluation of Mail and In-Person Contingent Value Surveys: Results of A Study of Recreational Boaters,"	*Journal of Environmental Management*, 32, 177-190.	1991	Wetland loss. Function-Use: Recreation.	CV	$/person.	1a) 69.80; 1b) 37.12; 1c) 37.85; 2a) 59.27; 2b) 39.47; 2c) 33.14.	Delta, lake, bay.	Regional	USA
Mooney, S.	"Relationship Between the Implicit Value of Riverside Property, Environmental Amenities, and Streambank Protection,"	paper presented at the Annual Meeting of the Western Agricultural Economics Association, Reno/Sparks, Nevada, USA.	1997	To estimate the marginal implicit value of planting a trees riparian buffer on residential properties with the objective of reducing stream temperature and improving fish habitat. Riparian and instream restoration/protection programs have received increasing attention as a measure to improve fish and wildlife habitat, stream bank stability and flood protection. Function-Use: industry and residential	HP	$ per (Square) feet and acres.	Marginal implicit prices of environmental attributes at their mean market values: FRTLGTH marginal price ($/foot of frontage): Model I/II: 60.51/48.41; ACRETREE marginal price ($/square foot of riparian area in trees): -1.40/-1.44.	riparian wetlands	regional	USA
O'Neill, C.E. and J. Davis.	"Alternative Definitions of Demand for Recreational Angling in Northern Ireland,"	*Journal of Agricultural Economics*, 42 (2), 174-179.	1991	The effects of three alternative definitions of demand on estimated parameters are explored in a TC-study of aggregate demand for recreational angling. Function-Use: Recreation.	TC	Millions of UK Pounds.	Estimated user benefits (in millions of UK pounds): 1. 9.1; 2. 22.21; 3. 10.66.	Lakes, river and beaches.	Regional	Ireland

Poor, J.	"The Value of Additional Central Flyway Wetlands in Nebraska's Rainwater Basin Wetland Region,"	unpublished paper, Department of Agricultural Economics, University of Nebraska-Lincoln, USA.	1997	The objective of this study is to apply the CVM to estimate the value to the people of Nebraska, of government acquisition and/or management programs to increase the current amount of Rainwater Basin (RWB) wetlands. Function-use: nature conservation	CV	$ 1995 per year.	Mean WTP: $126.79.	freshwater wetland	regional	USA
Shilling, J.D., J.D. Benjamin, and C.F. Sirmans.	"Adjusting Comparable Sales for Floodplain Location,"	*The Appraisal Journal*, July, 429-436.	1985	How values a housing market flood-plain locations in the selling prices of single-family residential housing? Function-use: recreation, residential and industry	HP	$/Square feet.	The mean sale price was $75,000.	river	regional	USA
Spaninks, F.A., O.J. Kuik, and J.G.M. Hoogeveen.	"Willingness to Pay of Dutch Household for Natural Wadden Sea. An Application of the Contingent Valuation,"	Report No. E-96/6, Institute for Environmental Studies, Free University Amsterdam, The Netherlands.	1996	To provide an estimate for the monetary value of the Dutch Wadden Sea Area as a natural area, using the CVM. More specifically, this study aims at estimating the WTP of households in the Netherlands for measures needed to restore the Dutch Wadden Sea Area from its present state to its "natural state". Function-use: nature conservation, recreation, fishing industry	CV	Dfl / year	1) 70,71Dfl; 2) 50,85Dfl; 3) 67,37Dfl.	sea	Internat.	Netherlands

Thibodeau, F.R. and Ostro, B.D.	"An economic analysis of wetland protection"	*Journal of Environmental management*, 12, 19-30	1981	Wetlands benefits in terms of flood control (a), increases in nearby land value (b), pollution reduction (c), water supply (d), recreation and aesthetics (e)	MV, HP	$/acre	(a): $33 000, (b) $150, (c)$16 960 (d) $100 730 (e) $56 100	Frehswater wetlands	Regional	USA
Turner, R.K. and J. Brooke.	"A benefits assessment for the Aldeburgh Sea defence scheme,"	Environmental Appraisal Group Report, School of Environmental Sciences, University of East Anglia, Norwich. Also reported in J-Ph. Barde and D.W. Pearce (eds.) *Valuing the Environment*, Ch. 6, Earthscan, London.	1988	Coastal recreation and amenity. Function-Use: Recreation, Amenity value.	CV	Pounds per household per annum.	Mean WTP: (a. locals: 15; (b. non-locals: 18.8.	Sea, Coast	Local	United Kingdom
Turner, R.K., C. Folke, I.M. Gren, and I.J. Bateman.	"Wetland Valuation: Three Case Studies,"	in Perrings, C., Z.-G. Mäler, C. Folke, C.S. Holking, and B.-O. Jansson, eds., 1995, Biodiversity loss, Economic and Ecological Issues, Cambridge University Press, 129-149.	1995	To discuss the significance and value of wetlands in relation to the valuation studies and to a sustainable use of natural capital. (Bateman et al., 1992: to assess the monetary value (WTP) of conserving the Broads via a protection stategy designed to mitigate the increasing risk of flooding due to the long term deterioration of flood defences). Function-use: recreation, agriculture	CV	In UK pounds per household and per year.	On-site survey: mean OE (WTP): 77 UK pounds per household per year. IB: 84 UK pounds; mean DC (WTP): 244 UK pounds per household per year. Mail survey: "Near-Broadland residents": 12.45 UK pounds per household and for the "Elswhere GB residents": 4.08 UK pounds per household.	freshwtater wetland	regional	United Kingdom
Wang, H.	"Treatment of "Don't-Know" Responses in Contingent Valuation Surveys: A Random Valuation Model,"	*Journal of Environmental Economics and Management*, 32, 219-232.	1997	Improving the environmental quality of Galveston Bay, Texas. Function-use: recreation, seafood	CV	$ a month	1) 11.860; 2) 11.438; 3) 2.647; 4) 10.243	Bay	regional	USA

Willis, K.G., G.D. Garrod, and C.M. Saunders.	"Benefits of Environmentally Sensitive Area Policy in England: A Contingent Valuation Assessment,"	*Journal of Environmental Management*, 33, 105-125.	1995	Determining the benefits the public derives from ESAs and assessing whether ESAs are efficient, by comparing the costs of ESA provision against their benefits to the general public. Function-use: nature conservation	CV	UK pounds, per household and per year.	Open-ended payment card (these were used later): 1) WTP additional taxes: residents/visitors/ general public: 27.52/ 19.47/36.65; 2) residents/ visitors: 17.53/11.84. Using Simpson's rule mean WTP: 138.37 per household (3.8 times > 36.65). The WTP values for all ESAs were apportioned out by people's utility for the different ESAs. This procedure resulted in a WTP value of: 1.98 per household per year (South Downs) and 2.45 per household per year (Somerset Levels and Moors).	river	regional	United Kingdom

Notes:

Valuation technique

SM= Simulation Models

MV= Market Valuation

TC= Travel Cost Method

DCM= Direct Choice Model

CV= Contingent Valuation Method

HP= Hedonic Price Approach