

**EA Anglian**



**ENVIRONMENT AGENCY**  
Anglian Region

# **SUFFOLK ESTUARINE STRATEGIES**

## **RIVER DEBEN**

### **STRATEGY REPORT** **Volume 1 Main Report**



**November 1999**

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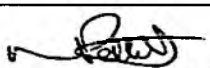
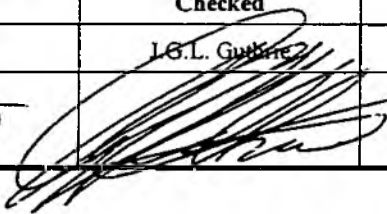
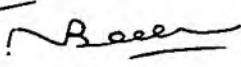


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ENVIRONMENT AGENCY  
SUFFOLK ESTUARINE STRATEGIES  
PHASE II - REPORT C  
DEBEN ESTUARY

Volume 1 - Main Report

November 1999

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## SECTION 1

### INTRODUCTION

#### 1.1 THIS REPORT

The Environment Agency have responsibilities for flood defence management under the Land Drainage, Water Resources and Environment Acts. In undertaking these responsibilities, to protect life and reduce risk to assets, the Environment Agency are keenly aware of their further obligations to the human and natural environment. Because of the close interaction and the possible far reaching impacts on the physical regime, the need for careful and co-ordinated flood defence management and the discharge of their other duties is nowhere more evident than within estuaries.

The Environment Agency, prompted by growing concern over several imminent problem areas on flood defence, commissioned the development of a long term strategy for three of the Suffolk estuaries; the Blyth, the Alde/Ore and the Deben<sup>1</sup>. Although each of the estuaries have very different characteristics, there is a need for a common and consistent approach in establishing the strategy.

The strategies, while concentrating on the policy for flood defence, necessarily take into account the broad diversity of interests associated with the estuaries. The development of a long term, high level, defence policy will provide an essential framework for the future physical management of each estuary; a framework from which other management plans for individual areas or for the management of specific aspects of estuary use can be developed with confidence.

This document is one of three reports, each report covering one of the three Suffolk Estuaries (Figure 1.1).

#### 1.2 PROJECT BRIEF

The aim of an estuarine strategy as identified in the project brief, is to produce a sustainable and balanced framework for the future management of the estuary as a whole, reflecting natural processes, planning pressures, current and future land use, flood defence needs, and environmental issues.

The study areas in the three estuaries extend from the upstream tidal limits (as designated by the Ministry of Agriculture, Fisheries and Food) to the estuary mouths. The landward limits are provisionally identified as those lines following the limit of an approximate 1:200 year water level.

The key requirements in developing the strategies identified in the brief, are to:

- Assess the estuary morphology
- Consider the interaction with the management of the adjoining open coast, which is the

<sup>1</sup> Consideration was given as to whether this strategy development should be extended to the estuary of the Orwell. It was decided against this on the grounds that the Orwell is a much larger estuary (of an order of magnitude greater than any of the three estuaries included within the study). This would have introduced significant differences in approach which might have resulted in obscurantism of what was already recognised as being a process of some complexity. The Environment Agency is involved with various detailed studies of the Orwell, and the development of a long term strategy for the estuary will be considered at an opportune time in the near future.

subject of the Lowestoft to Felixstowe Shoreline Management Plan

- Identify and quantify assets adjacent to the estuary shorelines that are likely to be affected by the estuary morphology and its management
- Identify and evaluate human and other environmental influences, aspirations, opportunities and potential conflicts which may affect or arise from policy recommendations
- **Produce an estuarine strategy – based on the generic flood defence policy options of Do Nothing, Hold the Line, Advance and Managed Realignment – that will provide a management framework for the estuary.**

In the process of developing the strategies, the following issues are considered:

- Estuarine processes
- The natural environment
- The human and built environment
- Economic benefits and costs
- Planning and land use
- Coastal and flood defence
- The Estuary/Open coast interface
- Future monitoring and studies
- Consultation.

### 1.3 CONTEXT

The Lowestoft to Felixstowe Shoreline Management Plan (SMP) adopted in 1998, provided recommendations for the management of defences along the open coast. These considered the generic defence policy options of Do Nothing, Hold the Line, Retreat and Advance. Although the SMP recognised the influence of the rivers flowing into the coast, no study of their physical processes or management was undertaken. The Suffolk Estuarine Strategies project is therefore required to produce a continuous and coherent management strategy for the whole of the Lowestoft to Felixstowe Shoreline.

The recommendations from both the Suffolk Estuarine Strategies and the SMP will be used by the Environment Agency (flood defence) and Local Authorities (coast protection) in their long term planning and budgeting. The strategies will identify specific areas which require attention. These areas will then be the subject of a detailed project appraisal, or similar study, and extensive consultation. It is only following this more in-depth investigation that specific schemes will be undertaken.

### 1.4 BASIS FOR RECOMMENDATIONS

The appraisal of potential flood defence policies has been based on the consideration and integration of three key factors. Policies for specific areas are assessed on the basis of:

- i) Economic viability (to the Nation), considering tangible assets;
- ii) Environmental impacts and opportunities;
- iii) Social acceptability;
- iv) Technical feasibility.

These are then reviewed in the context of the adjacent length of river, and the estuary as a whole. In doing this it is possible to achieve a balance between the three key factors, on an estuary-wide basis.



## 1.5 BACKGROUND

Reclamation of mudflats and saltmarsh in the estuaries, for agriculture, probably began in Roman Times but most significantly expanded during the 16<sup>th</sup> and 17<sup>th</sup> centuries with the enclosure of the high marshes. This reclamation continued through to the mid 19<sup>th</sup> century, when, certainly in the case of the Alde/Ore and Blyth Estuaries, but far less so in the case of the Deben, the estuaries were effectively canalised channels over much of their length.

The physical constraint imposed upon the natural form of the estuaries by reclamation was maintained and, in areas, reinforced through to the 1930's. During the earlier part of this century there was greater questioning of the economic justification for defence; brought about, partly, by an increase in formal national funding of schemes. Even so the general attitude was still to safeguard coastal and estuarial land at almost any cost.

The catalyst for significant change was the storm of 1953. Many of the embankments within the estuaries were breached, in places exposing the instability of old defences which had been raised as the demand for defence standard increased. The 1953 storm exposed the vulnerability of the situation, demonstrating that some defences were being perpetuated on borrowed time. In spite of this, even after 1953 the philosophy was still to maintain the status quo. As a consequence there was a wholesale response of repair; an action which proved to be futile in several areas as significant lengths of defences had to be abandoned during the 1960's, predominantly on the Blyth and the Alde/Ore.

The 1953 storm had the effect of "weeding out" the more vulnerable defences. These defences, although sensible in relation to the specific local problems, were constructed with little apparent regard to the overall physical structure or environment of the estuaries.

Despite a conscientious programme of maintenance and repair to defences, undertaken by the Environment Agency and its predecessors the present situation is possibly as critical in some areas as it was in the early 1950s: although the nature of the problem is somewhat different.

The pressures on the estuaries have increased. There is a greater appreciation of the value of the natural environment, reflected in international and national legislation. There is increased use of the estuaries for recreation and sport, and coupled to this a greater reliance of local economies on this use and the tourism it generates. In addition, there has been continued investment in agriculture and infrastructure. In many instances these assets or areas of interest are only sustained by defences; agriculture and freshwater habitats being maintained metres below sea level, water sports being carried out in channels defined by defences. Despite this, solely in terms of present use, activity and interest, it is a situation which is seen, by those consulted, as being relatively in balance. Only in terms of maintaining these uses does conflict arise; a conflict with the physical processes and with the way in which the form of the estuary wishes to evolve in the future. It is, therefore, an inheritance of use and interest which is artificially maintained at a considerable cost; a situation which is inherently out of balance with the physical processes at work, an imbalance which may become worse as the estuaries continue to respond to past change and to the impact of sea level rise and other external change.

The Environment Agency, with their dual role of defending assets from flooding and having due regard for the conservation of the natural environment, have appreciated the need to manage these responsibilities in the context of each estuary as a whole.

**The Environment Agency understand that the current situation must be reviewed. Rather than allow a new balance to be developed by default, there is a need to develop a**

long term strategy which aims to maintain the balance between human and environmental interest while achieving a more sustainable balance with the physical processes. This must be done in conjunction with those who have interests in the estuaries.

The first phase of developing this strategy involved a detailed study of the physical nature of each estuary. This study, undertaken by ABP Research and Consultancy Ltd in 1996 collected and collated physical data. Through the use of modelling it established a basic understanding of the estuary processes at work. Phase 2 of the work has been undertaken by Posford Duvivier in association with HR Wallingford. This report draws upon the findings of both phases of work and, in conjunction with and working within the framework developed in the Shoreline Management Plan for the open coast, goes on to explain the manner in which a strategy for the estuary has been developed and how this strategy may be implemented.

The main report has attempted as far as is possible with such a complex issue, to remain concise concentrating on the development of the strategy. Specific and localised description of the estuaries and the technical workings of the project are included in appendices.

## 1.6 REPORT STRUCTURE

*Section 2* provides an overall description of the estuary, drawing out key features of the physical, natural regime and other relevant issues. It then identifies the present and possible future problems.

*Section 3* describes the human, built and natural environments in the estuary. In doing so it identifies the key habitats and species in the estuary, and the conservation designations protecting them.

*Section 4* explains the basic principles, aims and objectives that have been formulated and used in the development of the strategy. Based on this, the section goes on to explain the manner in which the Estuary may be divided into zones and more local flood compartments. This process of division provides a framework for the development of the strategy. This ensures that local detail is considered during the development process. It also ensures that the overall appreciation of how each zone works, is influenced by or influences, the estuary as a whole is taken in to account in developing the estuary's future management.

*Section 5*, drawing upon the results of the detailed analysis presented in the appendices, examines each section, or zone, of the estuary and explains the evaluation of a preferred policy for defence.

*Section 6* sets out a number of requirements for the future management of the estuary, summarising the recommended strategy for each flood compartment, and identifying a programme and pathway of future work required to implement the strategic recommendations.



ENVIRONMENT AGENCY

**SUFFOLK ESTUARINE  
STRATEGIES  
PHASE 2**

**POSFORD  
DUVIVIER**

In association with  
HR Wallingford

**SUFFOLK ESTUARIES  
LOCATION PLAN**

**FIGURE 1.1**





## SECTION 2

### DESCRIPTION OF THE ESTUARY AND EXPLANATION OF THE PROBLEM

#### 2.1 DESCRIPTION

##### 2.1.1 General Description

###### **Extent**

The strategy area extends from the railway bridge crossing the upstream tidal limit of the estuary at Bromeswell to the mouth of the estuary at Felixstowe Ferry. This area includes all land below the 5m AOD contour and areas associated with or influenced by the use or regime of the Deben estuary. This area is shown in Figure 2.1.

###### **General ownership**

Land use around the estuary is predominantly agricultural and is largely in private ownership. Since the introduction of the Suffolk River Valleys ESA, some areas of previously arable farmland have been reverted to pasture, although around the southern half of the estuary arable farming still dominates. The National Trust own the Sutton Hoo Estate opposite Woodbridge, which includes a significant area of saltmarsh and mudflat in the upper estuary.

###### **General designations**

The estuary is contained within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty, with the lower half of the estuary also being a designated Heritage Coast. The estuary is a designated Site of Special Scientific Interest for its intertidal and estuarine habitats and a designated Special Protection Area and Ramsar site for the internationally important population of dark-bellied brent geese that these areas support. In addition there are geological SSSI's at Ferry Cliff and Ramsholt Cliff.

###### **Upstream boundary of estuary**

The source of the River Deben is approximately 3 km to the north of the village of Debenham, some 17km to the north-west of Woodbridge. From a height of about 60m above mean sea level the river meanders in a south easterly direction towards Wickham Market, and then makes a relatively sharp change in direction to the south-west towards Woodbridge. Just upstream of the railway bridge at Bromeswell the river becomes tidal, marking the upstream limit of the strategy area. The total length of the non-tidal river is 34 km.

##### 2.1.2 Description of the Estuary

###### **Bromeswell to Martlesham Creek**

In its upper reaches the Deben estuary is effectively confined to a narrow channel by floodbanks from its tidal limit to Wilford Bridge (B1084 crossing). From here the estuary runs in a south-westerly direction for approximately 3.5 kilometres to the confluence with Martlesham Creek. Between these two points the channel makes a series of small gentle meanders between relatively narrow mudflats and fringing saltmarsh. The estuary is effectively confined on its eastern side by the higher, undulating slopes leading up to Sutton Hoo and by a series of floodbanks and on its western side by the developed and protected lower lying frontage of Woodbridge. The flood walls opposite Melton have been allowed to collapse leading to the re-creation of mudflats and some saltmarsh.

Woodbridge was formally the focus of significant commercial activity within the Deben. In modern times, however, the river frontage is almost entirely devoted to boating activity with small marinas, boat yards and sailing clubs, with about 300 marina moorings in Woodbridge

and approximately 1200 swinging moorings on the river. In addition, Woodbridge hosts an active community of canoeists.

#### **Martlesham Creek to Ramsholt**

The estuary significantly widens just before Martlesham Creek joins the main channel. Martlesham Creek comprises a 1.5 km linear stretch of tidal inlet with the narrow mudflats and channel confined by flood walls on both sides.

The main low water channel tends to meander within the limits of the wide inter tidal area. The shape of the estuary along this stretch is controlled by the areas of high ground which separate areas of low-lying reclaimed land. This control is most notable at Ramsholt Lodge, where the flow pushing against the high ground has resulted in erosion. The higher ground, in limiting the natural development of the estuary meanders, has provided shelter to the low-lying areas in between. This is evident in areas such as at The Tips. In other areas the reclamation of low-lying land has tended to occur on the inside of bends, such as to the north of Hemley. These areas tend to be fronted by saltmarsh.

In essence, the high ground tends to offer resistance to the natural evolution of the estuary, taking the brunt of any pressure for the estuary to evolve.

Tree covered slopes, notably at Ramsholt where a ridge of Red Crag forms a low cliff at the estuary's edge, intermittently punctuate the otherwise low-lying agricultural landscape. At Hemley, on the western side of the estuary, the breach and collapse of a section of flood bank following the 1953 flood led to the development of an extensive area of saltmarsh and intertidal mudflat. Characteristically for this section of the estuary, this has not resulted in any significant change in shape of the main channel.

At the southern limit of this section the estuary narrows between Hemley and Ramsholt Lodge. This neck restrains change in the estuary form, and marks the divide between this section and the dramatically different character of the lower estuary plain.

#### **Ramsholt to Felixstowe Ferry**

From Ramsholt southwards to its mouth, the Deben estuary is confined on both sides by floodbanks, with large areas of low-lying agricultural land stretching for several kilometres on either side of the estuary. At the rear of this extensive flood plain the land rises up to the Felixstowe peninsula to the south-west and the village of Alderton to the north-east.

The channel follows a meandering path over this length, gradually becoming wider towards the coast, although being firmly restrained by the banks. On the outside of the meanders there are signs that the channel is starting to outgrow these restraints. Short lengths of sheet piling have been used to reinforce the earth flood banks. In front of these banks are narrow lengths of mudflats and saltings.

#### **The Shoreline**

The mouth of the estuary is unusual in that it narrows significantly just before entering the sea. A ridge of higher land to the east of the river runs down in a hook to the estuary at Bawdsey, constricting the estuary mouth between it and the low ridge of shingle and clay at Felixstowe Ferry on the opposite bank. At Felixstowe Ferry, behind these banks, there is an area of developed land with a number of properties flanking a golf course at the estuary mouth.

Interaction between tidal estuary processes and open coast processes has led to the development of a series of shifting shingle shoals at the mouth of the estuary known locally as The Knolls.



In spite of these shoals and shifting channels at its entrance, the mouth of the Deben is a popular estuary for yachting and general water-based activity. There are sailing clubs based at Bawdsey and Felixstowe Ferry; and the East Suffolk Water Ski Club, jet-skiers and canoeists all launch from the shingle beach at Felixstowe Ferry. This multitude of uses can cause conflicts between users, and byelaws therefore restrict speeds 10 knots around the mouth of the estuary

### 2.1.3 Physical Parameters

The Phase 1 report on the Estuary provides a thorough description of the results of modelling and measurement work undertaken and provides the fundamental assessment of the Estuarine processes. During the work undertaken in Phase II further consideration has been given to these physical processes with particular regard to the continuing evolution of the Estuary and the potential impact various scenarios may have on the Estuary as a whole and individual sections in particular. A report on this is included as Appendix B. This sub-section of the report provides a key point summary of the physical parameters affecting the management of the estuary.

#### River Inflow

Fresh water input to the Estuary under normal conditions is minimal in relation to the saline input. (Mean river flow is  $0.6\text{m}^3/\text{sec}$  compared to tidal flow of the mouth of  $1700\text{m}^3/\text{sec}$ ). During high level fresh water input river flow may increase to  $12\text{m}^3/\text{sec}$ . The estuary processes are driven by the influx of tidal saline water (Appendix B).

#### Water Level

Tidal levels at the Estuary mouth are defined in Admiralty tide tables and high water levels are given below.

|      |           |
|------|-----------|
| MHWS | 1.77m AOD |
| MHWN | 0.97m AOD |

The tides entering the estuary at Woodbridge Haven have mean spring and neap ranges of 3.2m and 1.9m respectively, with MHWS of 1.77m OD. By the time the tide has propagated 12km up the estuary to the town of Woodbridge high water levels have increased by 0.3m and low water levels reduced 0.1m, increasing the tidal ranges by 0.3 to 0.4m.

There is considerable variance in the results of different techniques of determining extreme water levels (levels generated during surge conditions). Estimates extrapolated from a scant but local one year data set give the value of the one in one hundred year level as being 3.1m AOD at Woodbridge Haven. In comparison extreme water level predictions at the coast give a one in one hundred year level of 3.73m AOD. The analysis presented in Appendix B provides best estimate values as set out in Table 2.1.

**Table 2.1 Best Estimate of Water Levels for Various Return Period (years)**

|                  | Water level (m AOD) |                       |             |             |
|------------------|---------------------|-----------------------|-------------|-------------|
|                  | MHWS                | Return Period (years) |             |             |
|                  |                     | 1                     | 10          | 100         |
| Woodbridge       |                     | 2.70 (3.20)           | 3.15 (3.65) | 3.62 (4.12) |
| Waldringfield    |                     | 2.60 (3.1)            | 3.03 (3.53) | 3.47 (3.97) |
| Ramsholt         |                     | 2.40 (2.90)           | 2.80 (3.30) | 3.32 (3.82) |
| Woodbridge Haven | 1.77 (2.27)         | 2.55 (3.05)           | 2.95 (3.45) | 3.35 (3.85) |

*Notes: All levels given in metres OD  
(Figures in brackets denote corresponding level in 50 years)*

Various estimates have been made of the rate of sea level rise over the next 50 years, ranging from relatively small values up to as much as a metre. The recommendations on assessing the impact of the possible rise highlight the importance of considering the sensitivity of the environment. An average "business as usual" rate of 6 mm per year is recommended on the open coast. The response of the regime of an estuary to sea level rise is likely to be more significant, due to the focussing effect of the narrowing channel on the propagation of the tidal inflow. In recognition of this a value of 0.5m over the fifty years of the strategy is used. The higher figure is taken throughout the report as being a realistic worse case. The impact on extreme water levels is shown in Table 2.1 as figures in brackets. In simple terms the fundamental effect will be to increase the volume of water moving into and out of the estuary and to raise the frequency of return of extreme water levels by a factor of 10 or greater. (The present day one in ten year level might even be anticipated to occur annually in fifty years time.)

Clearly there is still considerable uncertainty associated with the prediction of water levels and this should be addressed.

### **Tidal Volume**

The existing volume of water moving into and out of the Estuary is of the order of 8.95 million cubic metres each tide.

The total area of the Estuary, taking into account the potential flood areas which are defended at present, amounts to some 15 million square metres at present. If areas currently defended were to be abandoned, then the tidal volume of the Estuary, on a spring tide, would increase by a further 7.4 million cubic metres, nearly doubling the flow at the mouth of the estuary.

A sea level rise of 0.5m acting solely over the present inter tidal area of the estuary would result in a more modest increase of tidal volume from the present 8.95 Mm<sup>3</sup> to 11.77 Mm<sup>3</sup> (132% of the present volume). As a worst case where defences are abandoned, then in fifty years time, sea level rise would have a significantly greater impact with the total volume of the estuary reaching some 26.6 million cubic metres, representing 298% of present conditions. Table 2.2 provided a summary of this assessment for a spring tide, both in terms of the whole estuary and broken down into specific areas.

Table 2.2 Changes in Estuary Tidal Volumes

| Zone  | Upper Reaches                       | Middle Reaches | Lower Reaches | Totals     |
|---|-------------------------------------|----------------|---------------|------------|
| <b>Existing conditions</b>  |                                     |                |               |            |
| Existing tidal volume of river [Ver] (m <sup>3</sup> )  | 952,000                             | 5,141,000      | 2,856,000     | 8,949,000  |
| Cumulative existing tidal volume [ΣVe] (m <sup>3</sup> )  | 952,000                             | 6,093,000      | 8,949,000     | -          |
| Area of flood compartment (m <sup>2</sup> )   | 1,140,000                           | 1,510,000      | 12,220,000    | 14,870,000 |
| Volume of flood compartment below present Mean Sea Level [Vef] (m <sup>3</sup> )                                  | 570,000                             | 755,000        | 6,110,000     | 7,435,000  |
| <b>Potential Changes in Tidal Volumes, allowing for Sea Level Rise over 50 years</b>                              |                                     |                |               |            |
| Increase in River only [Vfr] (m <sup>3</sup> )  | 300,000                             | 1,620,000      | 900,000       | 720,000    |
| Increase in flood compartment volume below future Mean Sea Level [Vff] (m <sup>3</sup> )                          | 570,000                             | 755,000        | 6,110,000     | 7,435,000  |
| Potential total tidal volume if all flood compartments are flooded [Vf = Ver + Vef + Vfr + Vff] (m <sup>3</sup> ) | 2,392,000                           | 8,271,000      | 15,976,000    | 24,539,000 |
| Cumulative total tidal volume [ΣVf] (m <sup>3</sup> )   | 2,392,000                           | 10,663,000     | 26,639,000    | -          |
| Proportional increase in volume [ΣVf / ΣVe]   | 2.5                                 | 1.8            | 3.0           | -          |
| <b>Summary of Potential Increases in Tidal Volume</b>   |                                     |                |               |            |
| Future increase in Tidal Volume if all defences are held  | [(Ver + Vfr) / Ver] (%)             |                |               | 132 %      |
| Present increase in Tidal Volume if all defences are abandoned  | [(Vcr + Vef) / Ver] (%)             |                |               | 183 %      |
| Future increase in Tidal Volume if all defences are abandoned   | [(Ver + Vfr + Vef + Vff) / Ver] (%) |                |               | 298 %      |

NOTE: Tidal volumes are indicative, based on Mean Spring Tides and surveys and modelling undertaken as part of Phase I of the Suffolk Estuarine Strategies.

The physical impact of changes in tidal volume, due to sea level rise or the abandoning of defences, are considered in Appendix B. In summary these findings are:

- Increased flow making it harder to maintain defences.
- Loss of saltmarsh throughout the estuary due to change in water level and due to erosion of frontages.
- Redirection of flow resulting in changes in the alignment of channels.
- A widening and deepening of the estuary mouth, increasing the possibility of the spit breaching or as a minimum retaining greater quantities of material within the ebb tide delta and having a serious impact on the down drift coast.
- the meander of the channel between Ramsholt Lodge and Felixstowe Ferry would attempt to increase in length and amplitude, causing increasing conflict with defences, and shifting and extending the present pressure points

### **Interaction with the Coastal Regime**

The interaction of the estuary with the coastline was considered in the SMP, and in ABP's Phase 1 strategy report. Appendix B developed upon this initial assessment, drawing upon additional material such as air photography and detailed reports on the estuary, and applying the improved understanding to specific issues of defence management.

The interaction, and the stability of the banks at the estuary mouth, depends to a large degree on the volume of flow into and out of the Estuary. The process regime is complex, with the banks periodically forming and decaying. There is evidence that the banks (The Knolls) develop within limits beyond which growth is restricted by wave action and the outflow from the river.

Increases in the tidal volume of the estuary will probably effect the evolution and periodic growth of the banks. It may drive the sediment transport mechanism at the mouth of the estuary further offshore. This would result in a shortage on beach material both locally, on the Felixstowe Ferry frontage, and further afield towards Felixstowe. This, in turn, could lead to erosion along those frontages.

## **2.2 THE PROBLEM**

The use of the estuary; the activities it supports and the important environmental and economic interests within the estuary, is at present reasonably in balance. The large agricultural use of the land supports the local economy; the estuary is a focal point for tourism and provides recreational opportunity both for local residents and visitors, while at the same time containing nationally and internationally important features of the natural environment. These aspects are all underpinned by the flood defence structure of the estuary.

Furthermore the present regime of the estuary has achieved a relative balance with the coastal processes such that the coastal processes of sediment drift are being maintained. This is a premise upon which the SMP has been developed.

The interests and uses, and the process of sediment transport at the coast, have been developed from a situation where there has been near total control of the estuary channel over the last two centuries.

There are however indications that this delicate balance may be in the process of change. There is a loss of salt marsh and this may possibly be the first indication of coastal squeeze as a result of the increase in sea level rise, either due to the actual change in level or due to

increased flow rates. In some areas the salt marsh's active erosion is indicative of changing patterns or intensity of flow. There are also areas along the defences that are becoming more costly to defend either through general wear and tear or because of possible change flow and pattern within the overall estuary.

There are two factors which impose, or could impose, pressure on maintaining a balance in the management of the estuary:

First, despite a programme of maintenance and repair, the integrity of several lengths of defence are reported to be deteriorating. If this is allowed to continue there is long term concern that substantial areas of land will be flooded, and eventually abandoned. This, in turn, will increase the pressure on the remaining lengths of defence. One area of particular concern is at the estuary mouth. The channel at this point is significantly restricted in both alignment and, more importantly, width. The estuary mouth will become increasingly difficult to defend in its current form.

The second is related to the sea level rise, possible symptoms of which are noted above. Not only is there a direct threat from increased flow but also from the additional cost involved in raising defences, leading potentially to increased pressure to abandon defences.

Certainly all indications are that sea level rise will increase the need for defence expenditure if areas are to be defended to an appropriate standard in the future. Doing Nothing to defences in response to this increased cost or difficulty will not necessarily result in improved economy nor will it ease the problems of coastal squeeze. It may result in further change in regime and increased pressure. The use of the estuary is based upon having developed a relatively tight control on the way in which the estuary behaves. Indiscriminate Managed Re-alignment (in terms of the overall behaviour of the estuary) from a line of defences may result in immediate increase in tidal flow and a subsequent increase as sea levels rise. This could result in increased cost elsewhere, consequently resulting in further abandonment and further escalation towards the inability to justify any defence at all.

The problem now is the increased expenditure on defence in certain specific locations and the uncertainty as to future defence policy in areas where there is no apparent local economic justification for maintenance of defences. In the future the problem is seen as the potential threat from sea level rise and the difficulty in some areas to respond to this, the continuing deterioration in defences and the threat from both of these that they will result in increased pressure on defences, the use and the interest of the estuary. Underlying both the present problems and those of the future is the estuary's need to adapt to increasing tidal volume and increasing flows. A piecemeal approach in response to these threats would represent a problem in its own right, in that such an approach could lead to unsustainable management of the estuary.







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ENVIRONMENT AGENCY

# SUFFOLK ESTUARINE STRATEGIES PHASE 2



In association with  
HR Wallingford

DEBEN ESTUARY

FIGURE 2.1





## SECTION 3

### ENVIRONMENT

#### 3.1 OVERVIEW OF THE DEBEN ESTUARY

The 18 km of the tidal Deben marks a change from the larger estuaries to the south (the Stour and Orwell) to the more intimate estuaries of the north. It is a relatively sheltered and narrow estuary, particularly at its mouth, which is protected by shifting sand banks. Much of the inter-tidal area is occupied by mudflats with more sandy deposits occurring where exposed Crag erodes from small bluffs and cliffs. The Deben is located within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty and the southern half of the estuary is designated as Heritage Coast.

The Deben is also a designated Site of Special Scientific Interest for its populations of overwintering waders and wildfowl and for its extensive and diverse saltmarsh communities (the estuary supports approximately 30% of Suffolk's total area of saltmarsh). Several estuarine plants (e.g. dittander) and invertebrates with a nationally restricted distribution occur. Furthermore, the estuary is designated a Special Protection Area and Ramsar site for its internationally important populations of overwintering redshank and dark-bellied brent geese and nationally important overwintering avocet population.

Apart from Woodbridge at its head, the estuary is largely undeveloped. Arable production predominates on the extensive areas of low-lying reclaimed marshland adjacent to the estuary, particularly along its southern half. The National Trust own the Sutton Hoo Estate opposite Woodbridge.

Recreationally, the Deben is the most important of the three smaller Suffolk estuaries (Deben, Alde-Ore and Blyth). There is a low level of land based activity, which is largely confined to walking and bird watching, except for the golf club at Felixstowe Ferry. In spite of its notorious shingle bar and shifting channels at its entrance, the Deben is a popular estuary for yachting and general boating activity. There are marina moorings in Woodbridge and approximately 1200 swinging moorings on the river. These are regulated and managed by Fairways Committees, who lease stretches of the foreshore and river bed from the Crown Estate. There are sailing clubs at Woodbridge (2), Waldringfield, Bawdsey and Felixstowe Ferry. The East Suffolk Water Ski Club launch from Felixstowe Ferry and have a designated area up river of Kings Fleet, where skiing can take place without conflict. The Anglian Wildfowling Association lease a large part of the mudflats along the estuary from the Crown Estate and the summer months a pedestrian and cycle ferry operates from Felixstowe Ferry to Bawdsey.

Figures 3.1 and 3.2 show details of habitats and conservation designations, and tourism and recreation throughout the estuary.

#### 3.2 HUMAN AND BUILT ENVIRONMENT

##### 3.2.1 Land Use

As with much of the rest of the Suffolk coast, the land surrounding the Deben estuary is largely undeveloped and uncommercialised, lending the estuary and its environs a relatively undisturbed feel. Apart from residential and commercial development at Woodbridge, agricultural land use dominates. This is particularly apparent in the lower half of the estuary, where large open arable fields occupy the flat, reclaimed former floodplain on either side of the river. The agricultural landscape is interrupted by partially wooded slopes and spurs of

land coming down to the edge of the estuary, notably along its eastern flank at Sutton and Ramsholt.

### 3.2.2 Residential Development and Industry

Woodbridge, at the head of the estuary, is the only major settlement adjacent to the estuary. The Deben was formally the focus of commercial activity in Woodbridge, but now the river frontage is almost entirely devoted to boating activity with small marinas, boat yards and sailing clubs. The area is still characterised by traditional buildings, such as the Tide Mill, which make the waterfront an attractive and popular area with locals and visitors alike. There are several other small settlements along the river at Martlesham Creek, Waldringfield and Ramsholt and Felixstowe Ferry, all of which maintain a traditional character.

Bawdsey Manor, is a prominent residence on the eastern side of the mouth of the Deben. The house, built in 1886, is set in grounds that were specially designed to withstand the winds off the North Sea, with a 150 feet high rockery and a sunken garden. The Manor, now an educational establishment, was occupied by the Ministry of Defence between 1936 and 1990 as evidenced by the radio mast which still towers above the surrounding trees.

### 3.2.3 Recreation and Tourism

The River Deben is the most intensively used of the three smaller Suffolk estuaries (Deben, Alde-Ore and Blyth) for recreational activity, particularly in and around the main residential areas. Away from Woodbridge and villages alongside the estuary, such as Waldringfield and Felixstowe Ferry, access to the estuary is more restricted and subsequently these areas tend to experience a lower level of recreational activity. Land based activity is largely restricted to walking and bird watching, and the golf club at Felixstowe Ferry. There are popular picnic sites at Wilford Bridge, Melton and another at Bawdsey. Certain locations, such as Ramsholt Quay and Waldringfield can become very busy during the summer months with local visitors, yachtsmen and holidaymakers. The footpath network around the estuary is generally well used, particularly in the Woodbridge area. However, there is presently no complete pathway around the estuary

In spite of its notorious shingle bar and shifting channels at its entrance, the Deben is a popular estuary for yachting and general boating activity. There are about 300 marina moorings in Woodbridge and approximately 1200 swinging moorings on the river. These are regulated and managed by five Fairways Committees who lease stretches of the foreshore and river bed from the Crown Estate at Woodbridge, Martlesham Creek, Waldringfield, Ramsholt and Felixstowe Ferry. There are sailing clubs based at Waldringfield, Bawdsey, Felixstowe Ferry and two at Woodbridge.

The East Suffolk Water Ski Club launch from Felixstowe Ferry and have a designated area up river of Kings Fleet where skiing can take place without conflict. Felixstowe Ferry is used by other water-skiers and by jet-skiers, which can cause disturbance and nuisance to other water users. Byelaws restrict speeds to 8 knots up river of Falkenham Creek and to 10 knots between Kings Fleet and the Martello Tower at the mouth of the estuary. In the summer months a pedestrian and cycle ferry operates from Felixstowe Ferry to Bawdsey. The Anglian Wildfowlers Association lease a large part of the mudflats along the estuary from the Crown Estate.

Canoeing is also popular in the Deben estuary, where the east side of the estuary is an important moving water training site and is used by both recreational and competition canoeists. The shingle beach at Felixstowe Ferry provides a launching site and there is car parking facilities nearby. Other access points to the estuary for canoeists are also available at

Bawdsey, Ramsholt and Waldringfield. Access and egress at Woodbridge is also possible but can pose problems for paddlers without local knowledge.

### **3.2.4 Commercial and Recreational Fishing**

Shellfisheries are regulated by MAFF, who issue a Several Order granting permission to culture shellfish. Farming on intertidal areas also requires a lease from the owners of the foreshore, who are usually the Crown Estate. Shellfish harvested for human consumption require clean water, and the EEC has set water quality criteria for farmed areas under the Shellfish Waters Directive (79/923/EEC). Under the Directive member states designate shellfish waters where the water quality is supposedly improved or protected to within the set limits. In the past, the Deben estuary has been used for oyster cultivation. A Several Order for the farming of oysters has been issued but is presently not in operation, small numbers of native oysters are thought to occur in the estuary, but there is currently no commercial exploitation of these.

In general very little commercial fishing activity takes place in the estuarine waters of the Deben. There is a limited amount of netting for bass and mullet and some eel fyke netting. A small seasonal trawl fishery operates from the estuary, principally for sole. Approximately 15 licensed inshore vessels, of which half are currently considered active, operate from Felixstowe Ferry.

### **3.2.5 Agriculture and forestry**

Agricultural land dominates the former floodplain of the Deben and the surrounding slopes. The free-draining and acidic soils of the higher land have developed from glacial sands and gravels overlying Crag sands and pebble beds. These soils are relatively infertile giving rise to agricultural land which, without irrigation is largely unproductive and tends to support heathland vegetation, birch/gorse scrub and commercial conifer plantations. As with other light land areas the trend towards outdoor pig husbandry is particularly evident. Where, crops are grown with irrigation, these tend to be root crops, notably potatoes and carrots, onions and leeks and . The majority of the agricultural land which borders the Deben estuary, in particular in the upper to middle reaches, is classified by MAFF as Grade 4. In the lower reaches of the estuary the agricultural land is classified as Grade 3.

On the valley floor arable cropping and grazing marsh predominates. This land represents former intertidal estuary mudflats and saltmarsh which have been reclaimed and drained. The majority of reclamation took place in the 16<sup>th</sup> and 17<sup>th</sup> centuries. The amount of land that has been reclaimed amounts to about 2200 hectares, the large majority of this occurring in the lower reaches of the estuary. During the exceptional coastal flooding of 1953 a large part of the former floodplain was submerged. These floods provided the impetus to begin large-scale agricultural improvement with strengthening of the flood walls, field levelling and under-drainage taking place. Further breaches of the flood defences in the central part of the estuary at Hemley in the 1960s have since returned a significant area of former agricultural land back to saltmarsh and mudflat. In comparison with the Alde/Ore and Blyth estuaries there are no appreciable areas of grazing marsh habitat along the Deben estuary. The only significant area is at Shottisham Creek, where there is approximately 80ha of semi-improved cattle grazed grassland.

All of the agricultural land surrounding the Deben is included within the Suffolk River Valleys Environmentally Sensitive Area (ESA). The introduction of this scheme has led to the reversion of some areas of arable land behind the flood walls into pasture. The ESA has promoted the agricultural management of grassland in a more traditional fashion, notably in the raising of field water levels, and where this is undertaken, benefits to wildlife are quickly established.

There are only small areas of woodland and wooded hedgerows surrounding the Deben. The main area comprises the eastern side of the estuary north of Ferry cliff where several plantations, mainly of Scots pine, occur on the relatively steep-sided valley slope. In addition there are further small coniferous plantations to the north-west of Ramsholt.

### 3.2.6 Historic and Archaeological Heritage

The archaeological resource of the Suffolk estuaries is relatively unknown. From survey work in similar situations e.g. the Essex estuaries, it is clear that over the past 4000 years the sheltered interface between the land and the sea found along estuary shores has provided an important area for settlement and food gathering. The estuaries have also provided safe havens for ships and their cargoes for at least two thousand years. This fact is well illustrated by the famous archaeological remains at Sutton Hoo, opposite Woodbridge, where a series of burial mounds are located, including one which was found to contain the remains of a long ship of Anglo Saxon age. No systematic survey has been undertaken of the archaeological interest of the estuaries, but there is no reason to doubt their importance given the significant finds that have been made from the Essex estuaries.

The Royal Commission on the Historical Monuments of England has identified has two casualties (unknown wrecks) along with three known wrecks, one of which is charted. However, considering its past maritime history, it is likely that there are more wrecks in the area which remain undiscovered.

There are three Scheduled Ancient Monuments adjacent to the estuary; two Martello towers on Felixstowe Marshes, one at Felixstowe Ferry and one on the golf course, and the prehistoric settlement and barrows, including the ship burial site, at Sutton Hoo.

### 3.2.7 Water Quality

Water quality targets can be divided into those that are statutory or non-statutory. Statutory standards in the East Suffolk LEAP Consultation Report (Environment Agency, 1997) are set by the following EC Directives: the EC Freshwater Fish Directive (78/659/EEC), the EC Bathing Waters Directive (76/160/EEC), the Shellfish Waters Directive (79/923/EEC) and the EC Dangerous Substances Directive (79/464/EEC). The East Suffolk LEAP highlights the fact that the Deben (at White Bridge, Loudham) has complied with the requirements of the EC Freshwater Fish Directive every year between 1991 and 1995.

The best indication of estuarine water quality is provided by the CEWP Target Classes for Saline Waters. This incorporates both biological and chemical parameters. This system classifies 16 kilometres of the Deben estuary as Class A (Good), with no stretches of the estuary classified as Class B to D. Traditionally estuaries have been used for the dilution of domestic sewage derived from adjacent towns and villages. There are no untreated discharges directly into the estuary. Small discharges of treated sewage occur from various public sewage treatment works, notably in the Woodbridge and Martlesham area or from private sewage plants.

Blooms of suspended microscopic algae can occur in estuaries and may impact on the dissolved oxygen levels in the estuary waters. Algal growth may be promoted by high levels of nutrients, in particular nitrogen and phosphorus. The principal source of these is often sewage treatment works (point source discharges) and run-off from agricultural land (diffuse inputs). Suspended algal populations are determined on some watercourses by the concentration of *chlorophyll a* in the water. The Deben estuary is designated as a candidate Sensitive Area (Eutrophic) under the Urban Waste Water Treatment Directive (91/271/EEC) and *chlorophyll a* monitoring is regularly carried out.



### 3.3 NATURAL ENVIRONMENT

#### 3.3.1 Geology and Geomorphology

The solid geology of the Suffolk Coast is comparatively simple and is dominated by rocks formed by sedimentary processes. These soft, generally undisturbed rocks are responsible for creating the area's gently rolling landscape. North of the Deben estuary the solid geology is dominated by shelly marine sands and clays, known as Crag. These were deposited under shallow marine conditions during the late Pliocene to Pleistocene, some 2 million years ago. The older Coralline Crag surfaces as a ridge between Orford and Aldeburgh, through which the valleys of the Alde and Butley Rivers have been eroded, and also forms a small outlier on the northern bank of the Deben at Ramsholt. From the Deben southwards, the principal underlying rock is London Clay, formed during the Tertiary era approximately 50 million years ago.

Apart from on the open coast, natural outcrops of these various geological strata are rare. On the Deben estuary the Coralline Crag, overlain by Red Crag, is exposed in a low eroding cliff to the north of Ramsholt. This represents one of the most fossiliferous exposures of this deposit in Suffolk and it has featured strongly in the major scientific works on the Crag Series. This cliff section is a Geological Conservation Review site and is included within the Deben Estuary SSSI. Another cliff section on the northern side of the estuary, at Ferry Cliff, provides exposure through part of the London Clay. The sequence exposed on the foreshore and in the lower part of the cliff has yielded a number of fossil mammals which provide information on past climate and the evolution of particular mammal groups. The Crag outcrop and London Clay over much of East Suffolk is overlain by a series of sands and gravels deposited as outwash material as the last ice sheet retreated from Britain. These sediments give rise to the deep, free-draining acidic soils characteristic of the area.

In geological terms the Suffolk estuaries are of recent origin, having formed as sea-level rose following the end of the last Ice Age approximately 7,000 years ago. Coupled with the subsidence of the North Sea Basin, this rise in sea-level flooded the river valleys of east Suffolk. All of the Suffolk estuaries, with the exception of the Ore, have been formed by this process. The calm conditions that prevailed in the newly formed estuaries allowed sediment to settle and formed extensive areas of intertidal mudflat fringed by salt tolerant vegetation.

#### 3.3.2 Landscape

The Deben estuary marks the change from the large southern estuaries (Stour and Orwell) to the more intimate scale of those to the north. The river itself is narrower and more meandering than the Orwell, and the valley shallower and proportionately wider. At Woodbridge the river flows past the Tide Mill which is overseen by the wooded valley slopes of Sutton Hoo, the burial place of the Saxon kings. The area of countryside around the river at Woodbridge is quiet with the river being relatively enclosed by rising land on its eastern flank and the town to its west.

Downstream of Martlesham Creek the character of the valley changes as it broadens out, lending the estuary a sense of remoteness. Tree covered slopes, notably at Ramsholt where a ridge of Crag forms a low cliff at the estuary's edge, intermittently punctuate the otherwise low-lying land on either side. This is particularly apparent south of Hemley where agricultural land lies flat and open, stretching for several kilometres on either side of the estuary, before rising up to the Felixstowe peninsula to the south-west and the village of Alderton to the north-east. Between the estuary and this flat agricultural plain are squeezed the remnants of once extensive mudflats, saltings and marsh. Although, at Hemley, where flood defences have breached, saltmarsh has reclaimed some of its former extent. The ridge of land on which Alderton is located runs down in a hook to the estuary at Bawdsey,

constricting the estuary mouth between it and the low ridge of shingle and clay at Felixstowe Ferry on the opposite bank.

### 3.4 HABITATS AND SPECIES

#### 3.4.1 Saltmarsh and Mudflats

The intertidal areas of the estuary support a notable assemblage of breeding and wintering wetland birds. Breeding birds include shelduck (*Tadorna tadorna*), teal (*Anas crecca*), shoveler (*Anas clypeata*), redshank (*Tringa totanus*), oystercatcher (*Haematopus ostralegus*) and ringed plover (*Charadrius hiaticula*). The Deben is internationally important for the numbers of overwintering dark-bellied brent geese (*Branta bernicla bernicla*) that it supports and is also nationally important for wintering shelduck, grey plover (*Pluvialis apricaria*), black-tailed godwit (*Limosa limosa*), redshank and avocet (*Recurvirostra avosetta*). Over the last few years the Deben has become increasingly important for wintering avocet and it now regularly supports over 100 birds (approximately 5% of the British population). In addition to these species the estuary also supports wintering species such as pintail (*Anas acuta*), teal, dunlin (*Calidris alpina*), turnstone (*Arenaria interpres*) and twite (*Carduelis flavirostris*). The feeding areas provided by the mudflats and saltmarsh are particularly important for many species of waterfowl in years when severe weather reduces available food resources on the continent.

The recent breeding wader and wildfowl survey (1997) undertaken by Suffolk Wildlife Trust found that the salt marsh of the Deben estuary is by far the most important habitat along the estuary for breeding waterfowl with 100 pairs of redshank, 98 pairs of oystercatcher and 75 pairs of shelduck recorded. The saltmarsh at Falkenham Creek was found to support the highest density of breeding redshank of any site on the Suffolk estuaries (30 pairs).

The Deben estuary supports approximately 28% of Suffolk's area of saltmarsh and displays the most complete range of the vegetation's community types in the County. These occur in a highly complex mosaic with the variation in the proportions of species being dependant upon several factors including substrate type, frequency of tidal inundation, exposure, position within the estuary and past management practices. A saltmarsh survey undertaken by the Suffolk Wildlife Trust in 1993 identified sixteen saltmarsh communities and two swamp communities covering a total of 238 ha.

The total area of pioneer vegetation in the Deben is low (10%) suggesting that little accretion is taking place. Virtually all of the pioneer vegetation comprises the introduced and invasive cord grass (*Spartina anglica*). Stands of this species are developing throughout the estuary, most noticeably in the mid section. On the south side large areas of saltmarsh are occupied by *S. anglica*, but it is not clear whether it has invaded areas of established marsh or whether its presence as a pioneer community has enabled large stands of sea-aster (*Aster tripolium*) to establish later. Pioneer stands of glasswort (*Salicornia* spp.) saltmarsh are scarce on the Deben. However, large quantities of *Salicornia* occur as an underlayer to stands of *Aster tripolium* in the mid-estuary. Their presence makes it difficult to interpret whether these areas are eroding from mid to low marsh or accreting.

Low-marsh communities make up the majority of the saltmarsh on the lower part of the Deben and account for 29% of the saltmarsh on the whole estuary. Low marsh on the Deben is dominated by large stands of *Aster tripolium*, particularly on the west side of the river between Hemley and Woodbridge, with an understorey of *Spartina anglica* and *Salicornia* spp. Other low-marsh communities are dominated by saltmarsh grass (*Puccinella maritima*) saltmarsh. Both these communities occur as small fragmented stands, with the *P. maritima* community occurring at the back of the larger saltmarsh blocks where there has been erosion and/or accretion along creeks. These areas are often inundated by the tide, being lower than

central blocks of mid-marsh vegetation.

Low-mid and mid-marsh communities make up the bulk of the well-established and stabilised saltmarsh blocks, accounting for 53% of the saltmarsh on the Deben, and also represent the most floristically diverse saltmarsh found on the estuary. These communities are rather variable in composition and reflect local changes in sediment type and depth, extent of inundation and past management practices. Two basic communities dominate on the Deben. The low-mid marsh is dominated by communities of the sea-purslane (*Atriplex portulacoides*) saltmarsh, particularly, the *Puccinella maritima* sub-community which accounts for 28.3 % of the total saltmarsh on the estuary. The mid-marsh is dominated by the sea-lavender (*Limonium vulgare*) sub-community of the *Puccinella maritima* community. Large blocks of this saltmarsh occur throughout the lower half of the estuary and account for about 22% of the total area of saltmarsh on the estuary.

Upper marsh only forms a relatively small component (9%) of the overall saltmarsh area on the Deben. The most extensive community is that dominated by sea-couch (*Elytrigia atherica*), which occurs mainly along the highest edge of the saltmarsh, the vast majority of this being on flood walls. Around Woodbridge stands of this community contain appreciable numbers of the nationally rare dittander (*Lepidium latifolium*). Sea-couch is mainly confined to sea walls but at the northern-most end of the site it forms extensive stands which show a natural transition to blackthorn (*Prunus spinosa*) scrub on the higher ground. In addition, swamp communities occur in several places along the estuary, usually as relatively narrow fringes but occasionally forming large stands. Such areas may be dominated by sea club-rush (*Scirpus maritima*), greater pond-sedge (*Carex riparia*) or, most frequently, common reed (*Phragmites australis*).

The estuary supports three nationally scarce plant species, marsh mallow (*Althaea officinalis*), shrubby seablite (*Suaeda frutescens*) and small cord-grass (*Spartina maritima*). The nationally rare mollusc, (*Vertigo angustior*), occurs in one small area on the southern side of Martlesham Creek as does the nationally scarce *Vertigo pusilla*. The whorl snail, *V. angustior*, is listed on Annex II of the European Habitats and Species Directive and is on the short list of the UK Biodiversity Action Plan. Martlesham Creek represents one of eight known populations in Britain.

#### 3.4.2 Vegetated shingle

On the southern side of the mouth of the Deben estuary, a relatively extensive shingle beach has built up in front of the sea-wall and defences at Felixstowe Ferry cottages. Typical shingle species such as sea kale (*Crambe maritima*) and sea-poppy have colonised the beach which, judging by the extent of vegetation has been stable for a number of years. The shingle storm ridge support several good-sized patches of the nationally scarce sea-pea (*Lathyrus japonicus*). The central hollow running north-south between the sea-wall and the fronting storm ridge along the beach supports a flora more akin to that of saltmarsh with sea-purslane and a few plants of sea-aster.

#### 3.4.3 Grazing marshes

In comparison with the Alde/Ore and Blyth estuaries there are no appreciable areas of grazing marsh habitat along the Deben estuary. The only significant area is at Shottisham Creek, where there is approximately 80ha of semi-improved cattle grazed grassland. Water levels over parts of the site have been raised under the ESA scheme and now provide suitable habitat for breeding waders and wildfowl such as redshank, lapwing and shelduck. Small areas of semi-improved pasture are also present to the west of Ramsholt and at Kirton Creek. In the last couple of years the outfall sluice for the marshes at Ramsholt has been blocked leading to extensive winter and spring flooding of the grassland. This has proved to be an

attractive feeding area to a number of waterfowl species, particularly shelduck, when mudflats are covered at high tide.

#### 3.4.4 Reedbeds

Reedbeds are an important habitat for a number of rare birds and invertebrates. In Suffolk, there are 550 hectares of reedbed remaining, almost 25% of the national resource. Large reedbeds have developed on the coast either in estuaries or on former coastal grazing marshes and their dykes, or fringing brackish lagoons. Reedbeds, especially large coastal reedbeds, tend to be species-poor plant communities almost entirely composed of common reed (*Phragmites australis*).

In comparison with the Alde-Ore and Blyth reedbed, is relatively limited with only approximately 8ha occurring throughout the estuary. Common reed occurs along the fringes of some of the larger creeks, notably towards their landward ends where freshwater influence is greatest. The largest stands occur just to the north of Ramsholt, the southern side of Martlesham Creek and the eastern side of the estuary opposite Woodbridge.

#### 3.4.5 Conservation Designations

The Suffolk coast is recognised nationally and internationally as an area of unique landscape, wildlife and historic interest. This is reflected in the large number of statutory and non-statutory designations that have been applied to the area. Further information regarding these designations is provided in Section E5 of Appendix E.

The Deben estuary and surrounding land falls within the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB). The primary purpose of the designation is to conserve and enhance the natural beauty of the area and to protect its flora, fauna, geological interest and landscape features. However, in pursuing this primary purpose, account should be taken of the needs of agriculture, forestry and the economic and social needs of local communities.

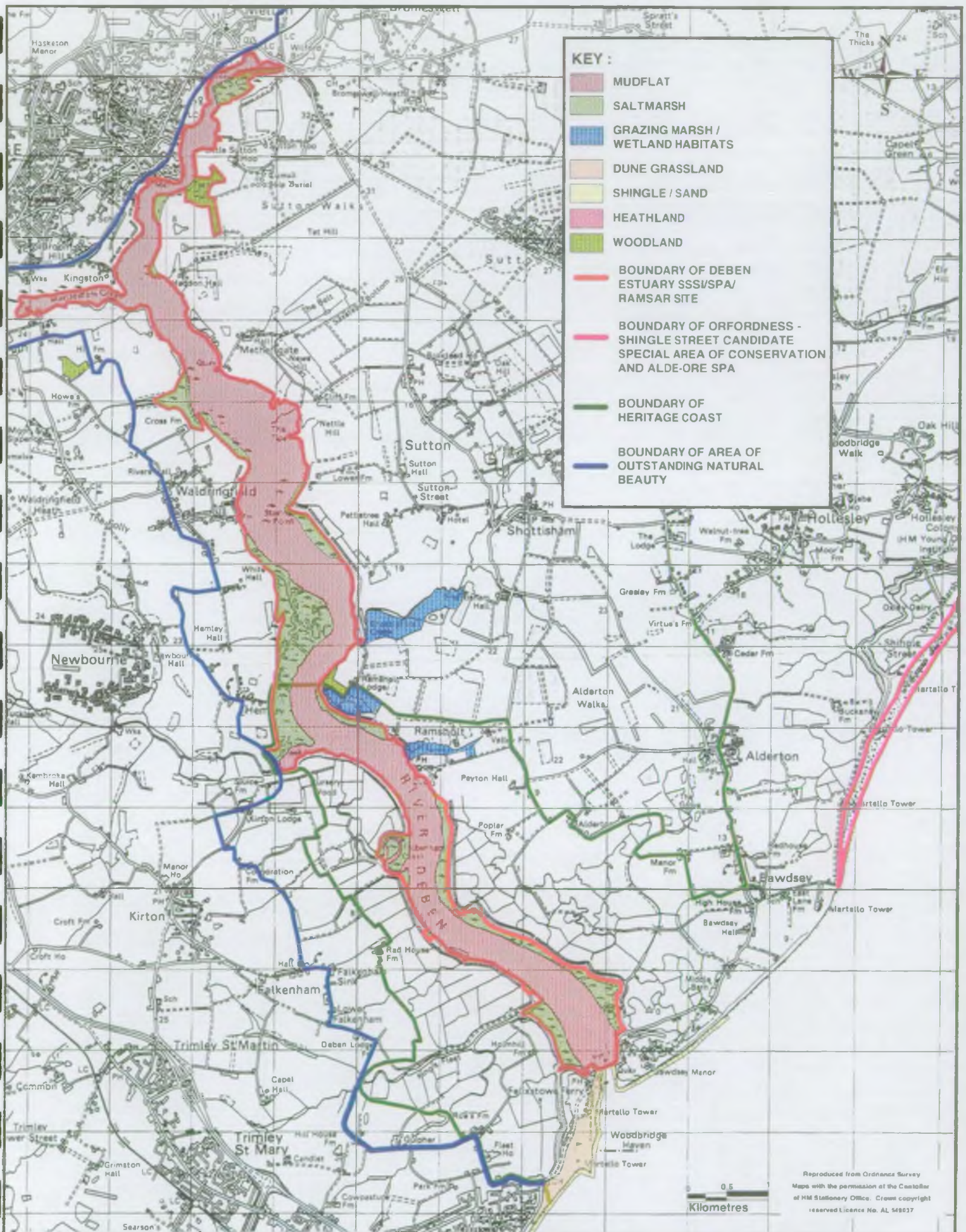
The lower half of the estuary is also contained within the Suffolk Heritage Coast (designated in 1973). The 1992 Heritage Coast Policy set national targets for all Heritage Coast, namely the provision of a semi-natural strip along the coast, accommodating a coastal path, the clearance of eyesores and meeting standards for water and beach cleanliness.

The entire intertidal area of the estuary downstream of Bromeswell is a designated Site of Special Scientific Interest (SSSI). The SSSI is also a designated Special Protection Area (SPA) and Ramsar Site for its internationally important wintering bird populations, including internationally important numbers of dark-bellied brent geese. The boundary of the SPA, which is coincident with that of the SSSI, is shown on Figure 3.1.

The following areas around the estuary are all County Wildlife Sites (CWS); open water and freshwater habitats at Kings Fleet, an area of semi-improved pasture at Hemley, the grazing marsh north of Ramsholt, semi-improved grazing marsh at Shottisham Creek, a small area of semi-improved grazing north of Methersgate and an area of semi-improved grassland at Kyson (south of Woodbridge).

The entire estuary and much of its hinterland is contained within the Suffolk River Valleys Environmentally Sensitive Area (ESA) which was designated in 1988 and extended in 1993 by MAFF.





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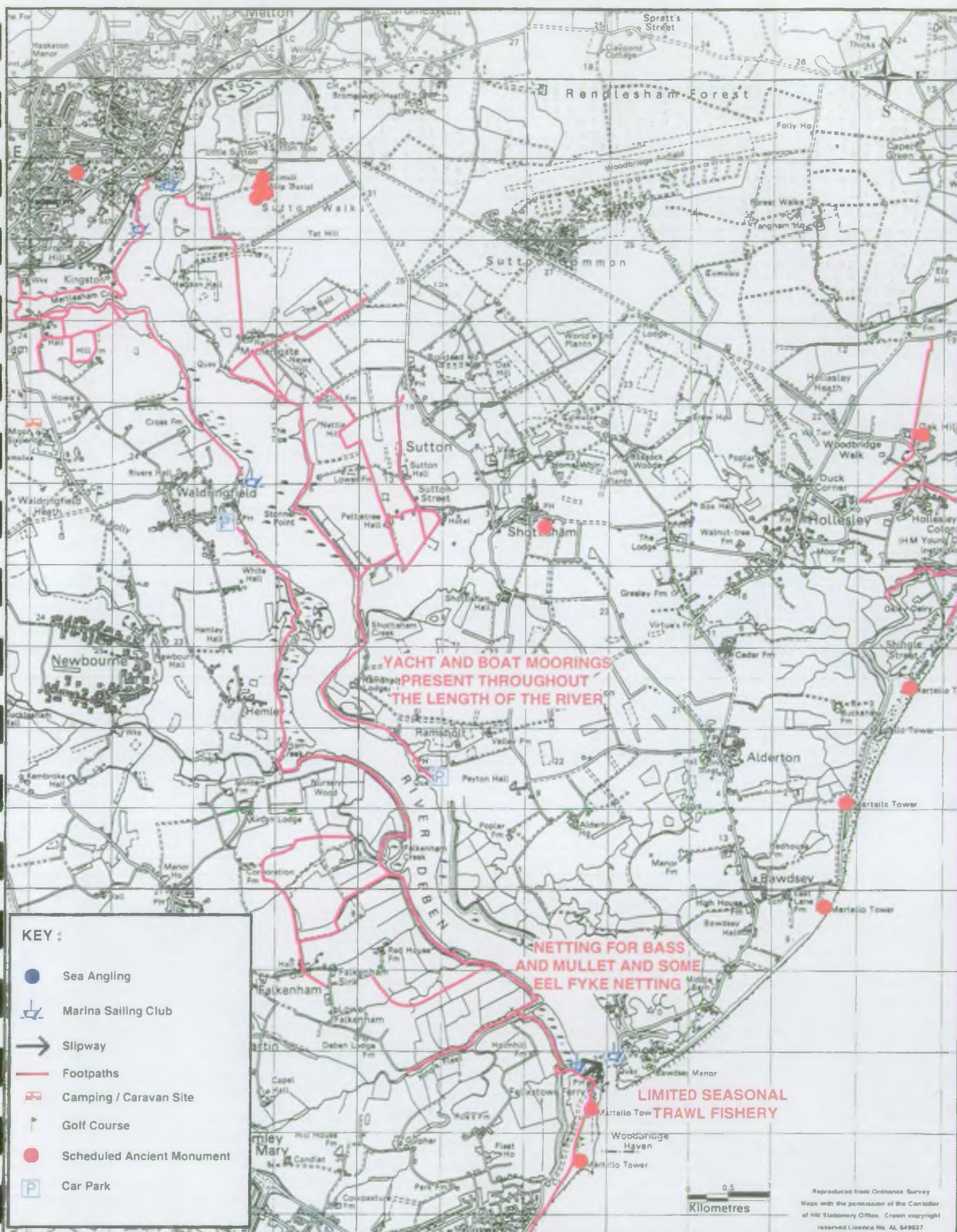
DEBEN ESTUARY  
HABITATS AND  
CONSERVATION

FIGURE 3.1









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DEBEN ESTUARY  
TOURISM AND  
RECREATION

FIGURE 3.2







## SECTION 4

### AIMS OF THE STRATEGY AND THE DIVISION OF THE ESTUARY

#### 4.1 STRATEGY AIMS AND OBJECTIVES

##### 4.1.1 Consultation

As part of the Phase 2 strategy development, organisations were consulted to identify their interests and involvement with the estuary. A list of those consulted is included in the section on Consultation Details at the rear of this report. The interest and the various comments made have been collated as a report on the environment presented as Appendix E. Key issues have already been summarised in Section 2. Based on these issues and based on the Environment Agency policy and MAFF guidance on defence, general and specific objectives for the estuary strategy have been drawn up and are presented below.

##### 4.1.2 Aim

The strategy must take on board all aspects of estuary use, interest and expenditure. Distilling the intent of the detailed objectives set out below (Section 4.1.3) an overall aim has been developed. This is:

"To develop a strategy for flood defence which maintains or, where possible, improves the overall balance of the estuary in terms of its natural and human environment, its use and recreational value and economic interests, while minimising the dependence of this balance on flood defence expenditure."

##### 4.1.3 General Objectives

###### i) Defence Management Objectives

To provide sustainable defence policy options that avoid tying future generations into inflexible and expensive defence requirements.

To ensure that defence policy options are compatible with the preferred options identified in the open coast Shoreline Management Plan (subcell 3c) for the mouths of the estuaries.

To select defence policy options that take into account the impact on the estuary as a whole and minimise the overall defence burden.

To provide sustainable defence options that are technically appropriate and environmentally sound.

Where economically justifiable and technically viable, to provide and maintain sustainable defence schemes that protect human life and property and maintain environmental interests.

###### ii) Nature Conservation

To ensure that the flood defence strategy takes account of the implications of the Habitats Directive and contributes towards the maintenance of a favourable conservation status for the estuaries

To ensure that wild species and wildlife habitats are conserved and enhanced in line with the UK biodiversity Action Plan.

**iii) Planning**

To provide defence from flooding and erosion in a manner consistent with the policies and objectives established within the planning framework.

To take account of, and co-ordinate with, the objectives of the relevant guidance and management planning initiatives beyond the statutory requirements for both the built and natural environment.

Where economically and technically feasible, to provide sustainable coastal defence schemes to protect agricultural land from flooding and erosion.

**iv) Fisheries**

To take into account the requirements of the fishing industry in formulating and implementing defence policies.

**v) Recreation**

Ensure that recreational activities and amenity areas are fully considered, and opportunities to enhance existing facilities are taken, in the development of the strategy.

**vi) Landscape**

To conserve and enhance the natural beauty of the estuaries in particular the varied landscape, wildlife and historic value.

To take account of the existing landscape character of the area and the Character and Natural Area objectives. To take account of both Heritage Coast and Area of Outstanding Natural Beauty objectives.

**vii) Water Quality**

To ensure that defence policy does not detrimentally impact upon the water quality of estuarine waters.

**viii) Archaeology**

Ensure that potential areas at risk from flooding and/or erosion are identified in order to allow surveys to be undertaken to assess whether archaeological interests could be damaged or destroyed.

To recognise the national and local importance of archaeological sites and historic buildings.

There will be a presumption in favour for the protection of Scheduled Ancient Monuments and Grade 1 listed buildings or a large number of well preserved sites.

To ensure that wherever possible that areas of known archaeological interest are conserved and to minimise and mitigate against any adverse impacts that defence policy may have on them, up to and including recording and excavation.

#### 4.1.4 Deben Estuary Specific Objectives

To ensure that the strategic defence policies:

- do not compromise coastal process movements nor increase the likely risk of flooding and/or erosion at Woodbridge, Waldringfield and Felixstowe Ferry
- maintain the navigable access to, recreational use and local economic importance of the harbour facilities at Woodbridge and Felixstowe Ferry
- recognise the recreational importance of the estuary for both water based and land based activities
- contribute towards maintaining the internationally and nationally important overwintering waterfowl populations that occur in the upper estuary
- are compatible with maintaining the nationally important landscape character

#### 4.1.5 Deben Estuary Specific Issues

During the course of the Phase 2 consultation certain specific issues were raised by consultees. These are commented on below.

One of the main concerns expressed involved the loss of saltmarsh. This habitat is very specific in its position in relation to high water. It is vulnerable to erosion due to increase flow within the channel and will die off if excessively submerged (due to sea level rise). This habitat is at present being lost in all three estuaries. Although some of this loss may well be due to other factors such as pollution, the die back of saltmarsh is considered to be a major indicator of sea level rise. This is discussed for each estuary in more detail in Appendices B and E. There is a need to monitor the behaviour of this habitat not only from the environmental view point but also in relation to the frontline protection it provides to defences and as an earlier indicator of change within the estuary.

The ability for saltmarsh to migrate to higher ground in response to rising tide levels is dictated by the nature and slope of the ground behind, the rate of increase of sea level and by the availability of sediment. These issues are discussed with reference to each estuary in Appendix B. The development process of the strategy has recognised that there is and is likely to be a continuing loss of salt marsh. Within the proposed strategy there is an attempt to maintain the balance of this habitat and this has been an important factor in considering the suitability of strategy options.

Other points raised include the abstraction of fresh water from some of the low lying marshes. This water supply is important in providing irrigation to higher ground. Although difficult to evaluate at a strategic level, recognition of this resource has been allowed for in the economic assessment.

Studies have in the past looked at constructing barrages across the river Deben with the specific intent of improving the freshwater supply to the area. The benefits of this were unproven. During the recent scoping consultation, however, the question of a barrage across the Deben has been raised, in part as a means of controlling flows throughout the estuary but also as a means of producing hydroelectric power. The scale of construction works needed is likely to make this impractical.

## 4.2 PRINCIPLES

In addition, in developing the strategy certain guidelines are applied. These are:

- That the estuary and its environs are considered as a whole in terms of environmental interests, recreational use and in assessing the economic case for specific options.
- That economic value is considered on a national basis, but that the local social and cultural impacts of decisions are recognised.
- That where possible decisions on defence should encourage the development of use or interests in areas appropriate to that use or interest. (e.g. Developing freshwater habitats significantly below sea level creates an artificial and dependent situation. Where opportunity exists to relocate such habitat to a more appropriate location then the defence policy should encourage this.)
- That economic and environmental impacts remote from specific lengths of defence must still be taken into account in developing the overall strategy.
- The strategy is a long term, 50 year, plan for the management of flood defences. The policies developed aim to redress the imbalance in the present conditions but recognise that this is a long term process. There may therefore be a need temporarily to adopt a policy which may change over the fifty years either because:
  - There is some inherent uncertainty which is critical to a decision and which must be measured over time
  - There is a need to develop mitigation measures before a preferred policy can be fully implemented.

## 4.3 DIVISION OF THE ESTUARY

An essential part of the overall strategy development process is examining how each and every section of the estuary would respond to the possibility of change somewhere else within the system. Fundamental to this is understanding the behaviour of each area; the pressures currently imposed on the area, its capacity to accommodate further physical pressure, the impact this would have on the interests within that area and the consequence that might arise from any subsequent response.

This understanding may be seen to relate to two aspects:

- The physical regime (the driving forces, the response and the consequence).
- The use (the activity, the economic value, the defence costs and the interests).

### 4.3.1 Division by Physical Regime

Despite the need, ultimately, for all aspects to be considered equally over the whole geographical extent of the estuary, the practical development of the strategy requires that smaller sections of the estuary are examined individually, but in such a way as to assist in building towards the larger picture. This only works if the division into smaller units is based on characteristics which reflect the interaction or linkage as a whole. The principal physical process in this respect is tidal flow, and the possible response to increased flow or the control of that flow.

Based initially upon the division of the estuary made in the Stage I study (by geomorphological characteristics) the estuary has, for the purpose of assessing various defence strategy options, been divided into three zones. The basic criteria for division is how

the estuary works and how, therefore, it responds to the pattern of flow through the zone. In essence:

- To what degree at any point in the estuary is the estuary width constricted? (i.e. Are defence banks hard up to the edge of the channel, so that there is little scope for the channel to adapt to change by change in its width, or, conversely, is the flow through a wide open plain, where significant change in tidal volume upstream may be accommodated without significant change in the regime of the zone?)
- To what degree is change in the alignment of the channel at any location restrained? (i.e. Will change in flow result in a wish for the estuary channel to change its alignment? If so, will this conflict with the position of defences, or if resisted, result in increased pressure to opposing banks and defences?)

For the Deben Estuary, three zones have been identified, each having different attributes, as follows:

#### **Zone 1 – Upper Reaches**

The narrow channel is restricted by the hard defence to the town of Woodbridge on the west bank, and by relatively high ground to the east. Being near the upstream tidal limit of the estuary, the potential for significant change in tidal volume is small. However, due to the tendency for the channel to meander, obstruction to the flow pattern may be quite significant.

#### **Zone 2 – Middle Reaches**

The wide meandering channel is relatively unrestricted in alignment, and is flanked by extensive areas of saltmarsh and inter tidal mud in front of discrete lengths of embankment and high ground. There is definite scope for future re-alignment of the main channel, together with the significant reduction in saltmarsh due to sea level rise. There is a degree of freedom for the alignment to change and to respond to change without major conflict with defences.

#### **Zone 3 – Lower Reaches**

The meandering channel becomes more constricted and restricted in alignment by the almost continuous flood embankments. There is a narrow margin of saltmarsh and inter tidal mud over much of the zone, indicating that the channel is not fully constricted. In places, however, the banks are already under pressure from erosion, the location of which indicates the trend of movement of the meanders. Future rise in sea level is likely to increase this pressure, particularly on the west bank. At the mouth of the estuary, the channel is constricted, and totally restrained in alignment.

### **4.3.2 Division by Use.**

In examining the economics of flood defence and use and interest of the estuary, and assessing how this is affected within any scenario for flood defence, two areas have to be recognised:

- The assets contained within the estuary channel.
- The assets within the potential flood plain which are currently defended against flooding.

For convenience, the former are generally considered on a zone by zone basis. The latter are divided by flood compartment so as to relate the cost of defence against the assets protected. There are 16 flood compartments identified.

The flood compartments (FC) and the zones are shown on Figure 4.1







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## DEBEN ESTUARY FLOOD COMPARTMENTS AND ZONES

FIGURE 4.1







## SECTION 5

### STRATEGIC APPRAISAL

#### 5.1 GENERAL

The strategic appraisal process follows a general procedure. The implications of various options at a local level (the options for specific flood compartments (FC)) are examined. Consideration is then given as to how these may combine as options for each zone<sup>2</sup> (zone options). Finally, the interaction and implications of different zone options are examined to see how they work together to produce a workable strategy for the estuary.

The process is, therefore, one of predicting the future evolution of the estuary, examining how this is affected by the choice of defence options at the local level and, at an estuary level, examining the consequences of this on other areas. This Integrated Predictive Process is shown schematically in Figure 5.0.

The rest of this subsection identifies specific issues relating to the overall process.

##### 5.1.1 Options

The individual flood compartment is the basic building block of the strategy. For each flood compartment the cost of maintaining defences has been assessed and the damages, which would occur should defences be allowed to fail, has been determined (Appendices C and D). The current value of these damages - to property, land, and the agricultural production thereon - has been assessed, and Treasury discount rates applied to arrive at present values of damage occurring in the future. The assessment of costs and damages has been carried out following the principles identified in MAFF's Project Appraisal Guidance Notes<sup>3</sup>. Other factors such as amenity or environmental value have also been identified (Appendix E). For each flood compartment consideration is given to the generic defence policy which could be adopted. The standard strategic options considered in the Shoreline Management Plan process are described below:

- "Do Nothing" (DN). Doing Nothing to the existing defences and undertaking no defence work to minimise or restrict any associated damage. This option should always be considered and must at least form the basis for comparison with other options.
- "Hold the Line" (HTL). Retaining the existing defence line and undertaking necessary maintenance, repairs or reconstruction as required. This option assumes that the current standard of defence is retained, rather than the current level. This option is always considered in detail.
- "Managed Re-alignment" (R). Managed Re-alignment may take different forms. A new line of defence may be chosen, protecting key assets within the larger area of the flood compartment. Alternatively, the line of defence may be realigned or the standard of defence may be allowed to decrease. In some cases Managed Re-alignment may not be feasible because there is no sensible line to re-align to.

<sup>2</sup> The rationale behind the division of the estuary into zones is discussed in section 4.5. This division allows impacts of options to be considered at a local level while ensuring that the broader implications of the various options for defence management are considered throughout the estuary.

<sup>3</sup> Further detailed assessment will be required to implement the strategy findings

- "Advance the Line"(ATL). This has only limited application to the estuary situation. Considering an estuary is different from considering the open coast, most obviously because the regime is confined between two shores; there is no open offshore boundary and there is often a high degree of interaction between the two sides of the estuary. Clearly in most situations Advancing the Line would increase this interaction and further constrict flows and increase the velocities. Advance the line is, therefore, not normally considered sensible.

In addition to the four standard options it is also important to consider other approaches:

- Where "Do Nothing" is a possible or probable option in the long term, then the cost of maintaining the existing defence in the short term has also been considered. The end result would still be to "Do Nothing" but this abandonment of defences would be triggered by the maintenance costs becoming excessive or impractical. This option is "Delay Do Nothing"(DDN). Such an approach, if found to be economically sensible, acknowledges the residual value of the existing defence and does allow better information to be obtained on the cost of maintaining the defence before a final decision is made. This cost of maintenance is generally the main area of uncertainty within the analysis presented. DDN would allow strategic decisions to be reviewed in light of better information. It would also in certain circumstances give advance notice of the intent to abandon a defence and allow time to plan how such a policy may be managed in the most advantageous manner.
- There are other options, which are appropriate to the individual nature of the estuaries but which are not easily classified under the four "SMP" generic headings, these are described and considered as appropriate in the local zone appraisals. Among these is the possibility of barrages or barriers. This possibility has been discussed with the Environment Agency and based on previous studies into such an approach the option of closing off major sections of the estuaries has been dismissed.

### 5.1.2 Transfer of Costs and Impacts

The decision to abandon, or hold, a defence in one area may result in additional cost or damage elsewhere. This may be due to an increase or redirection of the flow, more rapid erosion, and the need to install more costly forms of protection or the need to extend the defended length. Equally, it may create an opportunity for, or cause the loss of, habitat or use, which may detract from, or add, to the value of the estuary as a whole. Underlying the strategic analysis of the estuary is the need to add together these costs, benefits and other impacts across the whole area of the estuary. A mechanism has been set up by which this process of transfer can be assessed. The approach taken in achieving this is discussed below.

Each zone of the estuary contains various flood compartments. For each flood compartment, there are several possible defence management options (FC option). This results in several possible management options for the zone as a whole; based on the different logical combinations of FC options within the zone.

For any FC option, it is possible to assess the present value cost<sup>4</sup> (PVC) and present value

<sup>4</sup> Present value costs (PVC) are the discounted costs associated with maintaining, and where necessary rebuilding defences. Present value damages (PVD) are the discounted value of assets lost as a result of a specific option. The present value benefits (PVB) of an option is the difference between the damages which would still occur under that option and those that would arise if defences were abandoned (PVD "Do Nothing" - PVD "Option" = PVB). The Net Present Value (NPV) is the value of adopting a specific option; the difference between the value of benefits and the cost of that option (PVB - PVC = NPV). The time over which these values are discounted is linked to the residual life of defences. Further information is provided in Appendix D.

benefit (PVb) and, depending on the physical characteristics of the zone, the influence that an option may have on adjacent or opposite defences within the zone. The costs and benefits for each option may then be aggregated to provide a combined PVc and PVb for the zone under that particular combination of flood compartment options.

Under normal rules for economic appraisal the benefit cost ratio would be determined (the ratio of PVb/ PVc) and this would provide a comparative economic indicator of how worthwhile a particular option is. This method does not, however, provide any means of assessing the actual value of the option, neither in terms of its net economic advantage nor its net economic disadvantage (its deficit). If the benefit or burden of an option is to be assessed throughout the estuary, a different economic indicator has to be used.

The difference between the PVc and PVb is the net present value (NPV). If positive then the NPV demonstrates that there is an economic benefit in adopting an option; if negative the NPV demonstrates a deficit between the cost of defending a section of the estuary compared to the value of assets protected. This indicator provides directly the value of benefit or deficit for any zone option considered. It also allows the physical impact of an option in one zone to be reflected in the economic analysis of a zone elsewhere. The NPV provides a means of tracking the economic consequence of an option throughout the estuary. Summing the NPVs for compatible options for each and every zone provides a means of assessing the economic case for the various estuary wide strategic options.

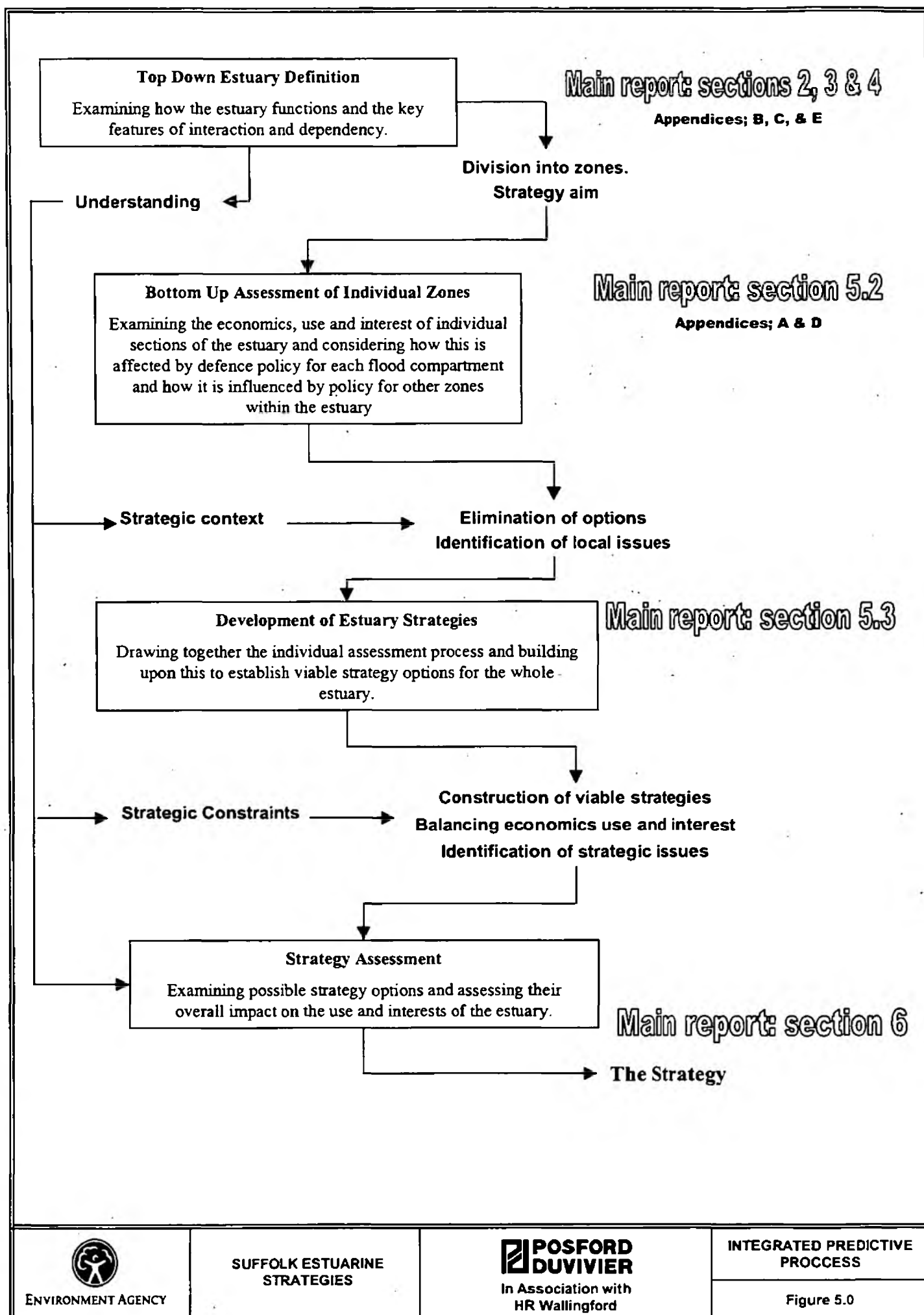
The environmental loss or gain, or the loss or gain in specific use of the estuary, may be assessed directly for any zone option and for the consequence of that zone option on other zones. In this way, and consistent with the approach adopted for the economics, a balance sheet can be maintained of loss, gain and opportunity, as the physical effect of any local option feeds through the estuary. In addition, an allowance for the cost of habitat management or recreation has been made where necessary.

In summary, therefore, the strategy appraisal starts by examining each flood compartment, considering how options for associated flood compartments may be put together to generate options for each zone. It then proceeds to examine how the zone options may be combined to create various strategy scenarios for the estuary as a whole. Throughout this process, the economic consequences are monitored by the cumulative NPV and the impact of the scenario tracked to ensure that the overall balance of interests in the estuary is maintained.

### **5.1.3 General Strategic Policy.**

The appraisal undertaken for the Estuary is at a strategic level. The outcome of the analysis for some isolated flood compartments may not be critical to the overall strategy and, because of this, may potentially distort the strategic economic analysis. Such isolated flood compartments are identified. Neither the potential damages, benefits nor cost associated with the preferred option for these compartments are considered in the overall economic summary of the strategy. Furthermore, it would be inappropriate in such cases for the strategy to be overly prescriptive. While a preferred option is given, this should be seen as guidance, recognising the level of confidence in the strategic economic appraisal.





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INTEGRATED PREDICTIVE  
PROCESS

Figure 5.0



## 5.2 ZONE APPRAISALS

The following sub-sections work through the appraisal process zone by zone. In each case a standard format is adopted.

### a) Zone Title Page

A brief description of the zone is given together with a list of zone options discussed in more detail further on within the sub-section and within Appendix A. The zones are shown in Figure 5.1.

### b) General Overview

A general overview is given in tabular form. The table identifies:

- The physical nature of the zone, highlighting changes that would, as a result of action in other parts of the estuary, have a critical bearing on the defence management of the zone.
- Existing areas of concern.
- A headline assessment of the significance of the zone in relation to the estuary and the interaction within the zone.
- Other aspects of the zone which are important in the context of the estuary as a whole. Particularly those assets or features which are associated with the river channel rather than individual flood compartments.
- The potential threat to features within the zone and the potential opportunities which might arise from certain management scenarios.

For each flood compartment the table includes:

- The nature and condition of the defence works associated with each flood compartment.
- The actual value of assets protected by the defences, which would be lost should the defence be abandoned.
- The possible defence options considered, with brief description of potential local impacts and an explanation of why some options are clearly inappropriate.

### c) Summary and Preliminary Conclusions

Preliminary (or local) conclusions for the zone are summarised, defining what conditions should be taken forward, from the possible options for the zone, when examining other zones. These preliminary conclusions form the basis for pulling together an overall estuary strategy at the end of Section 5. The detailed discussion upon which the above summary and conclusions are based is presented in Appendix A.

The manner in which the economic analysis has been derived is discussed in the Appendix A but is presented in more detail in Appendix D. A summary of the economic assessment for the relevant zone is presented in a table at the end of sub-section. This table is copied in Appendix A for convenience of reference.



## **ZONE 1. UPPER REACHES Bromeswell to Martlesham**

This zone is located at the upper end of the Deben estuary, extending from the tidal limit at the railway bridge near Bromeswell to the confluence with Martlesham Creek. Within the zone, shown in Figure 5.1 at the end of this sub-section, there are five flood compartments, FC16a, 16b, 15, 14 and 6, at Melton, Woodbridge north and south, Martlesham and Little Sutton Hoo respectively (Figure 5.1).

Table 5.2.1a provides a general summary of the zone.

Thirteen options are considered for the management of this zone. The principal consideration here is the town of Woodbridge on the north bank of the river, being the social and economic hub of the zone. For this reason the north bank is assessed first:

- 1. Do Nothing in FC16a**
- 2. Hold the Line in FC16a**
- 3. Delay Do Nothing in FC 16a**
  
- 4. Do Nothing in FC16b**
- 5. Hold the Line in FC16b**

Having arrived at a preferred strategy for Woodbridge, the remaining compartments were then assessed:

- 6. Do Nothing in FC6**
- 7. Hold the Line in FC6**
  
- 8. Do Nothing in FC15**
- 9. Hold the Line FC15**
  
- 10. Do Nothing in FC14**
- 11. Hold the Line in FC14**
- 12. Delay Do Nothing in FC14**

Table 5.2.1b provides a summary of the economic assessment for this zone

Table 5.2.1(a) General Summary of Zone 1

| Zone 1   |                               | Upper Reaches   |           |                        | Ch 0 km                 |                                  |           |
|--|-------------------------------|---|-----------|------------------------|-------------------------|----------------------------------|-----------|
| <b>Physical Attributes</b><br><u>Description:</u><br><br><u>Critical Influences:</u><br><u>Controls and Constraints</u><br><br><u>Present Pressures</u><br><u>Potential Impacts</u><br><br><u>Internal Interaction</u> |                               | Narrow meandering channel restricted by town of Woodbridge on west bank & high ground on east. Little scope for re-alignment without major disruption. Developments along Woodbridge frontage.<br>Upstream the channel is restricted by the railway bridge north east of Melton, and the road bridge east of Melton. Developments & high ground along most of the west & east banks respectively constrain channel alignment.<br>Local pressure points as channel meanders through inter tidal zone<br>Massive disruption to Woodbridge if defences fail. Only slight increase in tidal volume.<br>Little interaction between flood compartments. |           |                        |                         |                                  |           |
| <b>General Attributes</b><br><u>General</u><br><br><u>Threats</u><br><br><u>Opportunities</u>  |                               | Extensive areas of mudflat in front of defences, with some saltmarsh. Woodbridge extends over much of the west bank.<br>Few. Defences in front of Woodbridge are mainly in good condition, and to a high level.<br>Small areas of potential habitat recreation at Melton, Sutton Hoo & Martlesham Creek.  |           |                        |                         |                                  |           |
| Local Assessment   |                               |   |           |                        |                         |                                  |           |
| Flood compartment (FC)   |                               | Length  | Area (ha) | Actual Value of Assets | Defence                 |                                  | Adjoining |
| 16a  | Melton                        | 1030  | 20        | £498k                  | clay bank               | fair/poor                        | 16b       |
| 16b  | Woodbridge                    | 4080  | 50        | £7,067k                | Clay bank & sheet piles | good                             | 16a, 15   |
| 6  | Sutton Hoo                    | 730   | 10        | £3,106k                | clay bank               | fair                             | -         |
| 15   | Woodbridge (south)            | 2070  | 20        | £1,853k                | clay bank & revetment   | good                             | 16b       |
| 14   | Martlesham Creek (south bank) | 1750  | 14        | £76k                   | clay bank & revetment   | fair                             | -         |
| FC   | Option                        | Comment   |           |                        |                         |                                  |           |
| 16a  | Do Nothing                    | Loss of asset & change of habitat.  |           |                        |                         | Feasible & considered further    |           |
|  | Hold the line                 | Maintains existing use and interest.  |           |                        |                         | Feasible & considered further    |           |
|  | Managed Re-alignment          | No obvious line to re-align to ⇒ effectively same as Do Nothing.  |           |                        |                         | Not considered further           |           |
| 16b  | Do Nothing                    | Loss of significant economic & community asset.   |           |                        |                         | Considered as baseline case only |           |
|  | Hold the line                 | Maintains existing use and interest   |           |                        |                         | Feasible & considered further    |           |
|  | Managed Re-alignment          | Loss of significant economic & community asset. No obvious line to re-align to ⇒ effectively same as Do Nothing.  |           |                        |                         | Not considered further           |           |
| 6  | Do Nothing                    | Loss of asset & change of habitat   |           |                        |                         | Feasible & considered further    |           |
|  | Hold the line                 | Maintains existing use and interest.  |           |                        |                         | Feasible & considered further    |           |
|  | Managed Re-alignment          | No obvious line to re-align to ⇒ effectively same as Do Nothing.  |           |                        |                         | Not considered further           |           |
| 15   | Do Nothing                    | Loss of significant economic & community asset.   |           |                        |                         | Considered as baseline case only |           |
|  | Hold the line                 | Maintains existing use and interest.  |           |                        |                         | Feasible & considered further    |           |
|  | Managed Re-alignment          | Loss of significant economic & community asset. No obvious line to re-align to ⇒ effectively same as Do Nothing.  |           |                        |                         | Not considered further           |           |
| 14   | Do Nothing                    | Loss of assets, change of habitat   |           |                        |                         | Feasible & considered further    |           |
|  | Hold the line                 | Maintains existing use and interest.  |           |                        |                         | Feasible & considered further    |           |
|  | Managed Re-alignment          | Loss of some assets, change of habitat No obvious line to re-align to ⇒ effectively same as Do Nothing.   |           |                        |                         | Not considered further           |           |

### **Summary and Preliminary Conclusions for Zone 1**

The flood compartments within Zone 1 are relatively independent of each other, and can therefore be assessed on an individual basis. The zone is dominated by Woodbridge, in FC16b, which contains the majority of the area and assets at risk from flooding. An embankment divides FC16b from Melton (FC16a). Defences along FC15 also provide protection to the southern section of the town. The social and economic value of Woodbridge dictate that the line of defence in front of both of these compartments should be held.

On the opposite (southern) bank FC6 at Sutton Hoo is also of significant economic value, suggesting that defences here should also be held.

The future of the remaining compartments – FC16a and 14 – is less certain. Both are fairly small in area, with little potential to effect the processes in, or evolution of, the rest of the estuary. They do, however, all represent areas which could be easily and effectively managed, as part of an environmental mitigation process, to create either freshwater or saltwater habitats depending on the shortfalls elsewhere in the estuary. Their eventual abandonment would necessitate the re-alignment of the public footpath currently running along the crest of the defences.

Notwithstanding this, the initial preferred options are Delay Do Nothing for FC16a, and Do Nothing for FC14. Before defences at FC16a are abandoned it will be necessary to study and review the area in more detail to ensure that protection will still be given to the northern side of the adjoining FC16b (Woodbridge).

Table 5.2.1b Summary of Zone 1 Economic Assessments

| Option                  | 1    | 2    | 3   | 4    | 5    | 6    | 7    | 8    | 9    | 10  | 11   | 12   |
|-------------------------|------|------|-----|------|------|------|------|------|------|-----|------|------|
| Flood Compartments      | 16a  | DN   | HTL | DDN  |      |      |      |      |      |     |      |      |
|                         | 16b  |      |     |      | DN   | HTL  |      |      |      |     |      |      |
|                         | 6    |      |     |      |      |      | DN   | HTL  |      |     |      |      |
|                         | 15   |      |     |      |      |      |      |      | DN   | HTL |      |      |
|                         | 14   |      |     |      |      |      |      |      |      |     | DN   | HTL  |
| Associated options      | None |      |     |      |      |      |      |      |      |     |      |      |
| PVc Costs<br>£ x1000    | 0    | 529  | 164 | 0    | 1055 | 0    | 229  | 0    | 648  | 0   | 597  | 147  |
| PVd Damages<br>£ x1000  | 279  | 0    | 209 | 2191 | 0    | 1739 | 0    | 1038 | 0    | 48  | 0    | 38   |
| PVb Benefits<br>£ x1000 | 0    | 279  | 70  | 0    | 2191 | 0    | 1739 | 0    | 1038 | 0   | 48   | 10   |
| NPV<br>£ x1000          | 0    | -250 | -94 | 0    | 1136 | 0    | 1510 | 0    | 390  | 0   | -549 | -137 |
| Notes                   |      |      |     |      |      |      |      |      |      |     |      |      |

## **ZONE 2. MIDDLE REACHES**

### **Martlesham to Hemley**

This zone represents the middle reaches of the Deben estuary, extending from the confluence with Martlesham Creek to the promontory at Ramsholt Lodge, opposite Hemley. Within the zone there are four flood compartments, FC13, 12, 5 and 4, Waldringfield, White Hall, Methersgate and Shottisham respectively (Figure 5.1).

Table 5.2.2a provides a general summary of the zone.

Thirteen options are considered for the management of this zone:

FC 13, 12 and 5 are not viewed as being critical to the overall strategy for the estuary, being both small in area and distant from the main river channel. They are therefore considered in isolation.

1. **Do Nothing at FC13**
2. **Hold the Line at FC13**
3. **Managed Re-alignment at FC13**
  
4. **Do Nothing at FC12**
5. **Hold the Line at FC12**
6. **Delay Do Nothing at FC12**
  
7. **Do Nothing at FC5**
8. **Hold the Line at FC5**

The options for future management of FC4 are more varied, and offer more opportunities and potential impacts on the estuary as a whole.

9. **Do Nothing at FC4**
10. **Hold the Line at FC4**
11. **Hold the Line in the northern section of FC4**
12. **Hold the Line in the southern section of FC4**

Table 5.2.2b provides a summary of the economic assessment for this zone



Table 5.2.2(a) General Summary of Zone 2

| Zone 2                          |                      | Middle Reaches   |           |                        | Ch 6.0 km             |   |           |
|---------------------------------|----------------------|--|-----------|------------------------|-----------------------|---|-----------|
| <b>Physical Attributes</b>      |                      | <p>Wide meandering channel fixed in places by high ground or defences. Large areas of saltmarsh &amp; mudflats allowing potential future re-alignment.</p> <p>Shelter offered by saltmarsh likely to reduce in future.</p> <p>High ground north of Methersgate and near Ramsholt Lodge control alignment at upstream &amp; downstream limits respectively. Isolated control elsewhere.</p> <p>Isolated areas under pressure, most notably Waldringfield frontage.</p> <p>Disruption to Waldringfield. Increase in tidal volume only significant in FC4.</p> <p>Little interaction as areas generally small &amp; FCs isolated.</p> |           |                        |                       |   |           |
| <u>Description:</u>             |                      |  |           |                        |                       |   |           |
| <u>Critical Influences:</u>     |                      |  |           |                        |                       |   |           |
| <u>Controls and Constraints</u> |                      |  |           |                        |                       |   |           |
| <u>Present Pressures</u>        |                      |  |           |                        |                       |   |           |
| <u>Potential Impacts</u>        |                      |  |           |                        |                       |   |           |
| <u>Internal Interaction</u>     |                      |  |           |                        |                       |   |           |
| <b>General Attributes</b>       |                      | <p>Mainly rural land with few properties except Waldringfield in FC13. Extensive saltmarsh on west bank, with limited area on east bank.</p> <p>Main threat is to Waldringfield, with defences under pressure from meander in channel.</p> <p>The smaller FCs offer potential for habitat recreation.</p>  |           |                        |                       |   |           |
| <u>General</u>                  |                      |  |           |                        |                       |   |           |
| <u>Threats</u>                  |                      |  |           |                        |                       |   |           |
| <u>Opportunities</u>            |                      |  |           |                        |                       |   |           |
| Local Assessment                |                      |  |           |                        |                       |   |           |
| Flood compartment (FC)          |                      | Length   | Area (ha) | Actual Value of Assets | Defence Type          | Condition   | Adjoining |
| 13                              | Waldringfield        | 980  | 13        | £1,317k                | clay bank             | fair/poor   | -         |
| 12                              | White Hall           | 200  | 4         | £65k                   | clay bank & revetment | fair  | -         |
| 5                               | Methersgate          | 380  | 8         | £248k                  | clay bank & revetment | fair  | -         |
| 4                               | Shottisham           | 1210   | 126       | £1,016k                | clay bank & revetment | fair  | -         |
| FC                              | Option               | Comment  |           |                        |                       |   |           |
| 13                              | Do Nothing           | Loss of significant asset & change of habitat.   |           |                        |                       | Feasible & considered further   |           |
|                                 | Hold the line        | Maintains existing use and interest.   |           |                        |                       | Feasible & considered further   |           |
|                                 | Managed Re-alignment | Loss of some asset & change of habitat.  |           |                        |                       | Feasible & considered further   |           |
| 12                              | Do Nothing           | Loss of asset & change of habitat  |           |                        |                       | Feasible & considered further   |           |
|                                 | Hold the line        | Maintains existing use and interest  |           |                        |                       | Feasible & considered further   |           |
|                                 | Managed Re-alignment | No obvious line to re-align to ⇒ effectively same as Do Nothing.   |           |                        |                       | Not considered further  |           |
| 5                               | Do Nothing           | Loss of asset & change of habitat  |           |                        |                       | Feasible & considered further   |           |
|                                 | Hold the line        | Maintains existing use and interest.   |           |                        |                       | Feasible & considered further   |           |
|                                 | Managed Re-alignment | No obvious line to re-align to ⇒ effectively same as Do Nothing.   |           |                        |                       | Not considered further  |           |
| 4                               | Do Nothing           | Loss of assets, change of habitat  |           |                        |                       | Feasible & considered further   |           |
|                                 | Hold the line        | Maintains existing use and interest.   |           |                        |                       | Feasible & considered further   |           |
|                                 | Managed Re-alignment | Loss of some assets, change of habitat. It may be possible to split into north and south sections.   |           |                        |                       | Feasible & considered further as an option to split into north & south sections |           |

## Summary and Preliminary Conclusions for Zone 2

The flood compartments in Zone 2 are relatively independent of each other, and can therefore be assessed on an individual basis. However, this section of the estuary contains significant areas of saltmarsh which are under threat from sea level rise. In examining this zone, this loss of important habitat has to be considered.

FC13 includes part of the village of Waldringfield, which if possible should be protected. The economic assessment of the FC is weighted heavily by this, with the option of Managed Re-alignment to a line protecting only the village being shown to be more economically beneficial than Holding the Line throughout.

FC 4 contains sufficient assets to justify Holding the Line on economic grounds. In addition, the potential increase in tidal volume caused by Doing Nothing to the compartment would be sufficient to significantly increase the cost of maintaining defences downstream. Although the high ground around Ramsholt means that the position of the channel would not be greatly changed at this location, the flow pattern and speeds further downstream in Zone 3 would be affected. It is likely that that present areas of erosion on defences in Zone 3 would migrate either up or downstream, to areas less well equipped to deal with erosional forces. To lessen this impact, it is possible to abandon only half of the defences – preferably those to the north – and construct a return wall back to the high ground which nearly splits the compartment. This would reduce defence costs by approximately half, whilst protecting the majority of the assets. In addition, this would provide a substantial area for environmental mitigation. On balance, however, it is envisaged that the abandonment of any part of the compartment should be avoided unless absolutely necessary, as there are likely to be far more suitable areas for habitat mitigation elsewhere in the estuary.

FC5 covers only a small area of land, and has little potential to effect the rest of the estuary. Although there are no properties immediately at risk from flooding, a number of properties would lose access to the main road. In addition, there are two sites of rare habitats within the flood compartment. All these factors combine to give an initial preferred option of Hold the Line.

FC12 also covers only a small area of land. It too has little potential to effect the rest of the estuary. This area, however, could be used for environmental mitigation with only a small reduction in the Net Present Value of the overall estuary. Notwithstanding this, the initial preferred option for this FC is Do Nothing.

There is an extensive footpath network throughout Zone 2, running along a large proportion of both the past and present flood defences. Before a Do Nothing or Retreat strategy is implemented in a particular flood compartment, provision for alternative routes should be sought.

Table 5.2.2b Summary of Zone 2 Economic Assessments

| Option                  |        | 1   | 2                | 3                | 4  | 5                | 6                | 7   | 8                | 9   | 10               | 11               | 12               |
|-------------------------|--------|---|------------------|------------------|----|------------------|------------------|-----|------------------|-----|------------------|------------------|------------------|
| Flood Compartments      | 13     | DN  | HTL              | R                |    |                  |                  |     |                  |     |                  |                  |                  |
|                         | 12     |   |                  |                  | DN | HTL              | DDN              |     |                  |     |                  |                  |                  |
|                         | 5      |   |                  |                  |    |                  |                  | DN  | HTL              |     |                  |                  |                  |
|                         | 4      |   |                  |                  |    |                  |                  |     |                  | DN  | HTL              | HTL (N)          | HTL (S)          |
| Associated options      | Zone 1 | DN  | HTL <sup>1</sup> | HTL <sup>1</sup> | DN | HTL <sup>1</sup> | HTL <sup>1</sup> | DN  | HTL <sup>1</sup> | DN  | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> |
| PVc Costs<br>£ x1000    |        | 0   | 269              | 165              | 0  | 63               | 19               | 0   | 119              | 0   | 270              | 150              | 167              |
| PVd Damages<br>£ x1000  |        | 658   | 0                | 34               | 36 | 0                | 27               | 139 | 0                | 427 | 0                | 183              | 219              |
| PVb Benefits<br>£ x1000 |        | 0   | 658              | 624              | 0  | 36               | 9                | 0   | 139              | 0   | 427              | 244              | 208              |
| NPV<br>£ x1000          |        | 0   | 389              | 459              | 0  | -27              | -10              | 0   | 20               | 0   | 157              | 94               | 41               |
| Notes                   | 1      | The OVERALL option is HTL, but individual FC's may be DN or DDN. These, however, are sufficiently small to be ignored |                  |                  |    |                  |                  |     |                  |     |                  |                  |                  |

### ZONE 3. LOWER REACHES Hemley to Bawdsey

This zone comprises the lower reaches of the Deben estuary where the river channel becomes more restricted by the banks, and its meander increases in length. It extends from the promontory at Ramsholt Lodge to the mouth of the estuary at Felixstowe Ferry. Within the zone there are eight flood compartments, which can be split into two sub-zones depending on the degree of interaction between compartments. At the upstream end there is FC11, 3 and 2 at Hemley, Ramsholt Lodge and Ramsholt respectively; and along the main length of the channel there is FC 1, 10, 9, 8 and 7 at Bawdsey, Nursery Wood, Falkenham and Felixstowe Ferry north and south respectively (Figure 5.1).

Table 5.2.3a provides a general summary of the attributes and economic assessments of the zone.

FCs 11, 3 and 2 are not viewed as being critical to the overall strategy for the estuary, being both small in area and distant from the main river channel. They are therefore considered in isolation.

1. Do Nothing in FC11
2. Hold the Line in FC11
3. Do Nothing in FC3
4. Hold the Line in FC3
5. Delay Do Nothing in FC3
6. Do Nothing in FC2
7. Hold the Line in FC2
8. Delay Do Nothing in FC2

FCs 10, 9, 8, 7 and 1, however, are far more interactive, sharing a substantial length of river channel. The effective management strategy for a single unit is greatly dependant on the management of its neighbours.

9. Do Nothing in FC1
10. Hold the Line in FC1 (associated with HTL in Zone 3 West)
11. Hold the Line in FC1 (associated with DN in Zone 3 West)
12. Managed Re-alignment in FC1
13. Do Nothing in FCs 10, 9, 8 & 7
14. Hold the Line in FCs 10, 9, 8 & 7 (associated with HTL in Zone 3 East)
15. Hold the Line in FCs 10, 9, 8 & 7 (associated with DN in Zone 3 East)
16. Do Nothing in FC 10; Hold the Line in FCs 9, 8 & 7 (with HTL in Zone 3 East)
17. Delay Do Nothing in FC 10; Hold the Line in FCs 9, 8 & 7 (with HTL in Zone 3 East)
18. Do Nothing in FCs 10 & 9; Hold the Line in FCs 8 & 7 (with HTL in Zone 3 East)
19. Do Nothing in FCs 10 & 9; Hold the Line in FCs 8 & 7 (with DN in Zone 3 East)
20. Delay Do Nothing in FCs 10 & 9; Hold the Line in FCs 8 & 7 (with HTL in Zone 3 East)

Tables 5.2.3b/c provide a summary of the economic assessment for this zone.

Table 5.2.3a General Summary of Zone 3

| Zone 3                          |                      | Lower Reaches   |           |                        | Ch 11.0 km                    |           |           |
|---------------------------------|----------------------|---|-----------|------------------------|-------------------------------|-----------|-----------|
| <b>Physical Attributes</b>      |                      |   |           |                        |                               |           |           |
| <u>Description:</u>             |                      | Wide meandering channel, mostly flanked by earth embankments, protecting extensive flood plains. Mouth of river restricted in width & depth.                        |           |                        |                               |           |           |
| <u>Critical Influences:</u>     |                      | Current processes & future sea level rise, possibly resulting in elongation of the meander, will increase pressure on defences throughout zone.                     |           |                        |                               |           |           |
| <u>Controls and Constraints</u> |                      | High ground near Ramsholt Lodge & hard defences at estuary mouth control upstream & downstream limits. In between, clay banks currently constrain alignment.        |           |                        |                               |           |           |
| <u>Present Pressures</u>        |                      | Local pressure points just upstream of apex of bend, on the inside of bend  |           |                        |                               |           |           |
| <u>Potential Impacts</u>        |                      | Large increase in tidal volume if defences fail. Likely to cause progressive failure, eventually leading to unsustainable pressure at estuary mouth.                |           |                        |                               |           |           |
| <u>Internal Interaction</u>     |                      | High degree of interaction. Constraining one bank increases flow & pressure against the other, but retreating banks increases flow & pressure at the estuary mouth. |           |                        |                               |           |           |
| <b>General Attributes</b>       |                      |   |           |                        |                               |           |           |
| <u>General</u>                  |                      | Narrow margins of saltmarsh & mudflat along most the channel. Majority of the built assets are at the estuary mouth.  |           |                        |                               |           |           |
| <u>Threats</u>                  |                      | Defences along the west bank are under increasing pressure. Increased flows threaten the form & use of the estuary mouth.   |           |                        |                               |           |           |
| <u>Opportunities</u>            |                      | Small isolated areas with potential for habitat recreation upstream. Further downstream, more potential for larger schemes, particularly on the west bank           |           |                        |                               |           |           |
| Local Assessment                |                      |   |           |                        |                               |           |           |
| Flood compartment (FC)          |                      | Length  | Area (ha) | Actual Value of Assets | Defence                       |           | Adjoining |
|                                 |                      |   |           |                        | Type                          | Condition |           |
| 11                              | Hemley               | 440   | 51        | £323k                  | clay bank & revetment         | fair      | -         |
| 3                               | Ramsholt Lodge       | 750   | 10        | £92k                   | clay bank                     | fair      | -         |
| 2                               | Ramsholt             | 520   | 10        | £188k                  | clay bank                     | fair      | -         |
| 1                               | Bawdsey              | 4760  | 520       | £6,670k                | Clay bank & sheet piles       | fair/poor | -         |
| 10                              | Nursery Wood         | 2500  | 124       | £877k                  | clay bank & revetment         | poor      | 9         |
| 9                               | Falkenham            | 3000  | 229       | £2,103k                | clay bank                     | fair/poor | 10, 8     |
| 8                               | Felixstowe Ferry (N) | 900   | 248       | £2,131k                | clay bank                     | good      | 9, 7      |
| 7                               | Felixstowe Ferry (S) | 500   | 30        | £4,076k                | Clay bank & sheet piles       | fair/poor | 8         |
| FC                              | Option               | Comment   |           |                        |                               |           |           |
| 11                              | Do Nothing           | Loss of significant asset & change of habitat.  |           |                        | Feasible & considered further |           |           |
|                                 | Hold the line        | Maintains existing use and interest.  |           |                        | Feasible & considered further |           |           |
|                                 | Managed Re-alignment | Assets distributed evenly throughout area. No obvious line of re-align.   |           |                        | Not considered further        |           |           |
| 3                               | Do Nothing           | Loss of asset & change of habitat   |           |                        | Feasible & considered further |           |           |
|                                 | Hold the line        | Maintains existing use and interest   |           |                        | Feasible & considered further |           |           |
|                                 | Managed Re-alignment | No obvious line to re-align to ⇒ effectively same as Do Nothing.  |           |                        | Not considered further        |           |           |
| 2                               | Do Nothing           | Loss of asset & change of habitat   |           |                        | Feasible & considered further |           |           |
|                                 | Hold the line        | Maintains existing use and interest.  |           |                        | Feasible & considered further |           |           |
|                                 | Managed Re-alignment | No obvious line to re-align to ⇒ effectively same as Do Nothing.  |           |                        | Not considered further        |           |           |
| 1                               | Do Nothing           | Loss of significant assets, change of habitat   |           |                        | Feasible & considered further |           |           |
|                                 | Hold the line        | Maintains existing use and interest.  |           |                        | Feasible & considered further |           |           |
|                                 | Managed Re-alignment | Main property assets on boundary of FC. Loss of agricultural land.  |           |                        | Feasible & considered further |           |           |

Table continued.....



| FC | Option                      | Comment   |                                |
|----|-----------------------------|---|--------------------------------|
| 10 | <i>Do Nothing</i>           | Loss of asset & change of habitat.  | Feasible & considered further  |
|    | <i>Hold the line</i>        | Maintains existing use and interest.  | Feasible & considered further  |
|    | <i>Managed Re-alignment</i> | Re-align to high ground $\Rightarrow$ effectively DN, with additional work in FC9 | Considered as an option in FC9 |
| 9  | <i>Do Nothing</i>           | Loss of significant asset & change of habitat.                                    | Feasible & considered further  |
|    | <i>Hold the line</i>        | Maintains existing use and interest.  | Feasible & considered further  |
|    | <i>Managed Re-alignment</i> | Assets distributed evenly throughout area. No obvious line of re-align.           | Not considered further         |
| 8  | <i>Do Nothing</i>           | Loss of significant asset & change of habitat.                                    | Feasible & considered further  |
|    | <i>Hold the line</i>        | Maintains existing use and interest.  | Feasible & considered further  |
|    | <i>Managed Re-alignment</i> | Assets distributed evenly throughout area. No obvious line of re-align.           | Not considered further         |
| 7  | <i>Do Nothing</i>           | Loss of significant asset & change of habitat.                                    | Feasible & considered further  |
|    | <i>Hold the line</i>        | Maintains existing use and interest.  | Feasible & considered further  |
|    | <i>Managed Re-alignment</i> | Major assets along river frontage $\Rightarrow$ re-align would lose these         | Not considered further         |

### Summary and Preliminary Conclusions for Zone 3

There is a high degree of interaction and inter-dependence between flood compartments in this zone. The management of FCs 1, 7, 8, 9 and 10 should be considered as a single issue. The remaining compartments are more isolated.

In FC11 Hold the Line is the most logical option, with the compartment having such a short river frontage, which is sheltered from the main river.

In FCs 3 and 2 there is little economic justification for undertaking any work, with both Hold the Line and Delay Do Nothing having negative Net Present Values. The physical effect of Doing Nothing to these defences would be minimal, with the main river channel being hard up against the opposite bank, and with such small areas being involved. Once again, the Do Nothing option would also allow for environmental mitigation.

There is a certain degree of conflict in defending both the east and west banks along FCs 1, 7, 8, 9 and 10, in the lower reaches of the estuary. The land at risk behind the defences covers a large area and extends a long way inland, and contains a number of properties. There is therefore considerable justification for defending both sides. In addition, the physical impacts of Do Nothing are dramatic, with a likelihood the estuary mouth being unable to retain its current form.

As an alternative, Holding the Line throughout these compartments would retain the current form of the estuary mouth, and protect the assets in the hinterland. Although this would increase the effort required to maintain and replace the defences, the option is economically viable. It would, however, result in a loss of designated habitat, with no allowance for mitigation.

Most of the compartments along this stretch of river are sufficiently large in area to cause problems at the river mouth if they were abandoned, and do not offer a realistic line of retreat. By Doing Nothing to FC10, however, it is possible to re-align by extending the existing embankment between it and FC9. This would set aside a significant area of land for environmental mitigation, but would not increase tidal volumes enough to seriously threaten the defences at the river mouth. Continuity of the public right of way along the frontage must be considered in the development of such a solution. This option has been shown to be the preferred solution on an economic basis.

Table 5.2.3b Summary of Zone 3 (Upper) Economic Assessments

| Option                  |         | 1   | 2                | 3  | 4                | 5                | 6   | 7                | 8                |
|-------------------------|---------|---|------------------|----|------------------|------------------|-----|------------------|------------------|
| Flood Compartments      | 11      | DN  | HTL              |    |                  |                  |     |                  |                  |
|                         | 3       |   |                  | DN | HTL              | DDN              |     |                  |                  |
|                         | 2       |   |                  |    |                  |                  | DN  | HTL              | DDN              |
| Associated options      | Zone 1  | DN  | HTL <sup>1</sup> | DN | HTL <sup>1</sup> | HTL <sup>1</sup> | DN  | HTL <sup>1</sup> | HTL <sup>1</sup> |
|                         | Zone 2  | DN  | HTL <sup>1</sup> | DN | HTL <sup>1</sup> | HTL <sup>1</sup> | DN  | HTL <sup>1</sup> | HTL <sup>1</sup> |
|                         | Zone 3E | DN  | HTL <sup>2</sup> | DN | HTL <sup>2</sup> | HTL <sup>2</sup> | DN  | HTL <sup>2</sup> | HTL <sup>2</sup> |
| PVc Costs<br>£ x1000    |         | 0   | 121              | 0  | 235              | 73               | 0   | 163              | 50               |
| PVd Damages<br>£ x1000  |         | 135   | 0                | 51 | 0                | 38               | 105 | 0                | 79               |
| PVb Benefits<br>£ x1000 |         | 0   | 135              | 0  | 51               | 13               | 0   | 105              | 26               |
| NPV<br>£ x1000          |         | 0   | 14               | 0  | -184             | -60              | 0   | -58              | -24              |
| Notes                   | 1       | The OVERALL option is HTL, but individual FC's may be DN or DDN. These, however, are sufficiently small to be ignored<br>The OVERALL option is HTL, but this is dominated by FC1 which is far greater than the other FCs in the zone. The DN or R options may be applied to these smaller FCs with no effect on the overall option. |                  |    |                  |                  |     |                  |                  |
|                         | 2       |   |                  |    |                  |                  |     |                  |                  |

Table 5.2.3c Summary of Zone 3 (Lower) Economic Assessments

| Option                  |            | 9   | 10               | 11               | 12               | 13   | 14               | 15               | 16               | 17               | 18               | 19               | 20               |
|-------------------------|------------|---|------------------|------------------|------------------|------|------------------|------------------|------------------|------------------|------------------|------------------|------------------|
| Flood Compartments      | 1          | DN  | HTL1             | HTL2             | R                |      |                  |                  |                  |                  |                  |                  |                  |
|                         | 10         |   |                  |                  |                  | DN   | HTL              | HTL              | DN               | DDN              | DN               | DN               | DDN              |
|                         | 9          |   |                  |                  |                  | DN   | HTL              | HTL              | HTL              | HTL              | DN               | DN               | DDN              |
|                         | 8          |   |                  |                  |                  | DN   | HTL              | HTL              | HTL              | HTL              | HTL              | HTL              | HTL              |
|                         | 7          |   |                  |                  |                  | DN   | HTL              | HTL              | HTL              | HTL              | HTL              | HTL              | HTL              |
| Associated options      | Zone 1     | DN  | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | DN   | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> |
|                         | Zone 2     | DN  | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | DN   | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> | HTL <sup>1</sup> |
|                         | Zone 3 (W) | DN  | HTL <sup>2</sup> | DN               | HTL <sup>3</sup> |      |                  |                  |                  |                  |                  |                  |                  |
|                         | Zone 3 (E) |   |                  |                  |                  | DN   | HTL <sup>2</sup> | DN               | HTL <sup>2</sup> | HTL <sup>2</sup> | HTL <sup>2</sup> | DN               | HTL <sup>2</sup> |
| PVc Costs<br>£ x1000    |            | 0   | 1304             | 1170             | 894              | 0    | 2193             | 2134             | 1675             | 1962             | 1333             | 1369             | 1953             |
| PVd Damages<br>£ x1000  |            | 2801  | 0                | 0                | 1032             | 5156 | 0                | 0                | 389              | 288              | 1574             | 1574             | 1176             |
| PVb Benefits<br>£ x1000 |            | 0   | 2801             | 2801             | 1769             | 0    | 5156             | 5156             | 4767             | 4869             | 3582             | 3582             | 3980             |
| NPV<br>£ x1000          |            | 0   | 1497             | 1631             | 875              | 0    | 2963             | 3022             | 3092             | 2907             | 2249             | 2213             | 2027             |
| Notes                   | 1          | The OVERALL option is HTL, but individual FC's may be DN or DDN. These, however, are sufficiently small to be ignored           |                  |                  |                  |      |                  |                  |                  |                  |                  |                  |                  |
|                         | 2          | The OVERALL option is HTL, although FCs 9 & 10 may be DN. This option is therefore an upper bound, or most favourable situation |                  |                  |                  |      |                  |                  |                  |                  |                  |                  |                  |
|                         | 3          | The Managed Re-alignment of FC1 would negate the influence of Zone 3 West   |                  |                  |                  |      |                  |                  |                  |                  |                  |                  |                  |

## THE SHORELINE

The mouth of the River Deben joins the sea at Felixstowe Ferry. To the North a continuation of the southwards longshore transport system has created a series of offshore sandbanks. These evolve in a cyclic process which is heavily influenced by the flow from the river, which serves to deflect the transport from its longshore course. The banks build up over a period of time, gradually becoming more unstable, before a storm event drives material across the channel and onto the Felixstowe Ferry frontage. The cycle then begins again.

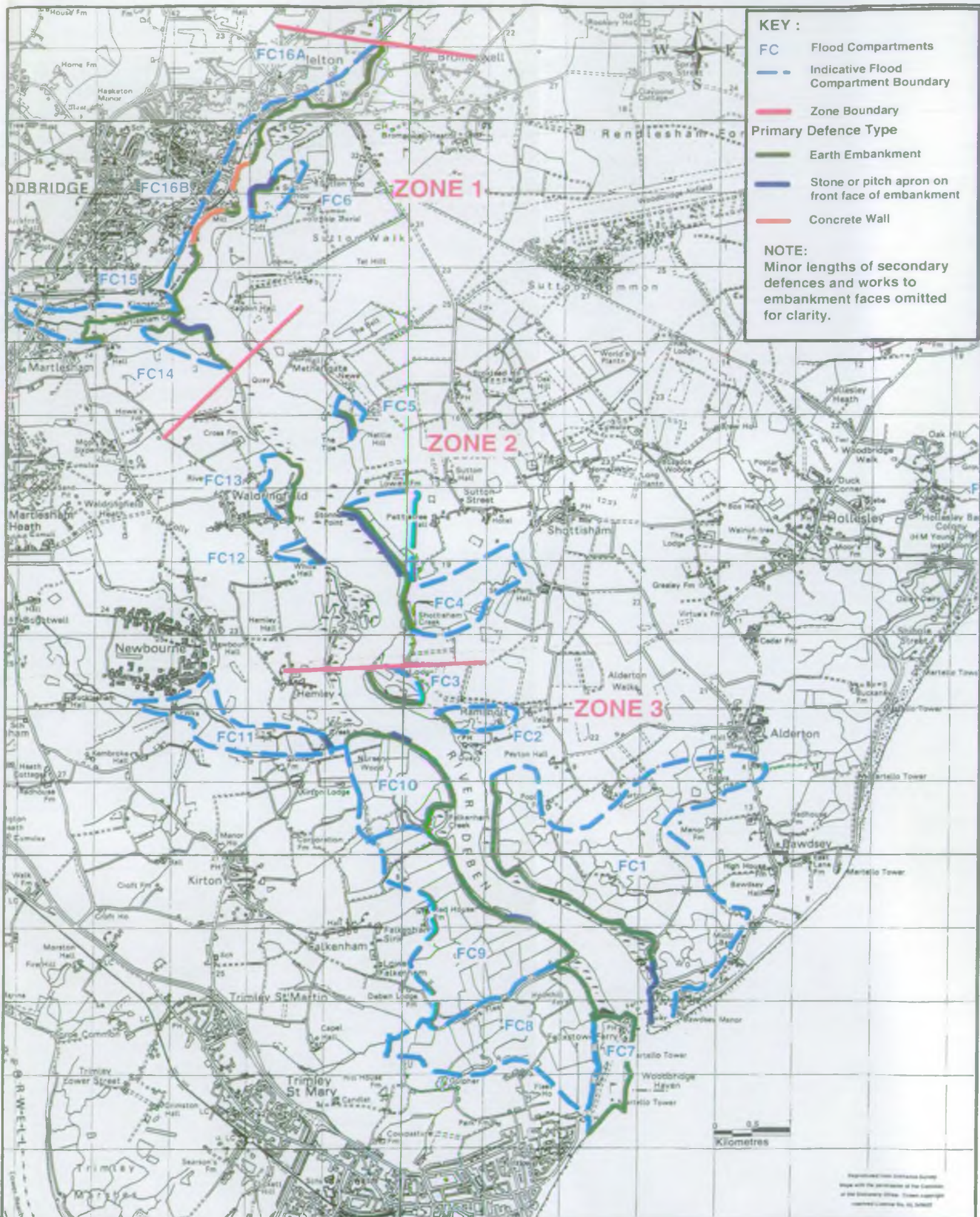
Increased flows from the estuary will result in an increase in current velocity and power at the mouth, which will have an effect on the evolution of these banks, and on the Felixstowe Ferry frontage.

An increased flow from the estuary is most likely to inhibit the initial development of the banks or, failing that, make the developing banks more susceptible to being broken up at an earlier stage in their evolution. The material removed from them is also likely to be deposited further away from the estuary mouth, downdrift towards Felixstowe. This would lead to a shortage of beach material, and therefore to an increasing problem from erosion, along the Felixstowe Ferry frontage.









ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2



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## DEBEN ESTUARY FLOOD COMPARTMENTS AND ZONES

FIGURE 5.1





## 5.3 DEVELOPMENT OF ESTUARY STRATEGY

### 5.3.1 Vision for the Estuary

The analysis in Section 5.2 has been developed on the basis of individual estuary zones. This section (5.3) of the report draws together the local conclusions, building up a strategy for the estuary as a whole. This recognises that impacts can extend over much of the estuary; a local option can give rise to a substantial increase in tidal volume or result in the loss of a specific feature of use or environmental interest, which then may be of significant strategic importance for the estuary's overall management.

Various issues have been identified, such as the loss of habitat or the opportunity for habitat gain or the importance of estuary use, and the transfer of cost from one area of the estuary to another. These issues need to be balanced to achieve a strategy in-line with the overall aim for the estuary:

*"To develop a strategy for flood defence which maintains or, where possible, improves the overall balance of the estuary in terms of its natural and human environment, its use and recreational value and economic interests, while minimising the dependence of this balance on flood defence expenditure."*

The estuary is at present heavily managed, and it is clear that the interests and uses of the estuary cannot be sustained unless a strong degree of management is continued. With care this is feasible over the fifty years of the strategy (and beyond), given the probable rate of sea level rise assumed in the study and assuming a recognition that areas of stress within the estuary must be appropriately dealt with.

There is little scope for allowing a fully "natural" evolution of the estuary, without total disregard for its use. This cannot, however, give "carte blanche" for maintaining defences wholesale throughout the estuary. Such an approach would ignore the increasing areas of pressure and would erroneously encourage an evolution of use, with a false sense of security, reliant upon defences and a form of estuary which could not be sustained into the future.

A balance must be struck and the key factors, apparent from the analysis for the Deben, are that:

The volume increase of the estuary must be controlled, together with the way in which this impacts upon and is influenced by the interaction with the coast.

The pressures, both man made and natural, on the environment must be recognised and a balanced and adequate habitat resource must be built into the strategy in a sustainable manner.

The significant social, cultural and economic value of the estuary must be maintained, in particular with respect to estuary use and the settlements.

Endeavouring to achieve this balance encapsulates the vision from which to examine and develop the strategy for the estuary and provides intent in the subsequent implementation guidance presented in this report.

### 5.3.2 Approach

The analysis in Section S.2 has been on the basis of individual estuary zones. This section of the report draws together the local conclusions, building up a strategy for the estuary as a whole.

Various issues have been identified, such as the loss of habitat or the opportunity for habitat gain, and the transfer of cost from one area of the estuary to another. These issues need to be balanced to achieve a strategy in-line with the overall aim for the estuary. In some cases these impacts only extend between adjacent zones, for example, the additional cost of defence where an adjacent flood compartment has been abandoned. In other cases, the impact extends over much of the estuary, as in the situation where a local option gives rise to a substantial increase in tidal volume or results in the loss of a specific feature of use or environmental interest.

In total four estuary strategy options are considered ranging from Do Nothing throughout the estuary to Hold the Line. Neither Do Nothing nor Hold the Line are compatible with the aim for the estuary. They are, however, the benchmarks from which to compare other options.

As with the approach adopted in assessing options for the flood compartments and the zones, it is neither sensible nor constructive to range through every possible alternative option for the overall strategy. Some zone options are obviously mutually exclusive and equally, as previously identified, there are issues of a relatively local nature. In strategic terms the main areas of contention focus around:

- The need to ensure that any increase in tidal volume in the estuary as a whole does not result in a major disruption of the coastal processes and in particular does not result in the destruction of the estuary mouth. (The more local impact of increase in tidal volume at locations within the estuary have as far as possible been taken into account during the assessment of each zone.)
- The need to minimise the economic damage while also reducing the cost of future work on defences.

### 5.3.3 Strategy Options

The four strategy options are:

- S1**            **Do Nothing throughout the estuary.** (This provides the economic baseline for the comparison of other options.)
- S2**            **Hold the Line to every flood compartment.** (This option provides a baseline on defence costs.)
- S3**            **Strategic Hold the Line.** (This option removes clearly uneconomic flood compartments from the economic assessment.)
- S4**            **Maximise NPV and reduce environmental impacts.** (This option allows some marginal flood compartments to be abandoned, slightly increasing the NPV for the overall estuary and creating a potential site for saltwater habitat mitigation, whilst limiting the future burden on defences at the estuary mouth.)

Table 5.3 summarises the policies which would apply to each flood compartment based on these four options. Table 5.4 considers the environmental impacts and opportunities in each option, and carries out an environmental audit. Table 5.5 summarises the economic assessment for each option.



Table 5.3 Summary of Strategic Options

| Strategy Options        |  | S1         | S2         | S3            | S4         |
|-------------------------|--|------------|------------|---------------|------------|
| Zone 1                  | (zone option)  | 1,4,6,8,10 | 2,5,7,9,11 | 3,5,7,9,10,11 | 3,5,6,9,10 |
|                         | FC16a Melton   | DN         | HTL        | DN            | DN         |
|                         | FC16b Woodbridge   | DN         | HTL        | HTL           | HTL        |
|                         | FC6 Sutton Hoo   | DN         | HTL        | HTL           | HTL        |
|                         | FC15 Martlesham Creek (north)  | DN         | HTL        | HTL           | HTL        |
|                         | FC14 Martlesham Creek (south)  | DN         | HTL        | DN            | DN         |
| Zone 2                  | (zone options)   | 1,4,7,9    | 2,5,8,10   | 3,4,7,10      | 3,4,7,10   |
|                         | FC13 Wadringfield  | DN         | HTL        | R             | R          |
|                         | FC12 White Hall  | DN         | HTL        | DN            | DN         |
|                         | FC5 Metersgate   | DN         | HTL        | HTL           | HTL        |
|                         | FC4 Shottisham   | DN         | HTL        | HTL           | HTL        |
| Zone 3 Upper            | (zone options)   | 1,3,6      | 2,4,7      | 2,3,6         | 2,3,6      |
|                         | FC11 Hemley  | DN         | HTL        | HTL           | HTL        |
|                         | FC3 Ramsholt Lodge   | DN         | HTL        | DN            | DN         |
|                         | FC2 Ramsholt   | DN         | HTL        | DN            | DN         |
| Zone 3 Lower            | (zone options)   | 9,13       | 10,14      | 10,14         | 10,16      |
|                         | FC1 Bawdsey  | DN         | HTL        | HTL           | HTL        |
|                         | FC10 Nursery Wood  | DN         | HTL        | HTL           | DN         |
|                         | FC9 Falkenham  | DN         | HTL        | HTL           | HTL        |
|                         | FC8 Felixstowe Ferry (north)   | DN         | HTL        | HTL           | HTL        |
|                         | FC7 Felixstowe Ferry (south)   | DN         | HTL        | HTL           | HTL        |
| Net Present Value (NPV) |  | 0          | £7,008,000 | £8,052,000    | £8,181,000 |
| Option S1               | Widespread economic damage, with repercussion throughout the region. Loss of use and loss of key habitats. Possible widening and realignment of the estuary mouth, and disruption to the coastal processes. This option is unacceptable and is rejected.   |            |            |               |            |
| Option S2               | Maintains existing use and freshwater interest in the estuary but with a substantial loss of intertidal habitat. Increasing and excessive cost of defence. This option is not sustainable economically or environmentally.   |            |            |               |            |
| Option S3               | Minimises the impact on the estuary regime while reducing cost of defence. Maintains the overall use of the estuary but with an increasing loss of intertidal habitat. Only limited areas of compensatory habitat. This option is sustainable over the period of the strategy but may not be sustainable in the longer term. |            |            |               |            |
| Option S4               | Maintains a balance of environmental interest with only slight increases in local impacts on the estuary regime, and in local defence commitment. This option is acceptable. This option appears to represent the best value for flood defence investment.   |            |            |               |            |

Key

|     |                  |     |                      |
|-----|------------------|-----|----------------------|
| DN  | Do Nothing       | R   | Managed Re-alignment |
| HTL | Delay Do Nothing | HTL | Hold the Line        |

Zone Options refer to the number of the option described in Section 5.2

Table 5.4 Summary of Environmental Impacts

| Likely Habitat Change due to Implementation of Strategy |  |         |        |        |
|---|--|---------|--------|--------|
| Strategy Options  | S1   | S2      | S3     | S4     |
| Intertidal Habitats                                     | +1392 ha   | - 95 ha | -6 ha  | +118   |
| Wetland Habitats  | - 28 ha  | Same    | -28 ha | -28 ha |
| Summary of Environmental Impacts                        |  |         |        |        |
| Option S1   | Would lead to large-scale ecological change as the former estuarine floodplain would effectively be re-instated. Area of intertidal habitat would increase by approximately 200%, with obvious benefits for ecological interests associated with this habitat type e.g. wintering waterfowl. Much of the former floodplain is in agricultural production with only small pockets of wetland habitat occupying some areas notably, Shottisham Creek and Ramsholt. Tidal inundation would result in the loss of all of these areas, although the potential exists for small areas of freshwater-brackish wetland habitat to form at the heads of the tributary streams. The large increase in tidal volume would lead to significant change at the mouth of the estuary. Disruption to the transport of nearshore sediment could lead to a large increase in the build up of shingle and sand, notably to the north of the estuary mouth. These new coastal formations could support dune and shingle communities. |         |        |        |
| Option S2   | Essentially the status quo with regard to existing habitats behind flood defences would be maintained. Hold the Line would provide opportunities for the creation of additional areas of freshwater grazing marsh and habitats such as reedbed where appropriate. However, this strategy would not be able to address the loss of saltmarsh habitat through the process of coastal squeeze, resulting in the loss of approximately 40-50% of saltmarsh in the estuary over the 50 year period covered by the strategy.   |         |        |        |
| Option S3   | The combination of Do Nothing and Retreat options would lead to the creation of some intertidal habitat. The total area could potentially offset the loss of saltmarsh/intertidal habitat through coastal squeeze over the 50 year period. However, this strategy would result in the loss of the only areas of wetland habitat adjacent to the estuary, including an area of species-rich lowland grassland at Methersgate. Maintenance of flood defences in the central and lower sections of the estuary could provide opportunities for wetland habitat creation. None of the wetland areas are designated SSSI or SPA but are all classified County Wildlife Sites.   |         |        |        |
| Option S4   | This Strategy differs from S3 in that the option for flood compartment FC10 would be to Do Nothing. This area is currently in arable production. This option would provide a relatively modest increase in the area of intertidal habitat within the estuary and would more than offset losses due to coastal squeeze. Existing areas of wetland habitat adjacent to the estuary would be lost.  |         |        |        |

Table 5.5 Summary of Economic Assessment

| Strategy Options |                               | S1                | S2                | S3                | S4                |
|------------------|-------------------------------|-------------------|-------------------|-------------------|-------------------|
| <b>COSTS</b>     |                               |                   |                   |                   |                   |
| Zone 1           | FC16a Melton                  | 0                 | 529,000           |                   |                   |
|                  | FC16b Woodbridge              | 0                 | 1,055,000         | 1,055,000         | 1,055,000         |
|                  | FC6 Sutton Hoo                | 0                 | 229,000           | 229,000           | 229,000           |
|                  | FC15 Martlesham Creek (north) | 0                 | 648,000           | 648,000           | 648,000           |
|                  | FC14 Martlesham Creek (south) | 0                 | 597,000           | 0                 | 0                 |
| Zone 2           | FC13 Wadringfield             | 0                 | 269,000           | 165,000           | 165,000           |
|                  | FC12 White Hall               | 0                 | 63,000            | 0                 | 0                 |
|                  | FC5 Metersgate                | 0                 | 119,000           | 119,000           | 119,000           |
|                  | FC4 Shottisham                | 0                 | 270,000           | 270,000           | 270,000           |
| Zone 3 Upper     | FC11 Hemley                   | 0                 | 121,000           | 121,000           | 121,000           |
|                  | FC3 Ramsholt Lodge            | 0                 | 235,000           | 0                 | 0                 |
|                  | FC2 Ramsholt                  | 0                 | 163,000           | 0                 | 0                 |
| Zone 3 Lower     | FC1 Bawdsey                   | 0                 | 1,304,000         | 1,304,000         | 1,304,000         |
|                  | FC10 Nursery Wood             |                   |                   |                   |                   |
|                  | FC9 Falkenham                 | 0                 | 2,193,000         | 2,193,000         | 1,675,000         |
|                  | FC8 Felixstowe Ferry (north)  |                   |                   |                   |                   |
|                  | FC7 Felixstowe Ferry (south)  |                   |                   |                   |                   |
| <b>TOTAL</b>     |                               | <b>0</b>          | <b>7,795,000</b>  | <b>6,268,000</b>  | <b>5,750,000</b>  |
| <b>DAMAGES</b>   |                               |                   |                   |                   |                   |
| Zone 1           | FC16a Melton                  | 279,000           | 0                 |                   |                   |
|                  | FC16b Woodbridge              | 2,191,000         | 0                 | 0                 | 0                 |
|                  | FC6 Sutton Hoo                | 1,739,000         | 0                 | 0                 | 0                 |
|                  | FC15 Martlesham Creek (north) | 1,038,000         | 0                 | 0                 | 0                 |
|                  | FC14 Martlesham Creek (south) | 48,000            | 0                 | 48,000            | 48,000            |
| Zone 2           | FC13 Wadringfield             | 658,000           | 0                 | 34,000            | 34,000            |
|                  | FC12 White Hall               | 36,000            | 0                 | 36,000            | 36,000            |
|                  | FC5 Metersgate                | 139,000           | 0                 | 0                 | 0                 |
|                  | FC4 Shottisham                | 427,000           | 0                 | 0                 | 0                 |
| Zone 3 Upper     | FC11 Hemley                   | 135,000           | 0                 | 0                 | 0                 |
|                  | FC3 Ramsholt Lodge            | 51,000            | 0                 | 51,000            | 51,000            |
|                  | FC2 Ramsholt                  | 105,000           | 0                 | 105,000           | 105,000           |
| Zone 3 Lower     | FC1 Bawdsey                   | 2,801,000         | 0                 | 0                 | 0                 |
|                  | FC10 Nursery Wood             |                   |                   |                   |                   |
|                  | FC9 Falkenham                 | 5,156,000         | 0                 | 0                 | 389,000           |
|                  | FC8 Felixstowe Ferry (north)  |                   |                   |                   |                   |
|                  | FC7 Felixstowe Ferry (south)  |                   |                   |                   |                   |
| <b>TOTAL</b>     |                               | <b>14,803,000</b> | <b>0</b>          | <b>483,000</b>    | <b>872,000</b>    |
| <b>BENEFIT</b>   |                               |                   | <b>14,803,000</b> | <b>14,320,000</b> | <b>13,931,000</b> |
| <b>NPV</b>       |                               |                   | <b>7,008,000</b>  | <b>8,052,000</b>  | <b>8,181,000</b>  |

### 5.3.4 Description Of Strategy Options

**Option S1** presents the basic Do Nothing case throughout the Estuary. This would result in the loss of the order of £14,803,000. This option would not meet the objectives for the strategy defined in Section 4. In particular there would be:

- Loss of important habitat significantly reducing the favourable conservation status of the SPA. There would be gain of mud flats and initially re-establishment of saltmarsh around the edge of the estuary. However, due to the steepening of the shore at higher tide levels this potential increase in salting would be subject to squeeze as sea level continues to rise.
- The use of the estuary would be disrupted, with the reaches around Felixstowe Ferry in particular becoming increasingly hazardous for any form of recreational use.
- The form of the estuary mouth would change, with the current restricted channel being unable to cope with the massive increases in tidal volume. This, in turn, would lead to the loss of properties in the vicinity of the estuary mouth.
- A massive impact on the local agricultural community, reflected also in the loss in terms of the national economy.
- There would be considerable change in the shoreline regime. In particular the evolutionary cycle of the banks offshore of the estuary mouth, and the mechanism of sediment transport across the mouth would be effected. This could have potentially serious consequences downdrift to the south of the estuary mouth along the Felixstowe frontage.

This option is clearly unacceptable, but provides the basis for comparison, in economic terms, of other options.

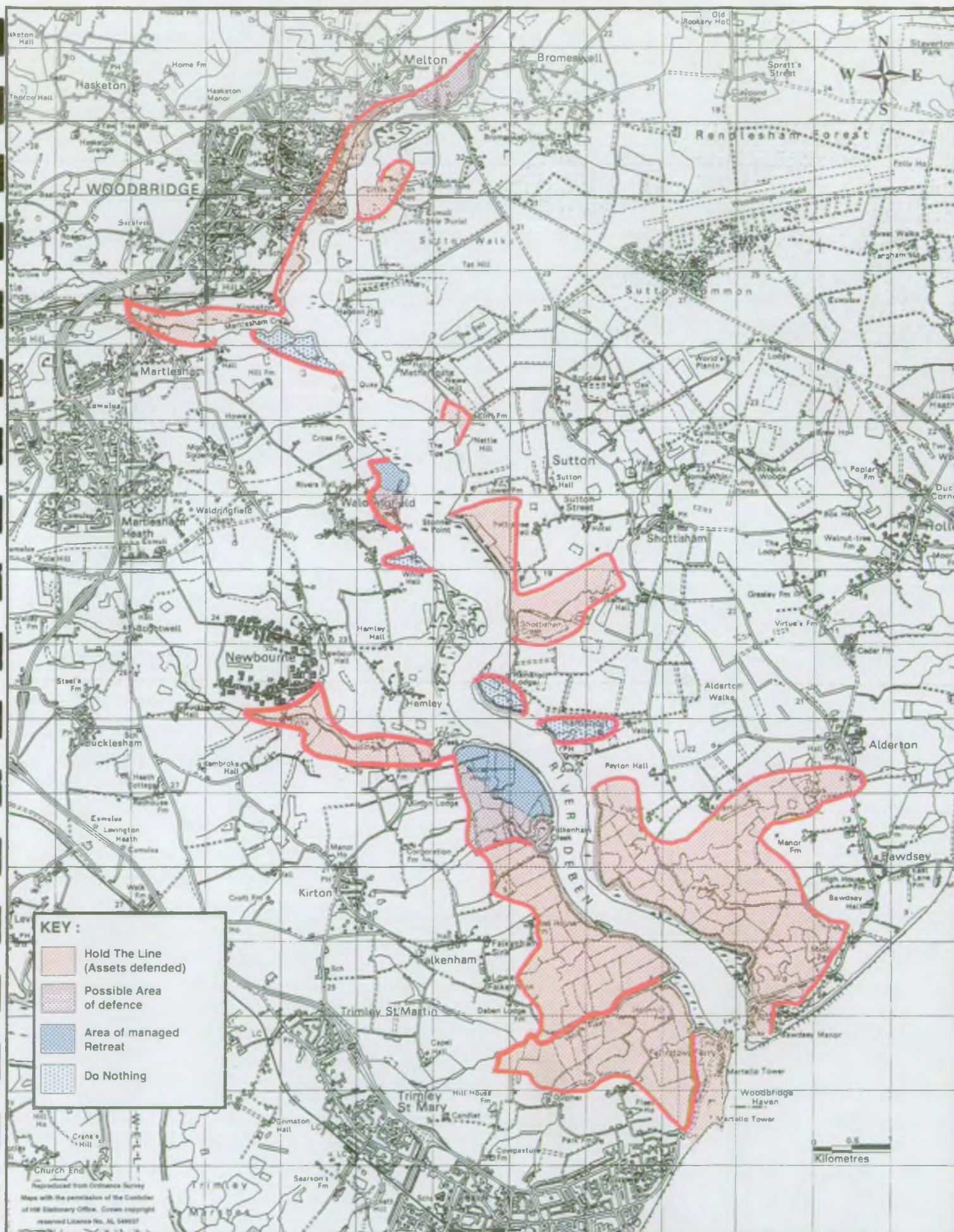
**Option S2** considers the other end of the defence spectrum, with the defences in all flood compartments being held. This takes no account of the non-viability of defending certain compartments, and should therefore not be the most beneficial option on an economic basis. The combined NPV of £7,008,000 suggests that Hold the Line is viable in this case. Under this option, however, there would be a substantial loss of mudflats and saltmarsh throughout the estuary. However, there has been no allowance for any environmental mitigation, which is required by the European Habitats Directive.

**Option S3** takes the appraisal one step further, by considering the most economically beneficial option for each compartment. In the lower reaches this is clouded somewhat by the interactive nature of the compartments, and so Hold the Line option is considered to be the baseline option for FCs 1, 7, 8, 9 and 10. The NPV of this option is around £8,052,000, making it more economically viable than Option S2. In addition, a number of small areas in the upper and middle reaches of the estuary will be available as potential sites of environmental mitigation. Care would have to be taken, however, to ensure the continuity of public footpaths in or around these areas.

**Option S4** considers the possibility of Holding the Line in the lower reaches (FCs 1, 7, 8 and 9) whilst Doing Nothing in FC10. This option would minimise the increase in pressure at the estuary mouth, whilst setting aside a considerable area for environmental mitigation. With an NPV of £8,181,000 this option is the most economically beneficial of those considered.

**Option S4** is, therefore, the preferred strategy, shown schematically on Figure 5.2, indicating the probable policies which would be adopted in any area.





ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2



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DEBEN ESTUARY  
RECOMMENDED  
MANAGEMENT STRATEGY

FIGURE 5.2





## SECTION 6

### CONCLUSIONS AND IMPLEMENTATION

#### 6.1 CONCLUSION

The study has examined the physical nature of the estuary, its use and the assets potentially at risk from it. There has been a strong message that with respect to its use and interest the estuary is in relative balance. It is clear, however, that that is not the case with respect to the physical behaviour of the estuary. There are several areas under extreme stress, with defence works hard up to the channel being undermined and other areas being severely eroded. Failure of defences, with the additional tidal volume this would create, together with sea level rise will increase pressure not only on the defences but also on the use of the channel for mooring and general boat use and on the coastal processes at the mouth of the estuary.

The principal issue has been shown to be the difficulty the estuary would have, in its present form, to respond to any substantial change in tidal volume, or indeed to be maintained effectively under the present pressure. This may be a result of the estuary adjusting following abandoning defences up to thirty years ago.

There are other issues relating to the high cost of maintaining certain areas of defence where, based solely on a local assessment of the economics, it would be hard to justify continuing to defend the potential flood areas.

There are, therefore, two main areas of concern. The first being that further Managed Re-alignment from lines of defence, particularly to some of the larger defended areas at the head of the estuary, would increase the tidal volume to such an extent that other areas lower down, as well as the bridges over the estuary may become excessively expensive to maintain.. The second is being the very real threat of rise in sea level. This phenomenon has the potential to increase tidal volumes generally through out the estuary by nearly 50% over the fifty year period of the strategy. Sea level rise will increase costs as the height of defences have to be raised in order that standards of defence are maintained.

The Strategy Study concludes that if a piecemeal approach is taken to the defence policy of flood compartments within the estuary then, by default, there will progressively be more difficulty in maintaining defences. Potentially, this will lead to abandonment and unmanaged change to the whole regime of the estuary and its interaction with the coast. The important natural environmental and human use interests of the estuary would suffer. Similarly, attempting to hold the line of defence throughout the estuary would be expensive and will also have a detrimental impact on the use and interest of the estuary. A mid course has to be struck.

The most cost effective option for dealing with defences throughout the estuary (based on the economic assessment of each estuary zone in isolation) would result in an increase in pressure on the entrance to the estuary and the coast. It is, however, considered to achieve the best balance between economic, environmental and social factors. This option, Option S4 discussed in Section 5, provides a framework whereby the key interests and uses of the estuary can be sustained.

There are still areas of uncertainty or areas where further discussion or investigation is needed, and in the light of this it is concluded that there needs to be a cautious approach to progressing the recommended strategy. The study presents a means by which policies can be adopted that are both flexible and in line with the overall strategy for the estuary. In this way the future policy for each area can be assessed, in a timeframe allowing for further investigation of the long term sustainability of the estuary and its defences.

The following section (Section 6.2) sets out the recommended short and long term strategy for each section of the estuary.

## 6.2 IMPLEMENTATION OF STRATEGY

As identified above there are certain areas where further work or discussion will be required to confirm, and if necessary, modify the preferred strategy for the long term management of defences throughout the estuary. It is, however, important, that in principle, the strategy is accepted so that future planning of estuary use and management of environmental interests can be progressed without compromising a sustainable approach to defence management. This section sets out, first in general terms, the main requirements for progressing the strategy, and then examines the way in which, at a more local level, it is proposed that the strategy be implemented.

### 6.2.1 General Implementation

It is recognised that there are certain areas of study being progressed at present, or that are likely to be undertaken in the near future, which may have an influence on the approach to the estuary. These include estuary research (such as the "Emphasys" programme), the survey of flood defences and CHaMPS. In addition, there are the planned updates or reviews of the Shoreline Management Plan. The proposed manner in which this information, and review of policies on allied issues, should be incorporated into the estuary strategy, both in the short term and over time, is shown in the overview programme presented in Figure 6.1a. The most immediate information will be that from the defence survey, the results of which must be used to update the anticipated programme for the strategy, and output of CHaMPS. In the latter case, there is a need for CHaMPS to take on board the findings of the estuary strategy and then to develop upon this a strategy for management of the estuary as a viable and sustainable eco-system. This, it is anticipated, will provide a more detailed audit of the ecological resource and provide a more specific target against which the environmental acceptability of the strategy outcome can be judged.

The strategy will need to be reviewed and potentially refined in light of this additional information.

The output of CHaMPS, and the defence survey, together with other factors potentially influencing the strategy will need to be monitored. The general policy for monitoring is discussed below.

#### Monitoring

The Environment Agency undertakes regular monitoring of the shoreline. It also undertakes regular inspection of its flood defences throughout the estuary. These are two critical areas of monitoring which must be continued to provide improved data on:

- The performance of 'The Knolls' and the estuary mouth in general. In particular from the point of view of the estuary behaviour the current profiles should be undertaken so as to monitor the beaches either side of the estuary, and the transfer of sediment.
- The condition and maintenance requirement of defences. A sensitive factor in assessing the economics for the defence of each flood compartment has been the cost of maintenance. An increase in maintenance requirements is a good indication of increasing pressure on defences and provides the most accurate way in which to determine the residual life of structures.

In addition to the above, there is a critical need for improving monitoring of tide level within

the estuary particularly on more extreme events. It is recognised that at present there is a considerable degree of uncertainty how extreme levels may vary within the estuary. Associated with this is the need to support monitoring of general sea level. The assumptions made within the report as to possible rates of sea level rise are critical to the findings of this study; an increasing rate beyond that already assumed would require the strategy to be reviewed with the intent of possibly reducing further the areas of defence which may be abandoned or re-aligned. A lower rate of sea level rise, while still being important, would be less critical in assessing the appropriate strategy. Other factors such as the present difficulty and expense of maintaining defences dictate, as much as the threat of sea level rise, the need to implement the proposed strategy. However, the rate of sea level rise in conjunction with improved information on the condition of defences will determine the time scale for implementing individual schemes within the strategy framework.

Sea level rise will also have a marked impact on coastal squeeze. Better monitoring procedures need to be put in place to track the loss or conversion of intertidal habitat throughout the estuary. This needs to be carried out on a more regular basis than at present and needs to be related to a specific monitoring of CHaMPS targets.

In all these areas there needs to be a co-ordination of information with a regular review process.

#### **6.2.2 Strategy Implementation and Programme**

Table 6.1 provides a summary breakdown of the recommended strategy and how this is implemented, both in the short and longer term in relation to individual flood compartments. This is expanded upon in the implementation guidance sheets included as Attachment 1 at the end of this section of the report. These sheets deal with each flood compartment, or coherent management group of flood compartments, on an individual basis, highlighting the strategic context from which the management of each compartment is derived. It also highlights local issues that have been raised during consultation and which must be considered when implementing the proposed policies of the strategy.

Figure 6.1b and Figure 6.2 present the strategy programme and a strategy decision pathway respectively. These attempt to draw together and highlight the main complexity of interactions discussed in section 5 and appendix A and define the basis for implementing the strategy at a local level. As stated earlier there is a recognition that the strategy must continue to evolve as further external information is incorporated. In addition, it is recognised, and shown in the figures, that at each stage there is a need to take stock of the way in which the strategy is developing and use the principals and constraints identified and discussed throughout the report to possibly redefine the next step.

The strategy programme (Figure 6.1b) is divided into two sections; the Strategic Development and the Detailed Appraisal. The former of these is subdivided into a section on Establishing Agreements and a section headed Strategic Studies. The various items identified are discussed below.

##### **Ongoing Consultation**

There are many parties involved with or with interests in the defence management of the estuary. These include, obviously, the Environment Agency, the Local Authorities and English Nature but extend to the parish and community councils, the internal drainage boards, individual land owners, RSPB and other environmental groups as well as various other societies. Management of the estuary, as stressed throughout the report, is a question of balance and fundamental to this is an understanding of issues and priorities. On going consultation and involvement is, therefore, a prerequisite for developing and implementing the strategy.

### **Establishing Agreements**

Resolving the problems of the Deben has called for quite a radical approach to the way in which benefits and impacts need to be viewed, and in the way in which aspects of the estuary ideally need to be re-organised so as to provide a more secure and sustainable framework for the future.

Certain assumptions, based on existing information and analysis and upon the results of the consultation process and therefore felt to be realistically robust, have had to be made in developing the strategy. In particular, assumptions have had to be made regarding the management of the natural environmental resource within the estuary, and also with respect to issues such as social acceptability of options and compliance of landowners. In addition the strategy has highlighted such issues as compensation where strategic benefit is gained at the loss to the individual. (Such issues as this are developed in the Addendum on consultation issues.)

The strategy provides a pragmatic way forward whilst still recognising that these issues can have a fundamental bearing on the strategy, potentially overturning certain decisions.

In the case of the Deben, the key issue surrounds the ability to maintain or enhance the balance of important freshwater and saltwater habitat in the estuary, through the managed realignment or abandonment of a number of sites along its length. From this comes the management of the estuary volume and flow, the reduction in existing defence pressure and the sustainability of the estuary mouth.

There are, immediately, several important issues identified, which must be addressed, at least in principle if the strategy is to progress along its proposed path. These issues are summarised on the programme (figure 6.1b) and in corresponding areas of the decision pathway (figure 6.2).

**The programme reflects the order both in which aspects need to be addressed, and the fact that negotiating agreements takes time. It identifies the priorities, which are driven by the need to confirm strategic policy before the condition of defences dictates a purely reactive response:**

- There must be sufficient confidence that the proposed realignment or abandonment of defences will satisfy the ecological requirements of the estuary, as identified in the CHaMPS findings. It must be confirmed that the proposed habitat, if managed correctly will be acceptable, that re-designation of the land is agreed in principle, and landowner agreements are in place, prior to making various decisions elsewhere in the estuary. This negotiation, although overseen and facilitated by the Environment Agency, will rely predominantly upon the co-operation of other estuary users.
- The next priority has to be examining, in a similar way, the basic agreements necessary for management of defences around the estuary mouth and lower reaches. This investigation too will develop in the light of the findings of the CHaMPS study. As part of this process, the physical processes at the estuary mouth and open coast interface will be investigated and reviewed. Findings from this will be used as a basis for the local appraisal of individual flood compartments.

Throughout this process it is important that sufficient flexibility is maintained within the implementation of the strategy so that the strategy, if necessary can be adapted to reflect further issues raised or opportunities created.



### Strategic Studies

There is one main area where further detailed information is required concerning the physical processes of the estuary:

- The detailed examination of the proposed Managed Re-alignment of the Waldringfield compartment (FC13). The intent of this Managed Re-alignment is to concentrate defence expenditure on areas which may be economically justified, whilst maximising the efficient use of available funds. The existing and potential flow pattern in this area needs to be examined in more detail, together with how best to realise the opportunities for intertidal habitat creation.

The programme and the pathway diagram aim to resolve this inevitable "chicken and egg" situation inherently associated with implementation of the strategy.

The strategic Development then feed into the mechanism for detailed appraisals.

### 6.2.3 Application of Strategy to Local Areas

Before examining the programme presented in figure 6.1b, there is a need to consider the practical mechanism by which the strategy can be implemented at the local level. Three mechanisms present themselves, of which two may be dismissed:

- **Detailed strategic appraisal.** This approach would attempt to progress the strategy directly to a detailed project appraisal for the whole estuary. Such an approach is considered to be impractical, failing to recognise the complexity of local issues, the time based uncertainties and the limitations of strategic level of analysis so far undertaken. In effect total (as in one off) management of the estuary is considered to be indeterminate. This approach to progressing the strategy is rejected.
- **Isolated local appraisal.** This approach, while appropriate where the strategy has identified a good degree of independence for certain defences, runs counter to the whole management concept; it is rejected.
- **Detailed appraisal within the context of an iteratively developing strategy.** This approach is proposed as the only sensible way forward. It is based on the understanding that the strategy itself will probably change over time as more detailed information is obtained externally, from the studies undertaken as part of the strategic development and from the detailed appraisals themselves. The approach therefore accepts the need to make decisions based on the concept of what the strategy provides at any particular time, even though that concept may change significantly. Accordingly, this approach accepts the need to consider, in some degree "what if" scenarios, so as to maintain as much future flexibility as possible, while still, however, making decisions rather than accepting a default of inaction.

The basic principle behind this approach is that in undertaking a detailed project appraisal, and in examining the technical, economic and environmental issues:

- a) The strategic policies defined for each defence within the estuary are assumed to apply in the future unless shown, by more detailed investigation, to be inappropriate. (e.g. When undertaking a detailed appraisal of compartment A, it is assumed that the strategic policy for defence B is as defined by the strategy, even though ultimately it may be shown that some other policy should be apply at B.) The sensitivity of key decisions as to the overall estuary management should, however, be examined.
- b) Local issues, those relating specifically to the defence in question, should be

examined in detail at a local level (i.e in the detail normally associated with a scheme based project appraisal).

- c) Impacts (beneficial or detrimental, ie. transfer impacts identified within the report) identified as potentially resulting from some specific defence policies should be revisited during a detailed project appraisal but at a strategic level and on the basis that the overall strategy applies. Again, this would be subject to any new more detailed information being available and to consideration of likely possible outcomes from any on going study or negotiation.
- d) Finally it is assumed rather obviously that the result of a detailed project appraisal and any information from an associated detailed examination is fed back into the strategy and if contrary to the anticipated strategy policy then the strategy is reviewed and, if necessary, revised.

Considering the programme in figure 6.1b it may be seen that the first project appraisal anticipated around the lower reaches of the estuary is that for Nursery Wood. Unless, there is evidence to the contrary, it would be assumed that the policies in the other compartments around the lower reaches would be Hold the Line. In no case, however, would this actually prescribe their future policy, but is used as a basis for evaluating the Nursery Woods reach.

The policy for Waldringfield would draw upon the detailed information provided by the study of the local area and upon the local discussion and consultation undertaken as part of the process of establishing agreements.

In both of these cases there is an assumption that issues concerning the ecological balance of the estuary, investigated as part of the CHaMPS study, have been resolved.

The strategy proposed by this report, summarised in Table 6.1 and discussed in more detail in the guidance sheets of Attachment 1, will develop and strengthen, while still providing flexibility and a sound framework from which to undertake proactive sustainable defence management of the Deben estuary.



**Table 6.1 Application of Recommended Strategy (S4) to Individual Flood Compartments**

| Flood Compartment                    | Short Term Policy | Key issues  | Long Term Policy     |            |
|--------------------------------------|-------------------|---|----------------------|------------|
|                                      |                   |   | Policy               | Time scale |
| FC16a – Melton                       | Hold the Line     | Monitor defence costs and maintenance requirements. Examine how Doing Nothing to defences can most appropriately be managed.  | Do Nothing           | 10 years   |
| FC16b – Woodbridge                   | Hold the Line     | Monitor defence costs and undertake detailed study of flow regime along the Woodbridge frontage.  | Hold the Line        | 30 years   |
| FC6 – Sutton Hoo                     | Hold the Line     | Monitor intertidal marsh development.   | Hold the Line        | 10 years   |
| FC15 – Martlesham Creek (north bank) | Hold the Line     | Monitor defence costs and condition of intertidal marsh. Consider the need to raise flood defence levels.   | Hold the Line        | 5 years    |
| FC14 – Martlesham Creek (south bank) | Do Nothing        | Review requirement for freshwater marsh relocation. Examine how Doing Nothing to defences can most appropriately be managed.  | Do Nothing           | 8 years    |
| FC13 – Waldringfield                 | Hold the Line     | Monitor defence costs and undertake detailed study of estuary regime. Undertake detailed economic analysis. Examine how Doing Nothing to defences, whilst retaining the protection to the village of Waldringfield can most appropriately be managed. | Managed re-alignment | 12 years   |
| FC12 – White Hall                    | Do Nothing        | Monitor intertidal marsh development.   | Do Nothing           | 10 years   |
| FC5 – Methersgate                    | Hold the Line     | Monitor defence costs and condition of protected freshwater habitats.   | Hold the Line        | 10 years   |
| FC4 – Shottisham                     | Hold the Line     | Undertaken detailed study of estuary regime. Undertake detailed economic analysis. Continue to defend shape of promontory.  | Hold the Line        | 20 years   |
| FC11 – Hemley                        | Hold the Line     | Monitor defence costs and condition of intertidal marsh.  | Hold the Line        | 20 years   |
| FC10 – Nursery Wood                  | Hold the Line     | Examine how Doing Nothing to defences can most appropriately be managed, to provide environmental opportunities.  | Managed re-alignment | 15 years   |
| FC9 – Falkenham                      | Hold the Line     | Monitor defence costs and condition of intertidal marsh.  | Hold the Line        | 15 years   |
| FC8 – Felixstowe Ferry (north)       | Hold the Line     | Monitor defence costs and condition of intertidal marsh.  | Hold the Line        | 20 years   |

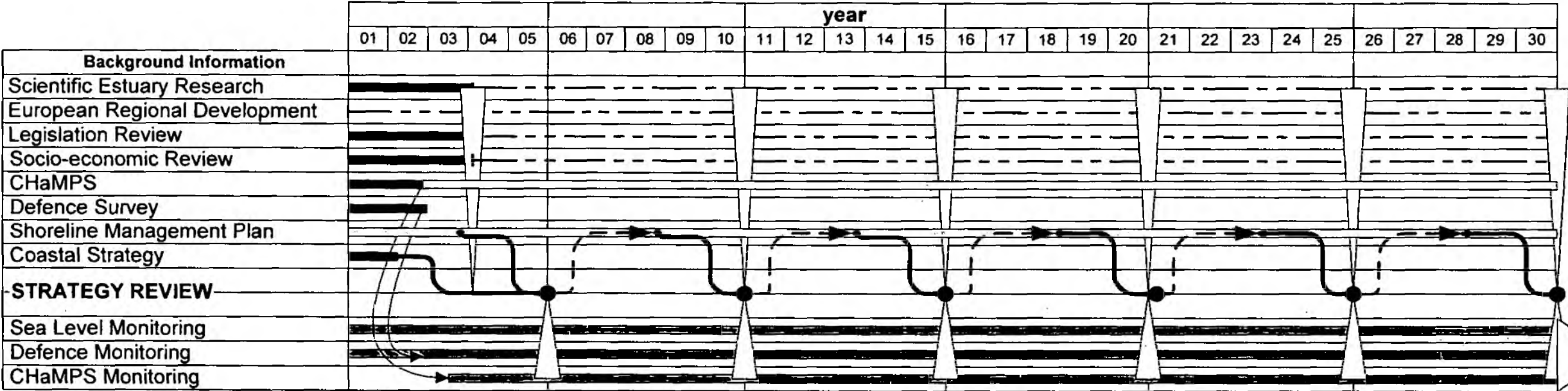
Table continued.....

| Flood Compartment              | Short Term Policy | Key Issues   | Long Term Policy |            |
|--------------------------------|-------------------|--|------------------|------------|
|                                |                   |  | Policy           | Time scale |
| FC7 – Felixstowe Ferry (south) | Hold the Line     | Monitor defence costs and condition of intertidal marsh. Review opportunities for local Managed Re-alignment.    | Hold the Line    | 15 years   |
| FC3 – Ramsholt Lodge           | Do Nothing        | Examine how Doing Nothing to defences can most appropriately be managed, to provide environmental opportunities. | Do Nothing       | 10 years   |
| FC2 – Ramsholt                 | Do Nothing        | Examine how Doing Nothing to defences can most appropriately be managed, to provide environmental opportunities. | Do Nothing       | 10 years   |
| FC1 – Bawdsey                  | Hold the Line     | Monitor defence costs and condition of intertidal marsh.   | Hold the Line    | 20 years   |

*NOTES: The time scale shown within the table is generally based on anticipated residual life, either with or without maintenance, depending on the proposed long term strategy. The time scale indicates the MAXIMUM time likely to be available in which to have made a final decision as to the long term future of the defence or before more major works are required to refurbish defences for the future. This time scale needs to be reviewed against defence monitoring.*



Overview Programme

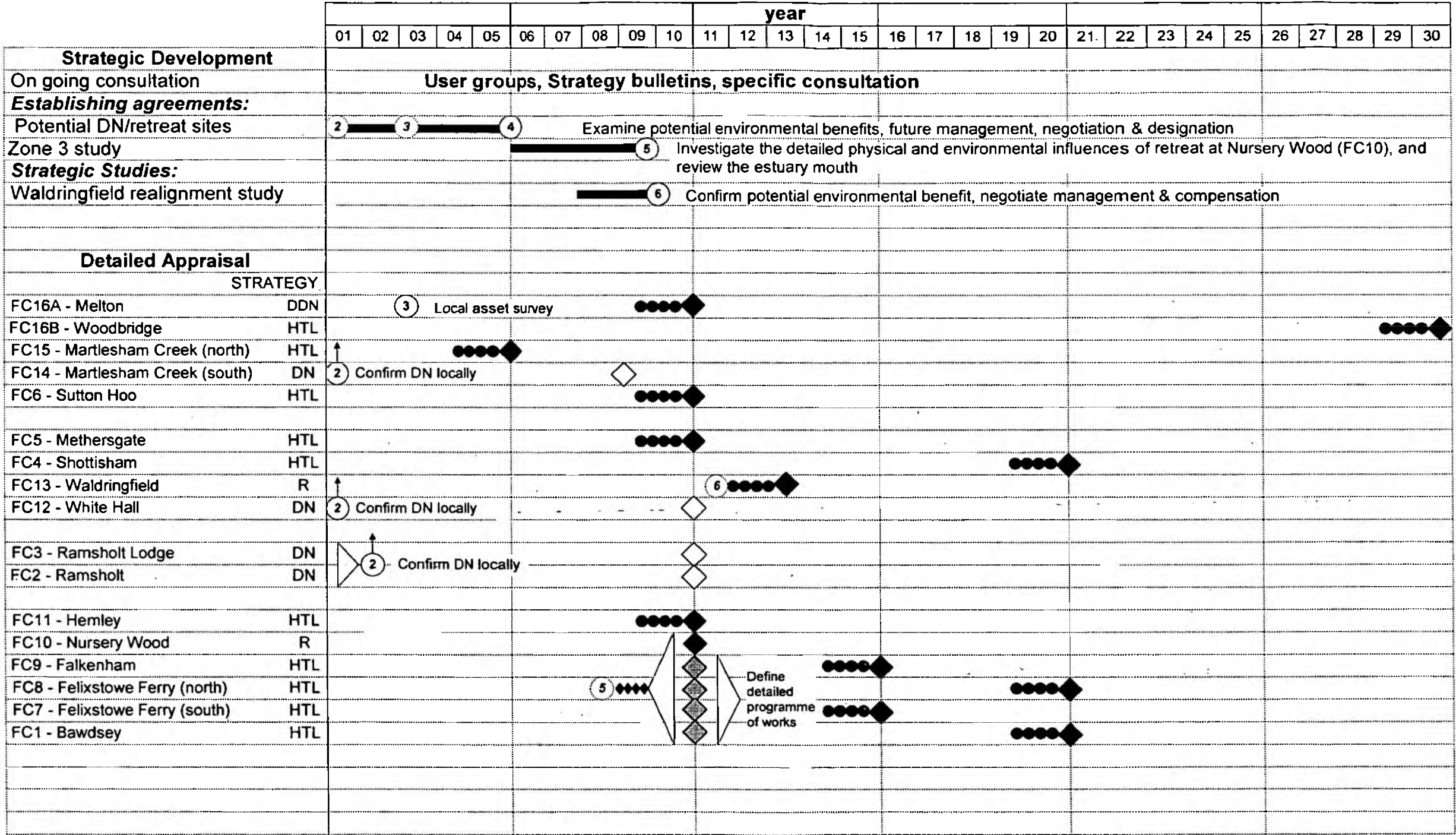


Timing of detailed studies and appraisals dependent on monitoring

Figure 6.1a



Strategy Programme - Deben



KEY

Anticipated deadline for works on flood compartment

Policy for flood compartment confirmed

Anticipated failure of abandon defences

Linked zone appraisal lead in

Local appraisal lead in

Reference Point (outcome):  
The outcome of this process will be used to influence other processes. [also shown on Figure 6.2]

Reference Point (input):  
This process will be influenced by the outcome of other processes as identified.

Strategy Key:

DN

Do Nothing

DDN

Delay Do Nothing

HTL

Hold the Line

R

Re-align defences

RD

Reduce defence standard

Figure 6.1b



# STRATEGY DECISION PATHWAY - Deben

Additional Data

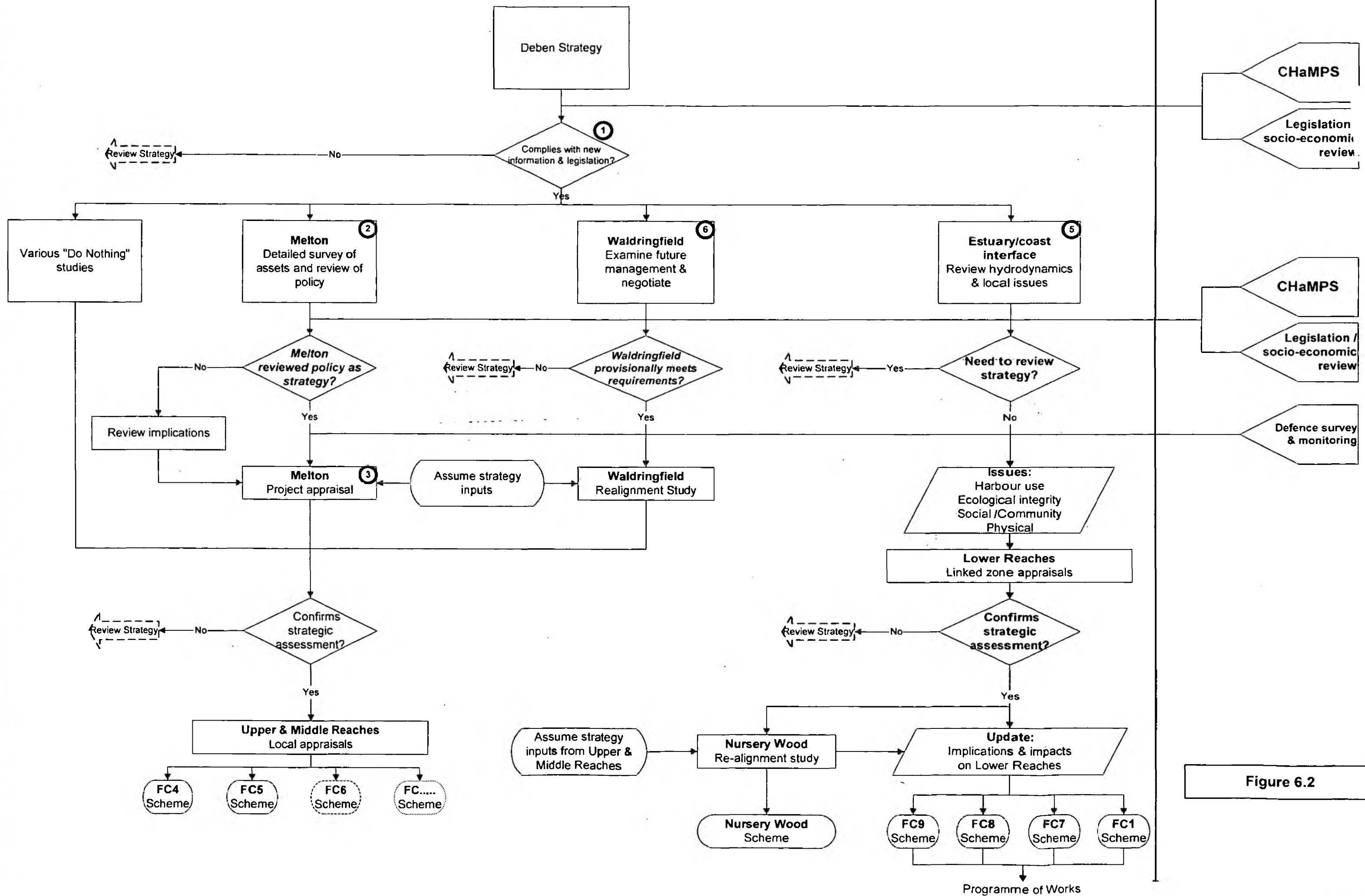


Figure 6.2





**ATTACHMENT 1**  
**FLOOD COMPARTMENT IMPLEMENTATION**  
**GUIDANCE SHEETS**



## ATTACHMENT 1

### Explanation And Discussion Of Guidance Tables.

The following tables are designed to provide guidance in identifying key issues relating to each flood compartment or group of flood compartments. The tables are based upon the strategy and strategy programme (Figure 6.1b) and decision pathway (Figure 6.2). The tables attempt also to assist in explaining the processes which are deemed necessary to further develop the strategy to implementation.

The tables are divided into three principal sections covering: the primary information on the compartment or group of compartments, the strategic context of these compartments and finally the management of local considerations (and implementation). All of these are supported with a plan of the specific geographical area under consideration.

Each section is explained and discussed below:

#### 1. Primary information

This section identifies the compartment or group, provides a simple description and identifies the length of defence and the extent of the area defended. These latter two attributes are important in appreciating such aspects as the typical magnitude of defence costs and the significance of impacts on the estuary, in terms of potential habitat change or increase in volume.

This section of the table also identifies, in terms of a simple priority indicator, the importance of dealing with the issues related to the compartment, raised by the strategy:

- **Priority three** indicates that the compartment or the impacts as a result of the policy for that compartment are not of major significance to the overall strategy. It may be that decisions can be deferred without influence on other areas of the strategy or that the policy for the compartment may in effect be considered in isolation from other decisions relating to the strategy as a whole.
- **Priority two** indicates a degree of importance as to the long-term policy for a compartment, in strategic terms, but indicates that the strategy may be progressed initially without this decision having been tested in detail. Typically, this priority is given in the situation where the policy is likely to be secure, where any detailed project appraisal is almost certain to confirm the strategic assessment and where the impacts, although potentially large, can be reasonably assumed to apply, when dealing with other areas of the estuary.
- **Priority one** indicates an urgency in addressing issues raised by the strategy; either because several other local policies may hang on the outcome of these issues or because defences are in poor condition or, ultimately, because the issue relating to the policy of defence is fundamental to the way in which the overall strategy has been developed.

#### 2. Strategic Context

This section, which is itself subdivided into three sections, attempts to elucidate on the thinking behind the strategy policy and upon the way in which issues relevant to the compartment, when examined in more detail, may influence the future implementation of the strategy.

**2.1 Strategy Policy** identifies the recommended future policy for the compartment (or group of compartments) based on the current understanding of the estuary and its interactions. The key issues, from a strategic point of view, are listed, together with flood compartments where there is interaction. The significance of this issue in strategic terms is assessed and notes provided supporting this. This explanation may best be expanded by examples:

- One of the principal areas of concern in developing the strategies is that of increased volume of the estuary as a result of abandoning defences. In smaller flood compartments this may not be a critical issue. In a larger compartment, or where there may be a significant cumulative effect, this issue becomes critical to the whole strategy of managing the estuary and the decision to hold the line of a defence becomes an essential factor in developing the policy for the compartment. The zones most affected by an increase in volume are where there is some constraint on the way in which the channel can evolve. These issues, summarised in the table, are discussed in more detail in the main text of the report and in Appendix A assessing each zone.
- The strategy attempts to establish a balance of defence investment, use and environmental resource. In table 5.4, in section 5 of the main report, an outline audit of habitat loss and gain under the preferred strategy is shown. This is based on a summation of the change in habitat resulting from the strategy policy for each compartment. It is recognised that an ideal balance is not always achieved and this whole balance has to be redefined as part of the CHaMPs process. In the case of the Deben and as a result of other issues, there is an apparent deficit of grazing marsh and a surfeit of intertidal habitat creation. In terms of the issues raised in this subsection of the table, habitat creation (or re-creation) is identified as a major issue. For some compartments, they are being defended, in part at least, so as to allow re-creation or re-location of important ecological interests. In such cases, this is considered critical in allowing the strategy to meet its aims. This is so indicated. In other cases, particularly in the case of the creation of intertidal areas, the significance of the policy is critical only if other areas where such re-creation is envisaged is not realised, (i.e. if all areas of potential intertidal gain were achieved there would be an apparent surfeit, if none were achieved there would be a deficit). The importance of any one compartment, therefore, in meeting this strategy aim, is conditional upon the detailed area of intertidal gain in other compartments. Other compartments, associated with this decision, are identified in the table.
- Economics and social impacts are also clearly important. On an individual basis, the defence of a compartment may, or may not, be economically sustainable. This issue may be economically significant but may not be critical to the development of the whole strategy; such a situation is identified in the table. It may, however, in the case of large productive compartments or in the case of compartments enclosing important cultural or social assets, be fundamental (or critical) to the aims of the achieving the correct balance within the estuary.

In each example given above the intent of the table is to highlight the key issues driving the policy recommended in the strategy. In implementing the strategy, and inevitably when some of these initial policies are questioned and reviewed, as more detailed information is obtained, these issues are the ones which must be addressed. Where the decision to retreat a defence is made purely on economic grounds, there may still be an argument that defence may still be undertaken, but not at public expense. Where a policy is conditionally critical to the overall aims of the strategy, then a final decision may have to be based upon the outcome of other negotiations or upon a choice between pursuing a policy in one area at the expense of some where else. Clearly, under such circumstances the question of strategic compensation may have to be addressed.

**2.2 Influence on Strategy** identifies issues which, if not satisfied, will almost certainly require either local or total review of the strategy. In this, it is recognised that the strategy relies on co-operation between various parties, as well as upon detail which has only been identified as part of the process of developing the strategies. This subsection identifies basic constraints relating to the individual compartments. Again by example:



- Several compartments include habitat designated as essential elements of the SPAs. Under legislation such assets cannot wilfully be destroyed unless there is excellent cause and unless adequate compensation is made with respect to the balance of habitat within the SPA. The strategy acknowledges this and builds within it realistic mechanisms for habitat re-creation where the policy is to abandon defence of designated habitat. However, in many cases, it is recognised that achieving this may be outside the control of any one responsible organisation and that a process of investigation and negotiation is needed before success could be confirmed. Should suitable re-creation not be achieved then there would need to be a review of the strategy. Despite this uncertainty, the principals behind developing the strategy remain and the recommended course of actions is considered to be the most appropriate way forward.
- Constraint issues can also apply to the use of the actual channel area of the estuary, or to areas where there is perceived to be significant impact on less tangible values such as landscape or cultural aspects of managing the estuary. In fact, to any area where there is a fundamental factor about which there is some degree of uncertainty or need for testing and clarification.

Clearly these constraint issues imply a degree of urgency in their resolution as they are important in determining the direction in which the strategy is heading. They are also recognised as often being areas where there will need to be further consultation, between the Environment Agency and interested groups, or between others with responsibilities for specific aspects of the estuary. The table identifies actions required to resolve these issues, and the programme and pathway diagrams (Figure 6.1 and 6.2) indicate where this fits into the overall programme such that other aspects of the strategy can still be progressed.

**2.3 Dependence on the Strategy** identifies issues where there tends to be some remote factor influencing the local policy for a flood compartment. While at the level of the project appraisal for any defence scheme the detailed economics and impacts relating to a section of defence can be, and needs to be, examined at a local and detailed level, there are other factors which need to be incorporated in some manner. Such factors may be the possible additional defence burden imposed on remote defences, or the impact remote defence policy may have on the local defences. As identified in section 6 of the main report, the general principle proposed is that in such cases, and until further investigation or information is obtained, the strategic assumptions should be held true. By example:

- In carrying out a detailed project appraisal on a defence such as Nursery Wood (in year 10), it should be assumed that the policy for adjacent areas (i.e. Falkenham and Felixstowe Ferry) is hold the Line. This, despite the fact that a detailed project appraisal may yet not have been undertaken on these areas. Therefore, in Nursery Wood's project appraisal the strategic need to defend FC7, 8 and 9 should be taken into account in looking at the detailed options.
- The strategy assumes that certain areas of defence will be retreated, increasing the flow further down the estuary. Additional defence costs will arise as a result of this. In appraising what action should be taken and what costs may ensue, the strategy policies and strategic assessment should be taken unless investigations have updated the strategy or provided more detailed information.

The table highlights key issues of this type and identifies the probable approach which can be adopted. Where the programme indicates that further relevant information should be available this is identified and the approach is to incorporate this data. Where no further information is likely to be available then the approach has to be that the assumptions made in the strategy should apply.

### **3. Management (Local Issues)**

This final section of the table highlights issues identified during the study or raised during consultation, which have a bearing on the management of the flood compartment but which are not strictly of a strategic nature. Such issues may for example relate to the need for archaeological survey work to be undertaken prior to loss of land, or to the need to consider important assets at the rear of a flood compartment, and hence the probable need to consider local defence action if the main line of defence is to be re aligned. It is unlikely that the list is exhaustive, detailed consultation would still be required to properly scope local concerns.

The section also briefly states the short term and longer term policy for the compartments. In both cases the table aims to highlight certain issues, referred to elsewhere in the table, which may dictate at what point the final policy would be confirmed. Therefore, even though in the short and long term a policy of do nothing may be considered appropriate, it may in reality be necessary to monitor defences and undertake some repair or maintenance work until some critical aspect of the strategy is confirmed.

|   |                                     |   |                |
|---|-------------------------------------|---|----------------|
| <b>FC(s):</b> 16A   | <b>FC (s) Name/Location:</b> Melton | <b>Figure</b> D1                            | <b>ZONE:</b> 1 |
| <b>Assessed critical time:</b> 10 years   |                                     | <b>Strategy Implementation – Priority</b> 1 |                |
| <b><u>Physical Characteristics:</u></b>   |                                     |   |                |
| <b>Description:</b> Flood compartment upstream from Woodbridge, with possible linkage to FC16B over dividing wall. Compartment contains limited tangible assets, and is defenced by lengthy embankment. |                                     | <b>Defence length:</b>                      | 1030 m         |
|   |                                     | <b>Defended area:</b>                       | 50 ha          |

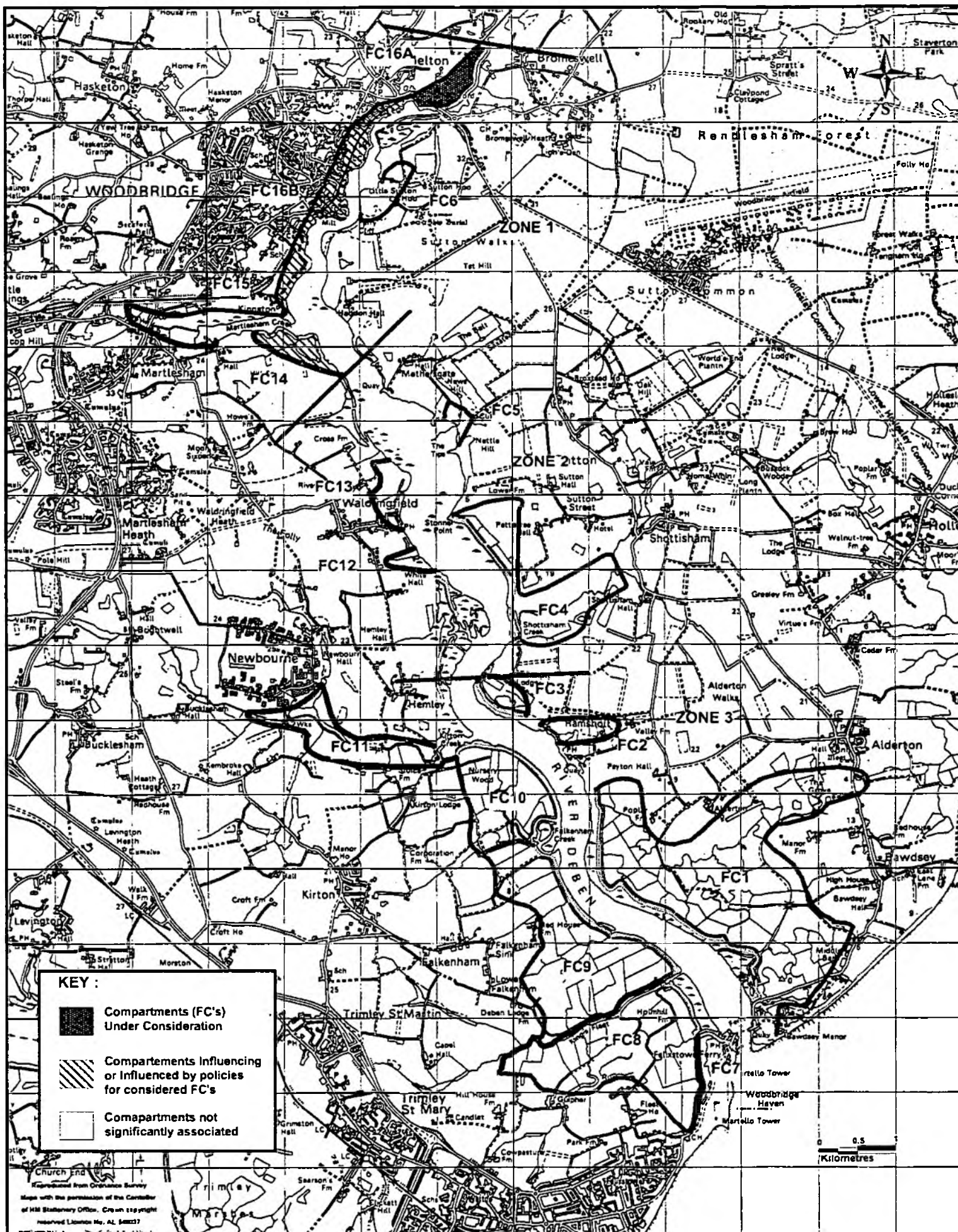
### Strategic Context

| Strategy Policy:   |   | Key Strategic Issues   |   |  |
|--|---|--|---|--|
| Abandon defences, ensuring that protection of Woodbridge not affected. | Issue   | Associated FC(s)   | Significance  | Notes  |
|  | Outflanking of Woodbridge defences.<br>Intertidal habitat | FC16B<br><br>FC14  | Economically significant<br>conditionally critical to strategy. | Outflanking would cause extensive damage to Woodbridge properties, negating the purpose of defences in 16b. New Saltwater habitat would contribute a significant element of the new intertidal area required to address sea level rise in the upper reaches. This would be critical if FC14 was not abandoned. |
| Influence on Strategy  |   | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |   |  |
| Issue  | Significance and Response                                 |  | Action  |  |
| None   | None  |  | None  |  |
| Dependence on Strategy   |   | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |   |  |
| Issue  | Notes   |  | Approach  |  |
| None   | None  |  | None  |  |

### Management

|   |  |
|---|--|
| <b>Local Issues:</b>  | Amenity value. Outflanking of Woodbridge defences. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Hold the Line, carry out local asset survey.       |
| <b>Long term approach (to be applied before critical time elapses):</b> | Do Nothing, following study to confirm.            |





ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

**POSFORD  
DUVIVIER**

In association with  
HR Wallingford

DEBEN ESTUARY IMPLEMENTATION  
GUIDANCE SHEETS:  
MELTON

**FIGURE D1**

|   |  |   |                |
|---|--|---|----------------|
| <b>FC(s):</b> 15  | <b>FC (s) Name/Location:</b> Martlesham Creek (north bank) | <b>Flgure</b> D2                            | <b>ZONE:</b> 1 |
| <b>Assessed critical time:</b> 5 years  |  | <b>Strategy Implementation – Priority</b> 3 |                |
| <b><u>Physical Characteristics:</u></b>   |  |   |                |
| <b>Description:</b> South of Woodbridge and the railway cuttings, this flood compartment follows the north bank of Martlesham Creek, extending west, dividing Martlesham from Woodbridge. |  | <b>Defence length:</b>                      | 2070 m         |
|   |  | <b>Defended area:</b>                       | 20 ha          |

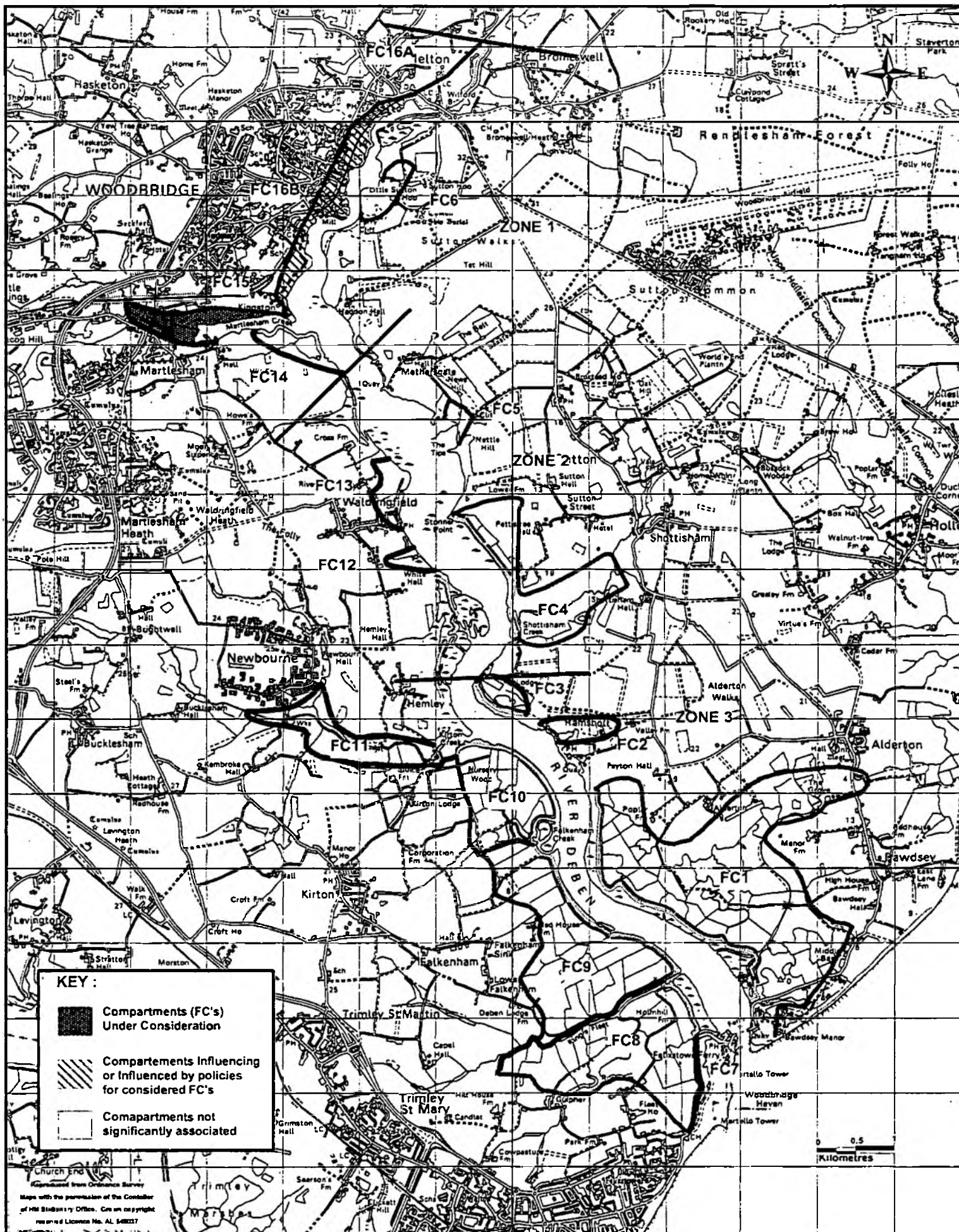
### Strategic Context

| Strategic Context                        |  | Key Strategic Issues |                          |   |
|--|--|----------------------|--------------------------|---|
| <b>Strategy Policy:</b><br>Hold the line | Issue  | Associated FC(s)     | Significance             | Notes   |
|  | Transport links  | FC16B                | Economically Significant | Abandoning defences would threaten road link to Woodbridge. |
| <b>Influence on Strategy</b>             | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                      |                          |   |
| <b>Issue</b>                             | <b>Significance and Response</b>   |                      |                          | <b>Action</b>   |
| None                                     | None   |                      |                          | None  |
| <b>Dependence on Strategy</b>            | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                      |                          |   |
| <b>Issue</b>                             | <b>Notes</b>   |                      |                          | <b>Approach</b>   |
| None                                     | None   |                      |                          | None  |

### Management

|   |   |
|---|---|
| <b>Local Issues:</b>  | Local road link, Martlesham properties. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.             |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences.             |





ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

**POSFORD DUVIVIER**

In association with  
HR Wallingford

DEBEN ESTUARY IMPLEMENTATION  
GUIDANCE SHEETS:  
MARTLESHAM CREEK (north)

**FIGURE D2**

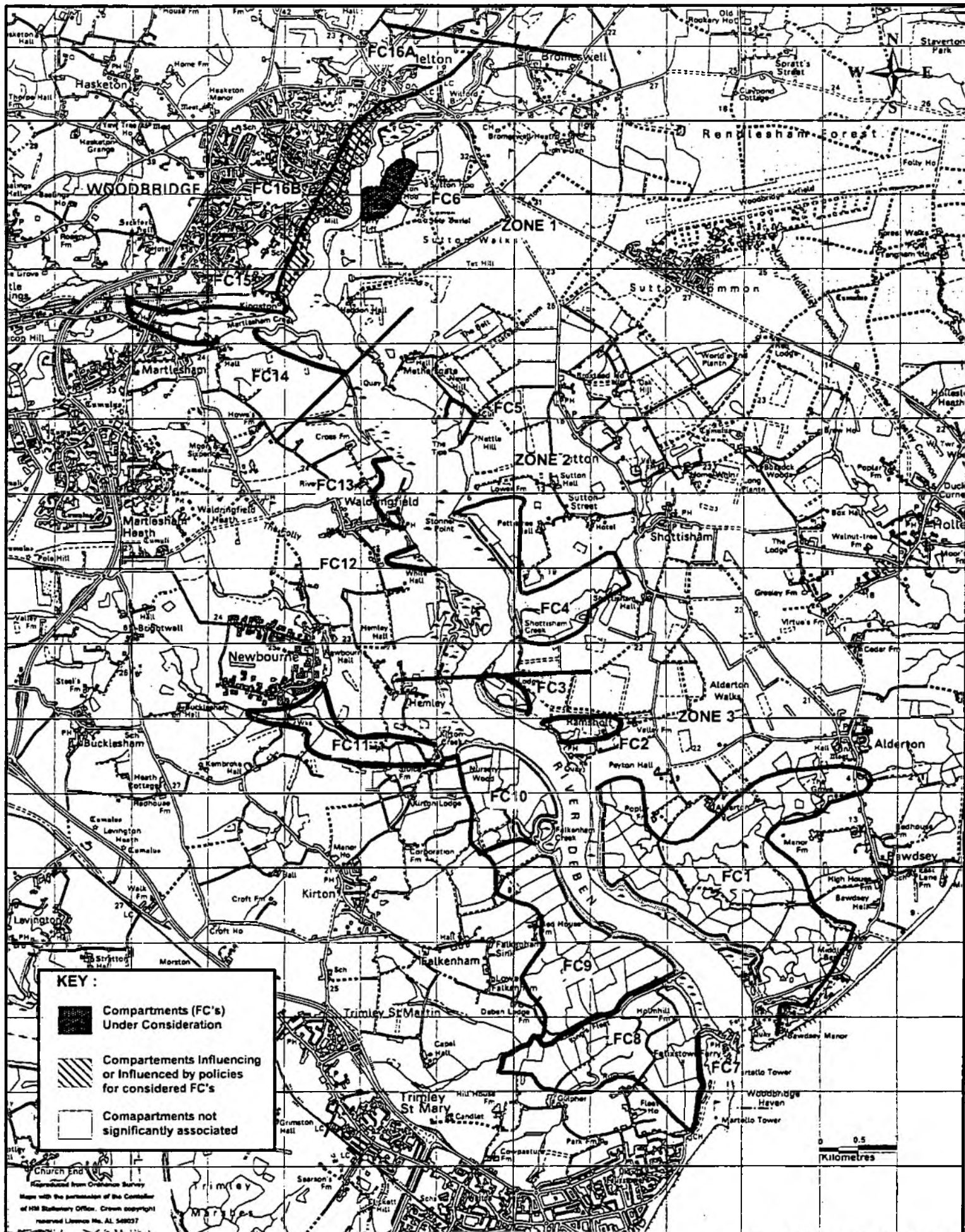
|   |   |                              |            |   |    |              |   |
|---|---|------------------------------|------------|---|----|--------------|---|
| <b>FC(s):</b>   | 6 | <b>FC (s) Name/Location:</b> | Sutton Hoo | <b>Figure</b>                             | D3 | <b>ZONE:</b> | 1 |
| <b>Assessed critical time:</b>  |   |                              | 10 years   | <b>Strategy Implementation – Priority</b> |    |              | 2 |
| <b>Physical Characteristics:</b>  |   |                              |            |   |    |              |   |
| <b>Description:</b> Located on the opposite bank to Woodbridge, Sutton Hoo, contains a number of residential properties. The compartment is fronted by a narrow winding channel, and areas of intertidal habitat. |   |                              |            | <b>Defence length:</b>                    |    | 730 m        |   |
|   |   |                              |            | <b>Defended area:</b>                     |    | 10 ha        |   |

### Strategic Context

| <u>Strategy Policy:</u>              |                                  | <u>Key Strategic Issues</u>  |                           |                 |
|--------------------------------------|----------------------------------|--|---------------------------|-----------------|
| Hold the line                        | <i>Issue</i>                     | <i>Associated FC(s)</i>  | <i>Significance</i>       | <i>Notes</i>    |
|                                      | Protection of properties         | None   | Economically significant. |                 |
| <b><i>Influence on Strategy</i></b>  |                                  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                           |                 |
| <i>Issue</i>                         | <i>Significance and Response</i> |  |                           | <i>Action</i>   |
| None                                 | None                             |  |                           | None            |
| <b><i>Dependence on Strategy</i></b> |                                  | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                           |                 |
| <i>Issue</i>                         | <i>Notes</i>                     |  |                           | <i>Approach</i> |
| None                                 | None                             |  |                           | None            |

### Management

|   |   |
|---|---|
| <b>Local Issues:</b>  | Loss of high value residential properties<br>7 <sup>th</sup> Century Archaeological concerns. |
| <b>Short term approach<br/>(on adoption of Strategy):</b>                       | Maintain existing defences.   |
| <b>Long term approach<br/>(to be applied before<br/>critical time elapses):</b> | Maintain existing defences.   |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

**POSFORD DUVIVIER**

In association with  
HR Wallingford

DEBEN ESTUARY IMPLEMENTATION  
GUIDANCE SHEETS:  
SUTTON HOO

**FIGURE D3**



|   |  |   |                |
|---|--|---|----------------|
| <b>FC(s):</b> 14  | <b>FC (s) Name/Location:</b> Martlesham Creek (south bank) | <b>Figure</b> D4                            | <b>ZONE:</b> 1 |
| <b>Assessed critical time:</b> 8 years  |  | <b>Strategy Implementation – Priority</b> 3 |                |
| <b>Physical Characteristics:</b>  |  |   |                |
| <b>Description:</b> Agricultural land, protected by a stone or pitch apron along a section of the front face of embankment. |  | <b>Defence length:</b>                      | 1750 m         |
|   |  | <b>Defended area:</b>                       | 14 ha          |

### Strategic Context

| <b>Strategy Policy:</b>       | <b>Key Strategic Issues</b>  |                         |                                     |  |
|-------------------------------|--|-------------------------|-------------------------------------|--|
|                               | <b>Issue</b>   | <b>Associated FC(s)</b> | <b>Significance</b>                 | <b>Notes</b>   |
| Do Nothing                    | Intertidal habitat   | None                    | Conditionally critical to strategy. | New saltwater habitat would contribute to the new inter-tidal area required to address sea level rise in the upper reaches. This may be critical if FC16A was not abandoned. |
| <b>Influence on Strategy</b>  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                         |                                     |  |
| <b>Issue</b>                  | <b>Significance and Response</b>   |                         |                                     | <b>Action</b>  |
| None                          | None   |                         |                                     | None   |
| <b>Dependence on Strategy</b> | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                         |                                     |  |
| <b>Issue</b>                  | <b>Notes</b>   |                         |                                     | <b>Approach</b>  |
| None                          | None   |                         |                                     | None   |

### Management

|   |   |
|---|---|
| <b>Local Issues:</b>  | Maintenance or reconstruction of footpaths. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Do Nothing.                                 |
| <b>Long term approach (to be applied before critical time elapses):</b> | Do Nothing.                                 |



|   |            |                              |                   |   |           |              |          |
|---|------------|------------------------------|-------------------|---|-----------|--------------|----------|
| <b>FC(s):</b>   | <b>16B</b> | <b>FC (s) Name/Location:</b> | <b>Woodbridge</b> | <b>Figure</b>                             | <b>D5</b> | <b>ZONE:</b> | <b>1</b> |
| <b>Assessed critical time:</b>  |            |                              | <b>30 years</b>   | <b>Strategy Implementation – Priority</b> |           |              | <b>3</b> |
| <b>Physical Characteristics:</b>  |            |                              |                   |   |           |              |          |
| <b>Description:</b> This compartment comprises the river frontage of the town of Woodbridge with a great number of economic and social assets. The river itself is narrow and winding, and has a number of boat moorings. |            |                              |                   | <b>Defence length:</b>                    |           | 4080 m       |          |
|   |            |                              |                   | <b>Defended area:</b>                     |           | 50 ha        |          |

### Strategic Context

| Strategy Policy:                     |   | Key Strategic Issues   |   |  |
|--------------------------------------|---|--|---|--|
|                                      | Issue   | Associated FC(s)   | Significance  | Notes  |
| Hold the line                        | Heavily populated, socially important area with high amenity value.                             | FC15 + FC16a   | Economically significant.   | Large proportion of human and built assets in the Deben are within this compartment. |
| Influence on Strategy                |   | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |   |  |
| Issue                                | Significance and Response   |  | Action  |  |
| Influence on defences at Sutton Hoo. | Impact of Woodbridge defences may affect hydrodynamic processes at Sutton Hoo on opposite bank. |  | Review hydrodynamic processes when considering Sutton Hoo defences. |  |
| Dependence on Strategy               |   | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |   |  |
| Issue                                | Notes   |  | Approach  |  |
| None                                 | None  |  | None  |  |

### Management

|   |  |
|---|--|
| <b>Local Issues:</b>  | Many properties along the river frontage.<br>Amenity centre.<br>Centre of extensive river use. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.  |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences.  |





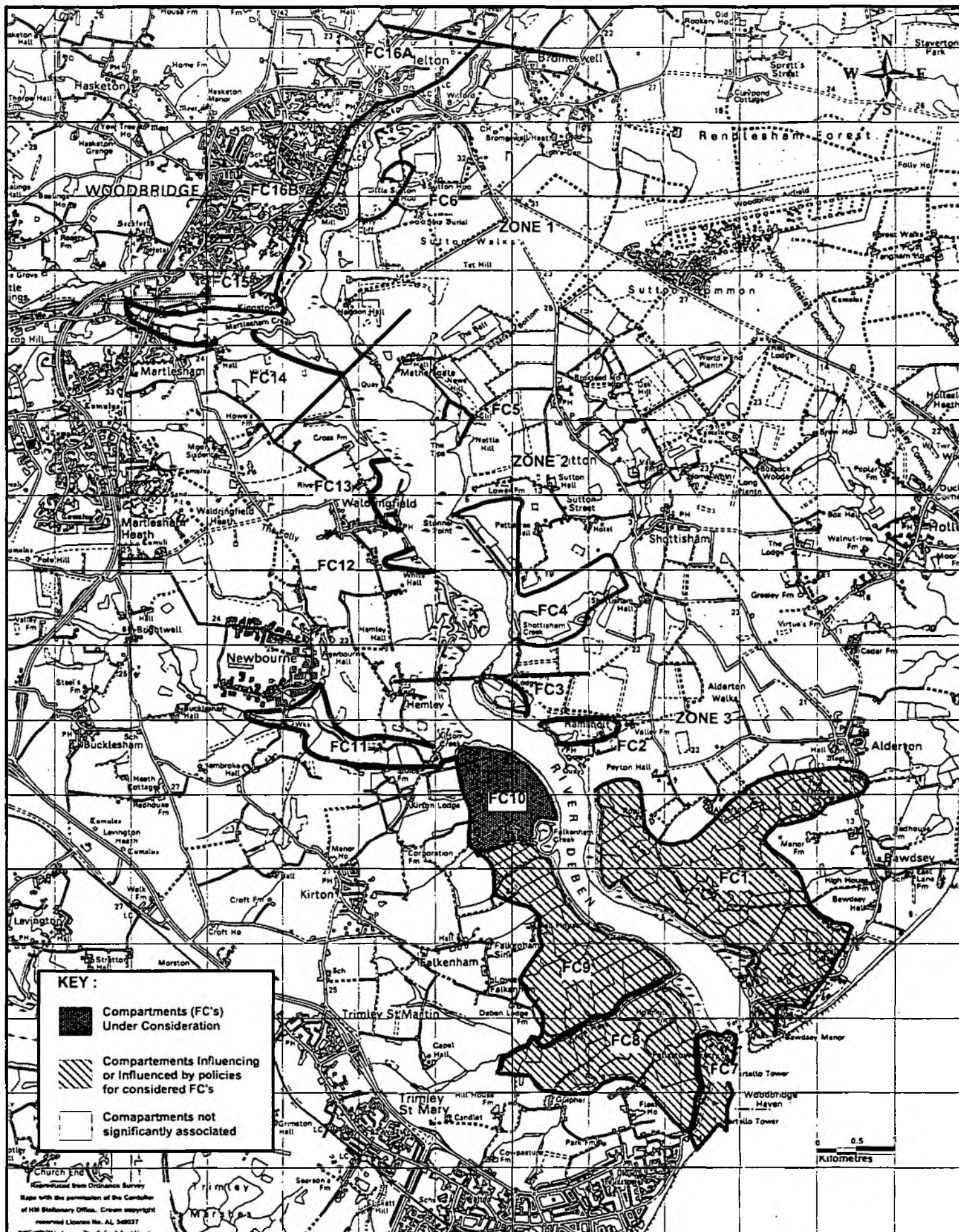
|   |   |   |                |
|---|---|---|----------------|
| <b>FC(s):</b> 10  | <b>FC (s) Name/Location:</b> Nursery Wood | <b>Figure</b> D6                            | <b>ZONE:</b> 3 |
| <b>Assessed critical time:</b> 15 years   |   | <b>Strategy Implementation – Priority</b> 1 |                |
| <b>Physical Characteristics:</b>  |   |   |                |
| <b>Description:</b> Extensive agricultural land extending between Kirton Creek to the north and Falkenham Creek to the south. |   | <b>Defence length:</b>                      | 2500 m         |
|   |   | <b>Defended area:</b>                       | 124 ha         |

### Strategic Context

| Strategy Policy:  |  | Key Strategic Issues  |                  |                                   |  |
|---|--|---|------------------|-----------------------------------|--|
|   |  | Issue   | Associated FC(s) | Significance                      | Notes  |
| Managed Re-alignment  |  | Large defended area.  | FC1, 7,8,9       | Potentially critical to strategy. | Failure to retain some line of defence would cause increase pressure on remaining defences, and risk outflanking of defences in FC8.   |
|   |  | Inter-tidal habitat   | FC1,7,8,9        | Potentially critical to strategy. | New saltwater habitat would contribute a significant element of new intertidal area required to mitigate against ongoing losses in the middle and lower reaches, and redress the ecological balance. Depending on a review of the requirements of CHaMPS this is critical. |
| Influence on Strategy   |  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary)  |                  |                                   |  |
| Issue   |  | Significance and Response   |                  |                                   | Action   |
| Influence on physical processes in estuary mouth, and balance of intertidal habitats. |  | Maintaining the present form and use within the estuary mouth is crucial to the overall strategy. Holding or realigning defences would keep pressure on the estuary mouth to an acceptable and manageable level. The degree of intertidal gain in FC10 will determine the requirements of the remaining compartments in fulfilling the obligations of CHaMPs and the EU Habitats Directive. |                  |                                   | Review estuary/coast interface   |
| Dependence on Strategy  |  | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)   |                  |                                   |  |
| Issue   |  | Notes   |                  |                                   | Approach   |
| Estuary volume  |  | Increase in volume from SLR or abandoning defences elsewhere in the estuary will increase the cost of defence of the compartment.   |                  |                                   | Detailed consideration of potential areas for habitat replacement (DN or Retreat sites) will be carried out shortly after adoption of the strategy. This information will be fed back into the realignment study.  |
| Intertidal balance  |  | The need for specific additional intertidal area may be influenced by policies elsewhere.   |                  |                                   |  |

### Management

|   |                               |                              |
|---|-------------------------------|------------------------------|
| <b>Local Issues:</b>  | Downstream erosional problems | Loss of productive farmland. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Hold the Line.                |                              |
| <b>Long term approach (to be applied before critical time elapses):</b> | Managed re-alignment.         |                              |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

**POSFORD DUVIVIER**

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DEBEN ESTUARY IMPLEMENTATION  
GUIDANCE SHEETS:  
NURSERY WOOD

**FIGURE D6**



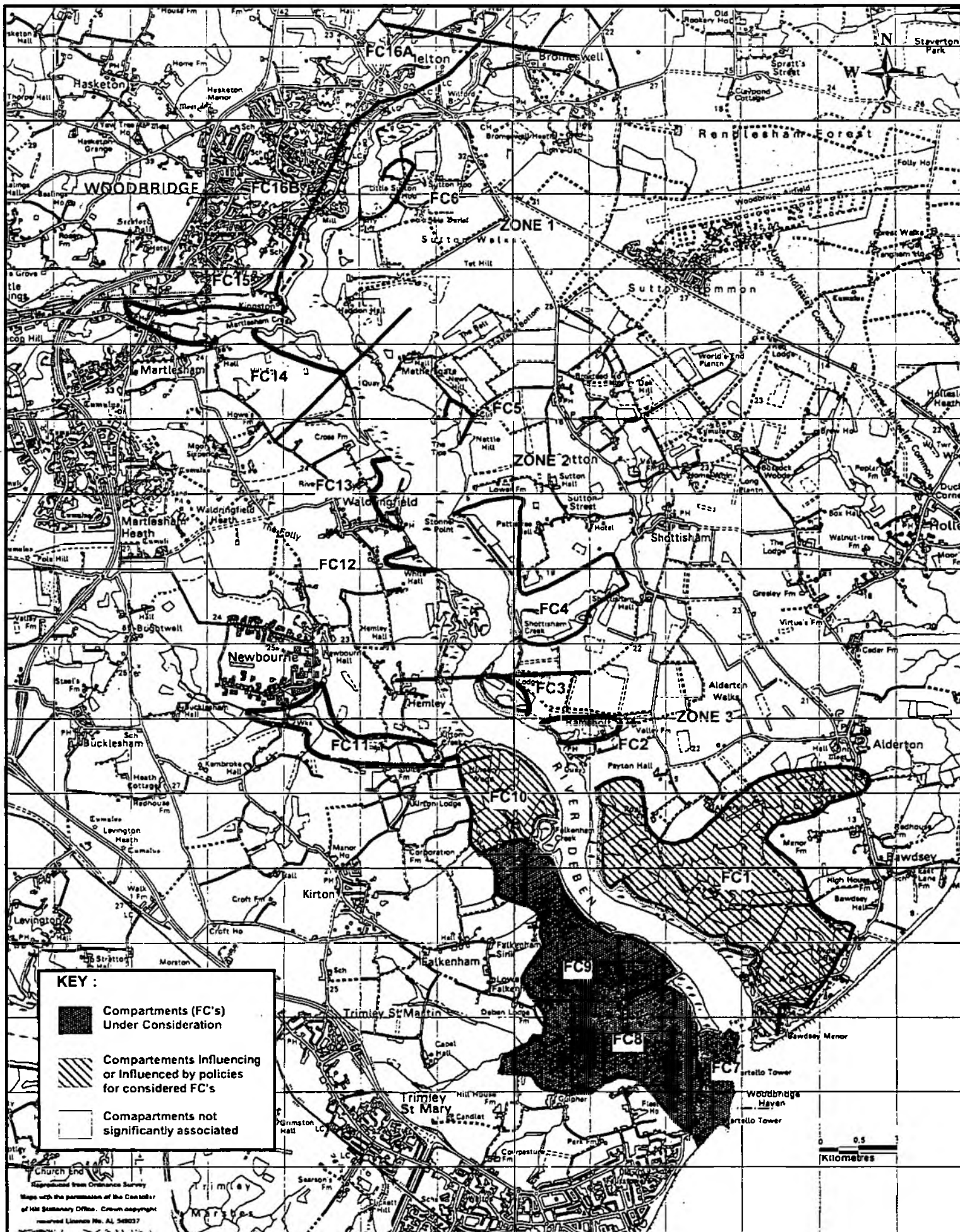
|   |         |                              |                              |   |    |              |   |
|---|---------|------------------------------|------------------------------|---|----|--------------|---|
| <b>FC(s):</b>   | 7, 8, 9 | <b>FC (s) Name/Location:</b> | Felixstowe Ferry & Falkenham | <b>Figure</b>                             | D7 | <b>ZONE:</b> | 3 |
| <b>Assessed critical time:</b>  |         |                              |                              | 15 years                                  |    |              |   |
|   |         |                              |                              | <b>Strategy Implementation – Priority</b> |    |              |   |
| <b>Physical Characteristics:</b>  |         |                              |                              |   |    |              |   |
| <b>Description:</b> Wide meandering channel flanked by earth embankments, protecting extensive flood plains, which are mainly agricultural. There is a concentration of properties at the estuary mouth (Felixstowe Ferry), which is restricted in width and depth. |         |                              |                              | <b>Defence length:</b>                    |    | 4400 m       |   |
|   |         |                              |                              | <b>Defended area:</b>                     |    | 507 ha       |   |

### Strategic Context

| Strategy Policy:                     |  | Key Strategic Issues      |                                   |  |
|--------------------------------------|--|---------------------------|-----------------------------------|--|
|                                      | Issue  | Associated FC(s)          | Significance                      | Notes  |
| Hold the line                        | Large defended area. Defences interacting with those on opposite bank.                               | FC1                       | Potentially critical to strategy. | Failure to hold any part of the existing defences would dramatically increase pressure on remaining defences in FC 1,7,8 and 9 and on the form of the estuary mouth. |
| Influence on Strategy                | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                           |                                   |  |
|                                      | Issue  | Significance and Response |                                   | Action   |
| Physical processes in estuary mouth. | Holding the line will minimise increase of pressure on defences around estuary mouth due to SLR.     |                           |                                   | Review estuary/coast interface.  |
| Dependence on Strategy               | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                           |                                   |  |
|                                      | Issue  | Notes                     |                                   | Approach   |
| Cost of defence.                     | Increase in volume from remaining defences in FC10 will increase.                                    |                           |                                   | Review estuary/coast interface.  |

### Management

|   |  |                                       |
|---|--|---------------------------------------|
| <b>Local Issues:</b>  | Erosion increase due to FC10 policy<br>Potential progressive collapse of defences along FCs 7, 8, 9 and 10 | Loss of high value agricultural land. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.  |                                       |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences.  |                                       |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

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GUIDANCE SHEETS:  
FELIXSTOWE FERRY TO FALKENHAM

**FIGURE D7**

|  |                                       |   |                |
|--|---------------------------------------|---|----------------|
| <b>FC(s):</b> 1  | <b>FC (s) Name/Location:</b> Bawdsey. | <b>Figure</b> D8                            | <b>ZONE:</b> 3 |
| <b>Assessed critical time:</b> 20 years  |                                       | <b>Strategy Implementation – Priority</b> 2 |                |
| <b><u>Physical Characteristics:</u></b>  |                                       |   |                |
| <b>Description:</b> Eastern side of the River Deben extending from south Ramsholt to the open coast. Extensive agricultural use. |                                       | <b>Defence length:</b>                      | 4760 m         |
|  |                                       | <b>Defended area:</b>                       | 520 ha         |

### Strategic Context

| <b>Strategy Policy:</b>       | <b>Key Strategic Issues</b>  |                         |                          |  |
|-------------------------------|--|-------------------------|--------------------------|--|
|                               | <b>Issue</b>   | <b>Associated FC(s)</b> | <b>Significance</b>      | <b>Notes</b>   |
| Hold the Line                 | Large area defended.   | FC 7,8,9,10             | Economically significant | Holding the line reduces future additional burden on defences in lower reaches due to SLR. |
| <b>Influence on Strategy</b>  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary)                   |                         |                          |  |
| <b>Issue</b>                  | <b>Significance and Response</b>   |                         |                          | <b>Action</b>  |
| Estuary mouth defences.       | Retaining defences here means that continued defence of the opposite bank of the estuary mouth is sustainable.         |                         |                          | Review estuary/coast interface.  |
| <b>Dependence on Strategy</b> | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)                          |                         |                          |  |
| <b>Issue</b>                  | <b>Notes</b>   |                         |                          | <b>Approach</b>  |
| Cost of defence.              | Increase in volume from retreating defences in FC10 will increase pressure on defences along part of this compartment. |                         |                          | Review estuary/coast interface.  |

### Management

|   |   |
|---|---|
| <b>Local Issues:</b>  | Extensive agricultural assets<br>Increase in tidal volume<br>Impacts of FC10 retreat<br>Residential property around Bawdsey Manor and Alderton. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.   |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences.   |





ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

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GUIDANCE SHEETS:  
BAWDSEY

**FIGURE D8**

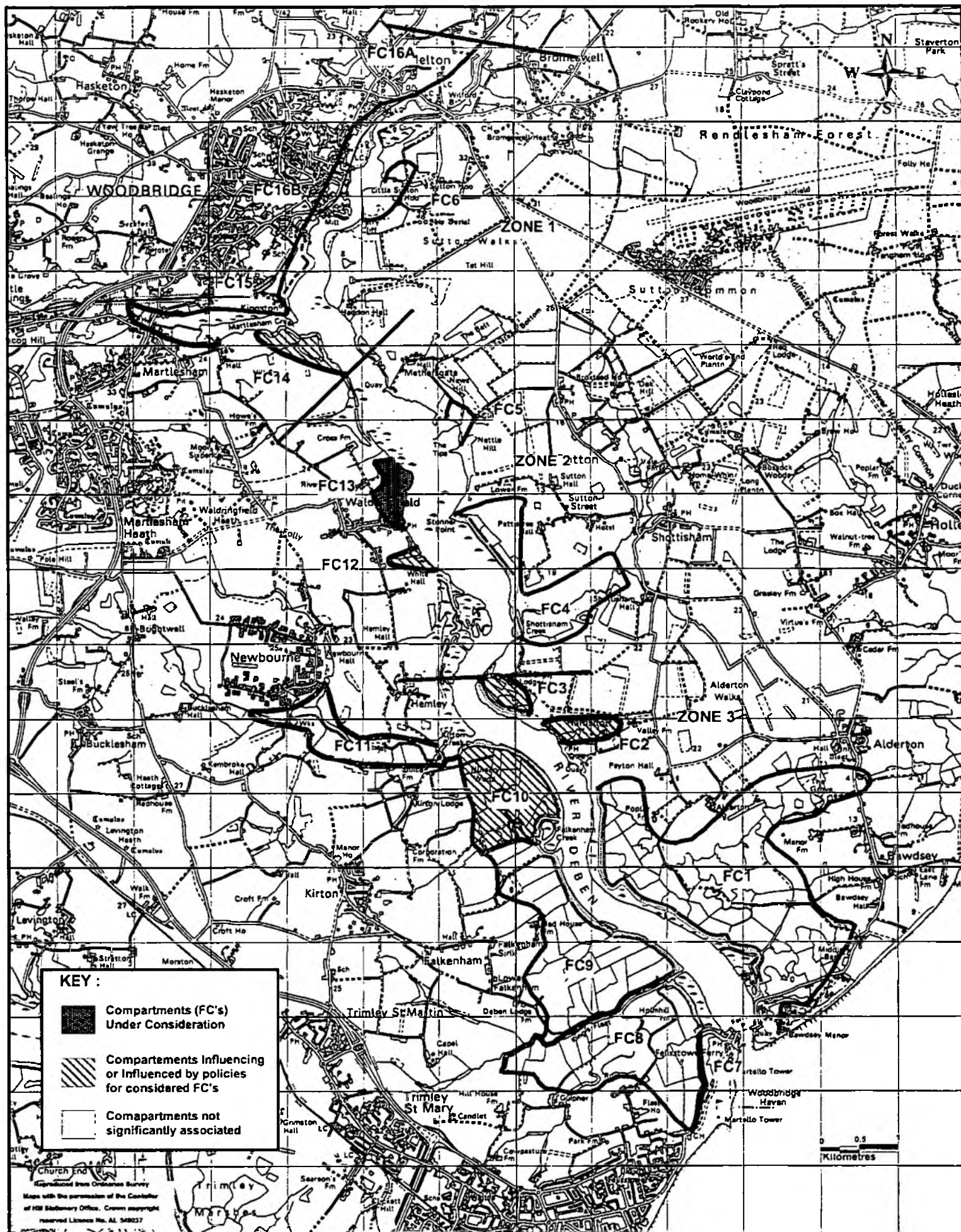
|  |  |   |                |
|--|--|---|----------------|
| <b>FC(s):</b> 13   | <b>FC (s) Name/Location:</b> Waldringfield | <b>Figure</b> D9                            | <b>ZONE:</b> 2 |
| <b>Assessed critical time:</b> 12 years  |  | <b>Strategy Implementation – Priority</b> 1 |                |
| <b>Physical Characteristics:</b>   |  |   |                |
| <b>Description:</b> Wide meandering channel flanked by eroding intertidal areas. Compartment includes properties in the village of Waldringfield to the south behind defences under increasing pressure. |  | <b>Defence length:</b>                      | 980 m          |
|  |  | <b>Defended area:</b>                       | 13 ha          |

### Strategic Context

| Strategic Context   |  | Key Strategic Issues       |   |   |
|---|--|----------------------------|---|---|
| Strategy Policy:  | Issue  | Associated FC(s)           | Significance  | Notes   |
| Managed Realignment, still defending the village of Waldringfield | Continue protection of Waldringfield. Intertidal habitat.  | None<br><br>FC2,3,10,12,14 | Economically and socially significant. Potentially environmentally significant. | None<br><br>Area in front of retired defences could contribute to intertidal area in estuary. |
| Influence on Strategy   | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                            |   |   |
| Issue   | Significance and Response  |                            |   | Action  |
| Habitat balance.  | Freshwater habitat north of Waldringfield will be changed to saltwater.                              |                            |   | Review estuary balance and findings of CHaMPs.  |
| Dependence on Strategy  | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                            |   |   |
| Issue   | Notes  |                            |   | Approach  |
| Habitat balance.  | Additional fresh or saltwater habitat may be required in estuary, depending on policies elsewhere.   |                            |   | Review estuary balance and frontage of CHaMPs.  |

### Management

|   |   |
|---|---|
| <b>Local Issues:</b>  | Properties in Waldringfield<br>Boat use and mooring<br>Coastal pathway. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.   |
| <b>Long term approach (to be applied before critical time elapses):</b> | Managed re-alignment, still defending the village of Waldringfield      |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

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GUIDANCE SHEETS:  
WALDRINGFIELD

**FIGURE D9**



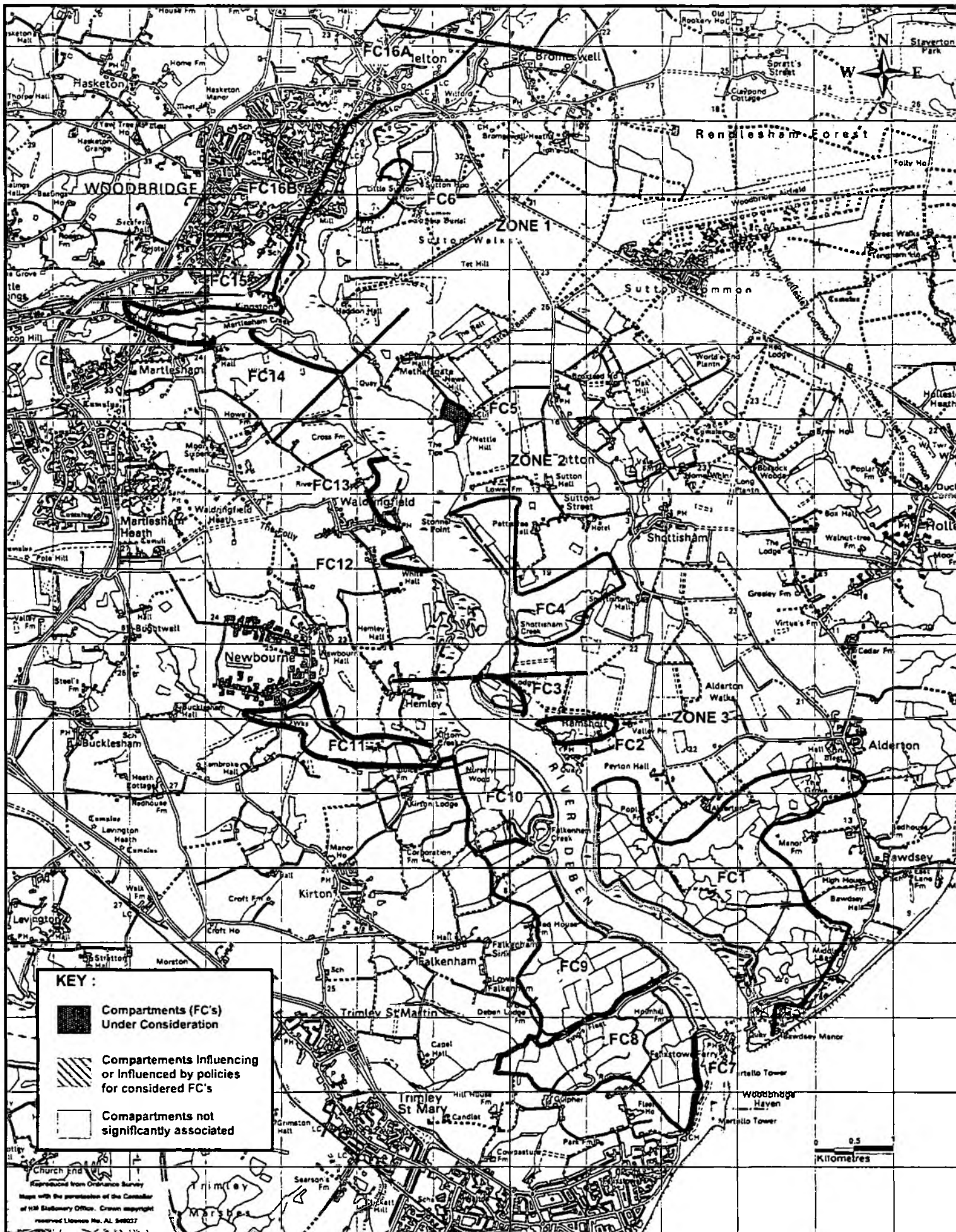
|  |          |                              |                    |   |            |              |          |
|--|----------|------------------------------|--------------------|---|------------|--------------|----------|
| <b>FC(s):</b>  | <b>5</b> | <b>FC (s) Name/Location:</b> | <b>Methersgate</b> | <b>Figure</b>                             | <b>D10</b> | <b>ZONE:</b> | <b>2</b> |
| <b>Assessed critical time:</b>   |          |                              | <b>10 years</b>    | <b>Strategy Implementation – Priority</b> |            |              | <b>2</b> |
| <b>Physical Characteristics:</b>   |          |                              |                    |   |            |              |          |
| <b>Description:</b> Mainly rural land with some properties, the access to which would be affected by flooding. Also contains sites of ecological interest. High ground at Methersgate, contributing to the control of the alignment of the meandering river. |          |                              |                    | <b>Defence length:</b>                    |            | 380 m        |          |
|  |          |                              |                    | <b>Defended area:</b>                     |            | 8 ha         |          |

### Strategic Context

| Strategic Context             |  |  |                     |  |  |
|-------------------------------|--|--|---------------------|--|--|
| <b>Strategy Policy:</b>       | <b>Key Strategic Issues</b>  |  |                     |  |  |
|                               | <b>Issue</b>   | <b>Associated FC(s)</b>  | <b>Significance</b> | <b>Notes</b>   |  |
|                               | Hold the Line  | Maintain ecological interests  | None                | Highly significant sites in compartment                              | The compartment contains two sites of ecological interests which could not be re-created elsewhere |
| <b>Influence on Strategy</b>  |  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                     |  |  |
| <b>Issue</b>                  | <b>Significance and Response</b>   |  |                     | <b>Action</b>  |  |
| None                          | None   |  |                     | None   |  |
| <b>Dependence on Strategy</b> |  | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                     |  |  |
| <b>Issue</b>                  | <b>Notes</b>   |  |                     | <b>Approach</b>  |  |
| Ecological balance            | Possible conflict between need for fresh and saltwater habitats depending in policies in other compartments. |  |                     | Review ecological balance of estuary in the light of CHaMPs findings |  |

### Management

|   |  |
|---|--|
| <b>Local Issues:</b>  | Methersgate access road potentially cut off<br>Compartment contains an Country Wildlife site<br>Abstraction water few agricultural production. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.  |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences.  |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

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GUIDANCE SHEETS:  
METHERSGATE

**FIGURE D10**

|  |                                     |   |                |
|--|-------------------------------------|---|----------------|
| <b>FC(s):</b> 11   | <b>FC (s) Name/Location:</b> Hemley | <b>Figure</b> D11                           | <b>ZONE:</b> 3 |
| <b>Assessed critical time:</b> 20 years  |                                     | <b>Strategy Implementation – Priority</b> 3 |                |
| <b><u>Physical Characteristics:</u></b>  |                                     |   |                |
| <b>Description:</b> Large compartment, extending far inland, but with very short and sheltered frontage in Kirton Creek. |                                     | <b>Defence length:</b>                      | 440 m          |
|  |                                     | <b>Defended area:</b>                       | 51 ha          |

### Strategic Context

| Strategic Context      |  |                  |              |          |
|------------------------|--|------------------|--------------|----------|
| Strategy Policy:       | Key Strategic Issues   |                  |              |          |
|                        | Issue  | Associated FC(s) | Significance | Notes    |
| Hold the Line          | None   | None             | Low          | None     |
| Influence on Strategy  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                  |              |          |
| Issue                  | Significance and Response  |                  |              | Action   |
| None                   | None   |                  |              | None     |
| Dependence on Strategy | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                  |              |          |
| Issue                  | Notes  |                  |              | Approach |
| None                   | None   |                  |              | None     |

### Management

|   |                             |
|---|-----------------------------|
| <b>Local Issues:</b>  | Local farm holdings.        |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defence.  |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences. |





ENVIRONMENT AGENCY

# SUFFOLK ESTUARINE STRATEGIES PHASE 2



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GUIDANCE SHEETS:  
HEMLEY

FIGURE D11

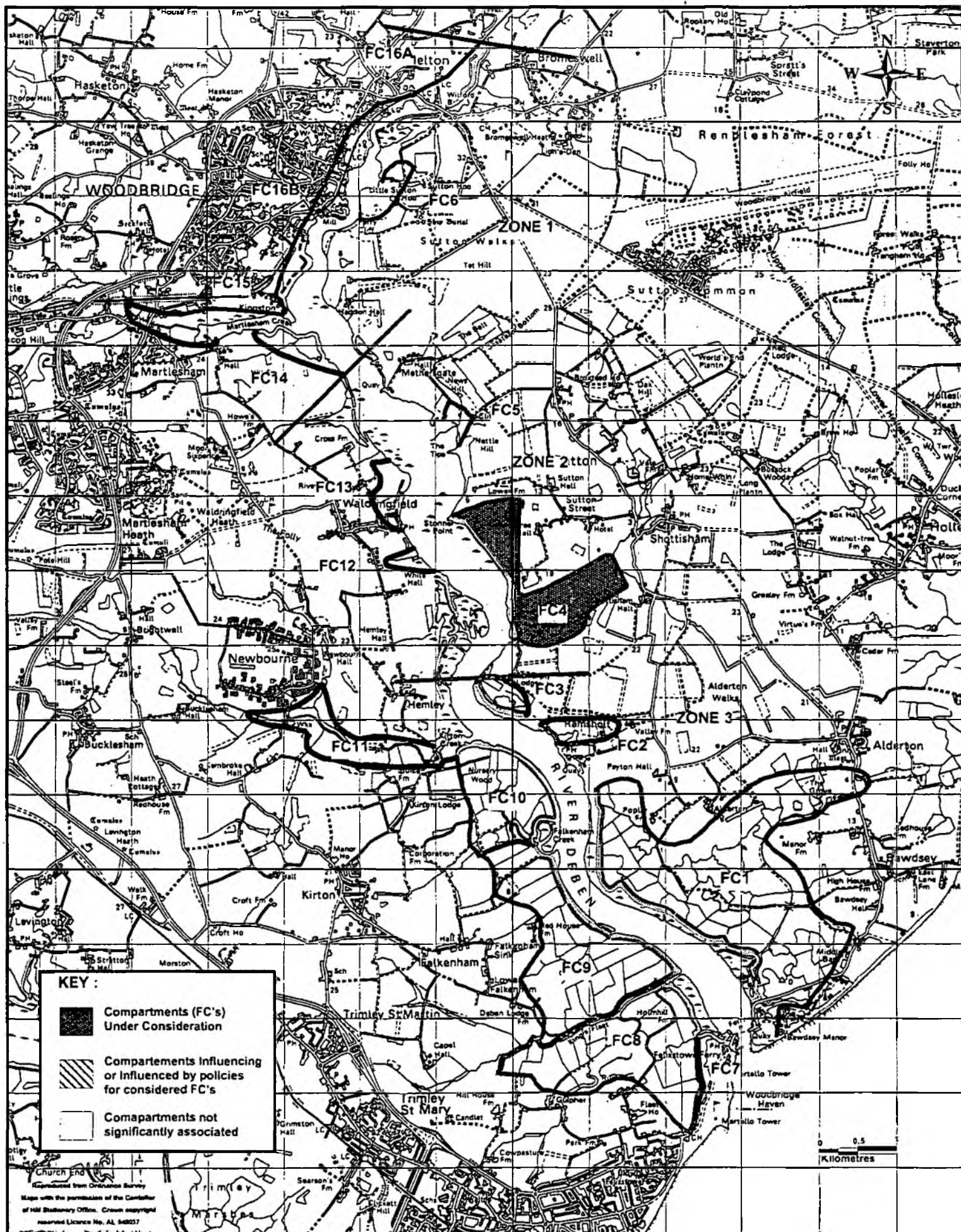
|  |   |   |                |
|--|---|---|----------------|
| <b>FC(s):</b> 4  | <b>FC (s) Name/Location:</b> Shottisham | <b>Figure</b> D12                           | <b>ZONE:</b> 2 |
| <b>Assessed critical time:</b> 20 years  |   | <b>Strategy Implementation – Priority</b> 2 |                |
| <b>Physical Characteristics:</b>   |   |   |                |
| <b>Description:</b> Extensive mudflats in front of the flood compartment, with a stone or pitch embankment covering a section of its frontage. The large compartment extends into Shottisham, mainly across agricultural land. |   | <b>Defence length:</b>                      | 1210 m         |
|  |   | <b>Defended area:</b>                       | 126 ha         |

### Strategic Context

| Strategic Context      |   |                  |                           |   |
|------------------------|---|------------------|---------------------------|---|
| Strategy Policy:       | Key Strategic Issues  |                  |                           |   |
|                        | Issue   | Associated FC(s) | Significance              | Notes   |
| Hold the Line          | Large defended area potentially effecting tidal volume if flooded.                                    | -                | Economically significant. | Abandoning flood compartment would increase burden on remaining defences downstream and at the estuary mouth in particular. |
| Influence on Strategy  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary)  |                  |                           |   |
| Issue                  | Significance and Response   |                  |                           | Action  |
| Defence costs          | If defences were to be abandoned there would be an increase in defence costs around the estuary mouth |                  |                           | None  |
| Dependence on Strategy | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)         |                  |                           |   |
| Issue                  | Notes   |                  |                           | Approach  |
| None                   | None  |                  |                           | None  |

### Management

|   |  |
|---|--|
| <b>Local Issues:</b>  | Extensive local farm holdings<br>Increase in tidal volume. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Maintain existing defences.                                |
| <b>Long term approach (to be applied before critical time elapses):</b> | Maintain existing defences.                                |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

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GUIDANCE SHEETS:  
SHOTTISHAM

**FIGURE D12**



|  |                                       |   |                |
|--|---------------------------------------|---|----------------|
| <b>FC(s):</b> 2  | <b>FC (s) Name/Location:</b> Ramsholt | <b>Figure</b> D13                           | <b>ZONE:</b> 3 |
| <b>Assessed critical time:</b> 10 years  |                                       | <b>Strategy Implementation – Priority</b> 3 |                |
| <b>Physical Characteristics:</b>   |                                       |   |                |
| <b>Description:</b> Small isolated area with potential for habitat recreation. |                                       | <b>Defence length:</b>                      | 520 m          |
|  |                                       | <b>Defended area:</b>                       | 10 ha          |

### Strategic Context

| Strategic Context             |  |                  |              |   |
|-------------------------------|--|------------------|--------------|---|
| <u>Strategy Policy:</u>       | Key Strategic Issues   |                  |              |   |
|                               | Issue  | Associated FC(s) | Significance | Notes   |
| Do Nothing                    | None   | None             | Low          | Relatively independent compartment                    |
| <u>Influence on Strategy</u>  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                  |              |   |
| Issue                         | Significance and Response  |                  |              | Action  |
| Intertidal habitat            | May contribute to intertidal habitat defence   |                  |              | Include in review of potential habitat creation sites |
| <u>Dependence on Strategy</u> | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                  |              |   |
| Issue                         | Notes  |                  |              | Approach  |
| None                          | None   |                  |              | None  |

### Management

|   |                      |
|---|----------------------|
| <b>Local Issues:</b>  | Local farm holdings. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Do Nothing.          |
| <b>Long term approach (to be applied before critical time elapses):</b> | Do Nothing.          |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

**POSFORD  
DUVIVIER**

In association with  
HR Wallingford

DEBEN ESTUARY IMPLEMENTATION  
GUIDANCE SHEETS:  
RAMSHOLT

**FIGURE D13**



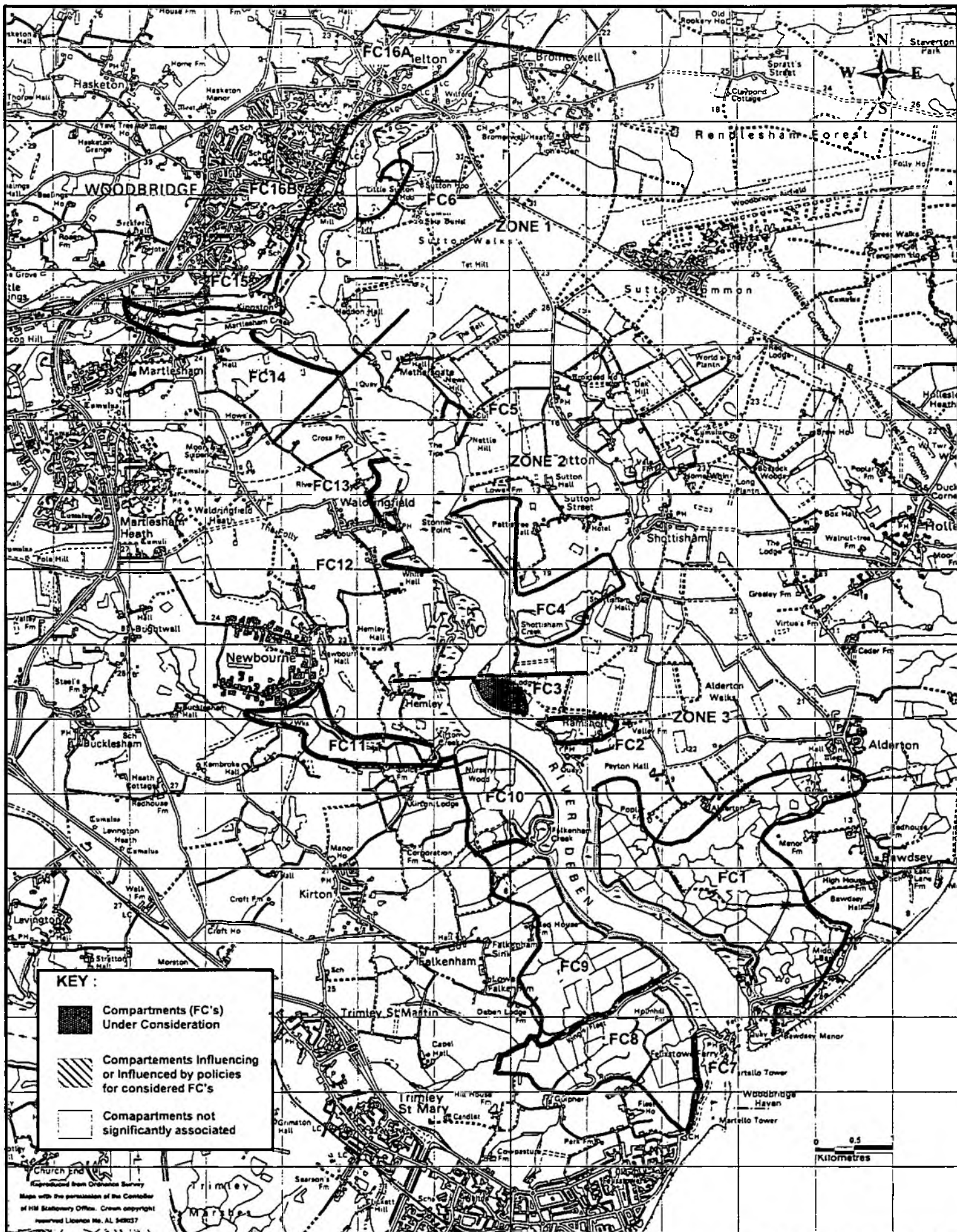
|  |   |   |                |
|--|---|---|----------------|
| <b>FC(s):</b> 3  | <b>FC (s) Name/Location:</b> Ramsholt Lodge | <b>Figure</b> D14                           | <b>ZONE:</b> 3 |
| <b>Assessed critical time:</b> 10 years  |   | <b>Strategy Implementation – Priority</b> 3 |                |
| <b>Physical Characteristics:</b>   |   |   |                |
| <b>Description:</b> Small isolated area of agricultural land in front of Ramsholt Lodge with potential for habitat recreation. Ramsholt Lodge is situated on high ground which restricts the alignment of the river channel. |   | <b>Defence length:</b>                      | 750 m          |
|  |   | <b>Defended area:</b>                       | 10 ha          |

### Strategic Context

| <u>Strategy Policy:</u>              | <u>Key Strategic Issues</u>  |                         |                     |   |
|--------------------------------------|--|-------------------------|---------------------|---|
| Do Nothing                           | <i>Issue</i>   | <i>Associated FC(s)</i> | <i>Significance</i> | <i>Notes</i>  |
|                                      | None   | None                    | Low                 | Relatively independent compartment.                   |
| <b><i>Influence on Strategy</i></b>  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                         |                     |   |
| <b><i>Issue</i></b>                  | <b><i>Significance and Response</i></b>  |                         |                     | <b><i>Action</i></b>                                  |
| Intertidal habitat                   | May contribute to intertidal habitat balance   |                         |                     | Include in review of potential habitat creation sites |
| <b><i>Dependence on Strategy</i></b> | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                         |                     |   |
| <b><i>Issue</i></b>                  | <b><i>Notes</i></b>  |                         |                     | <b><i>Approach</i></b>                                |
| None                                 | None   |                         |                     | None  |

### Management

|   |                              |
|---|------------------------------|
| <b>Local Issues:</b>  | Loss of local farm holdings. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Do Nothing.                  |
| <b>Long term approach (to be applied before critical time elapses):</b> | Do Nothing.                  |



ENVIRONMENT AGENCY

## SUFFOLK ESTUARINE STRATEGIES PHASE 2

**POSFORD  
DUVIVIER**

In association with  
HR Wallingford

DEBEN ESTUARY IMPLEMENTATION  
GUIDANCE SHEETS:  
RAMSHOLT LODGE

**FIGURE D14**

|  |   |                        |              |
|--|---|------------------------|--------------|
| <b>FC(s):</b> 12   | <b>FC (s) Name/Location:</b> White Hall     | <b>Figure</b> D15      | <b>ZONE:</b> |
| <b>Assessed critical time:</b> 10 years  | <b>Strategy Implementation – Priority</b> 3 |                        |              |
| <b>Physical Characteristics:</b>   |   |                        |              |
| <b>Description:</b> Small area of land fronted by a stone or pitch apron on front face of embankment |   | <b>Defence length:</b> | 200 m        |
|  |   | <b>Defended area:</b>  | 4 ha         |

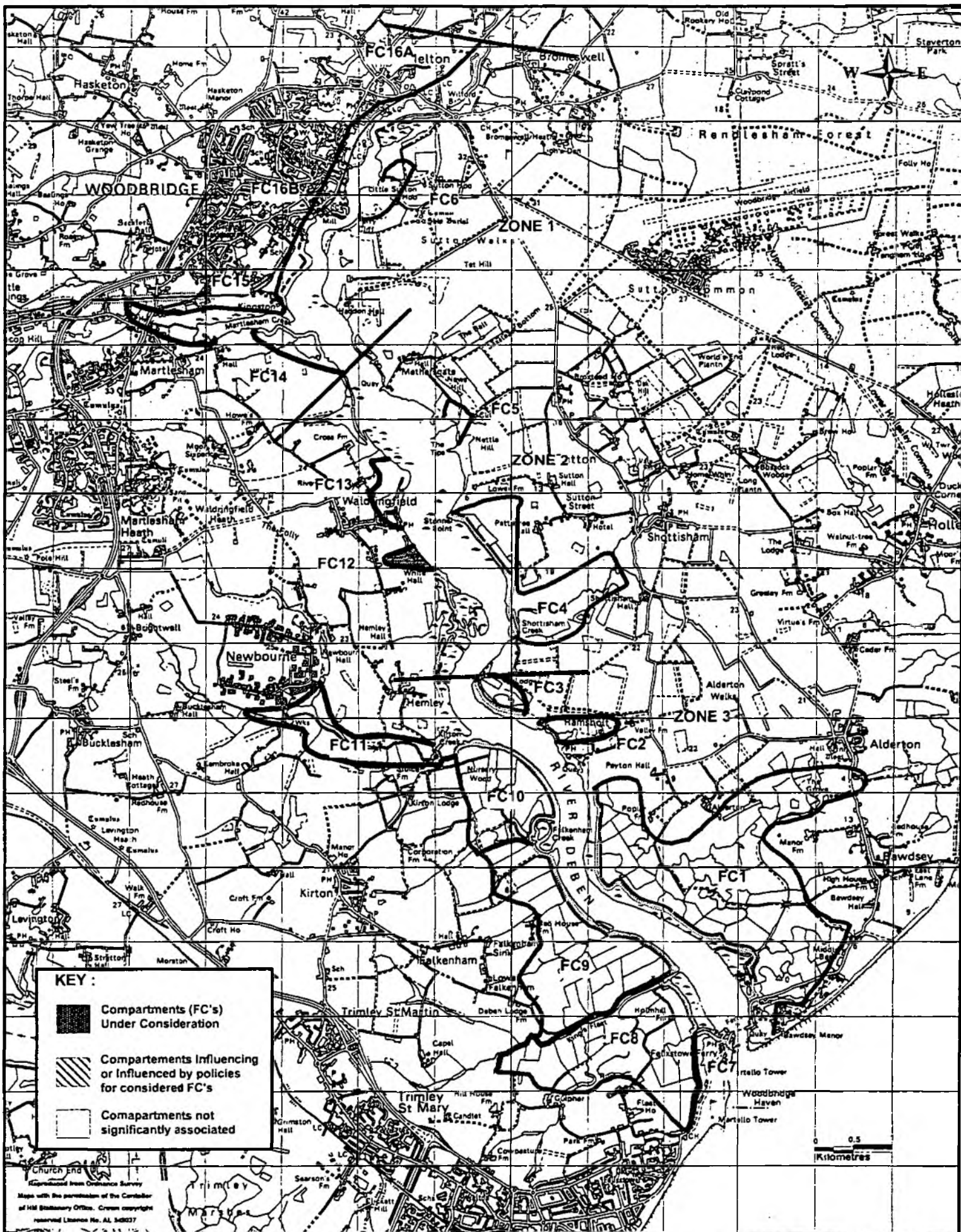
### Strategic Context

|                               |  |                         |                     |                         |
|-------------------------------|--|-------------------------|---------------------|-------------------------|
| <b>Strategy Policy:</b>       | <b>Key Strategic Issues</b>  |                         |                     |                         |
|                               | <b>Issue</b>   | <b>Associated FC(s)</b> | <b>Significance</b> | <b>Notes</b>            |
| D Nothing                     | None   | None                    | Low                 | Independent compartment |
| <b>Influence on Strategy</b>  | (Potential constraints which may have a significant bearing on the overall strategy for the estuary) |                         |                     |                         |
| <b>Issue</b>                  | <b>Significance and Response</b>   |                         |                     | <b>Action</b>           |
| None                          | None   |                         |                     | None                    |
| <b>Dependence on Strategy</b> | (Strategic assumptions upon which the detailed project appraisal of this compartment depends)        |                         |                     |                         |
| <b>Issue</b>                  | <b>Notes</b>   |                         |                     | <b>Approach</b>         |
| None                          | None   |                         |                     | None                    |

### Management

|   |  |
|---|--|
| <b>Local Issues:</b>  | Intertidal area used to land/launch boats. |
| <b>Short term approach (on adoption of Strategy):</b>                   | Do Nothing.                                |
| <b>Long term approach (to be applied before critical time elapses):</b> | Do Nothing.                                |





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ENVIRONMENT AGENCY

**SUFFOLK ESTUARINE  
 STRATEGIES  
 PHASE 2**



In association with  
 HR Wallingford

**DEBEN ESTUARY IMPLEMENTATION  
 GUIDANCE SHEETS:  
 WHITE HALL**

**FIGURE D15**

## **ADDENDUM**

### **DISCUSSION OF FLOOD DEFENCE POLICY, AND ENVIRONMENTAL AND ECONOMIC ISSUES RAISED DURING THE CONSULTATION PROCESS**



**CONTENTS**

- 1. INTRODUCTION**
- 2. FLOOD DEFENCE POLICY**
  - 2.1 Individual Flood Compartments**
  - 2.2 Strategic Decisions**
- 3. ENVIRONMENTAL ISSUES**
  - 3.1 Implications of the Habitats Directive**
  - 3.2 Coastal Habitat Management Plans**
  - 3.3 Mechanism For Saltmarsh Creation**
  - 3.4 Recreation and Tourism**
- 4. ECONOMIC ISSUES**
  - 4.1 Introduction**
  - 4.2 Asset Evaluation**
  - 4.3 Defence Costs**
  - 4.4 Application Of Costs**
  - 4.5 Sensitivity**

## 1. INTRODUCTION

The response to the second phase of consultation (Consultation on the draft strategies) has been comprehensive and wide ranging. Much useful additional information, material to the development of the strategies, has been forthcoming, allowing an initial review of the policies making up the strategy.

In addition, a considerable amount of detailed information has been obtained which, although not directly relevant to the strategy development, provides valuable data for future detailed examination of specific areas and helpful background to the current higher level study.

A third element of the responses identify issues and concerns relating to fundamental policy, legislation and matters of management with respect to interest other than these directly associated with flood defence.

**These third category responses are, of necessity, outside the scope of the strategy study, in that the strategy must be developed within existing policy and legislative framework and should not attempt to dictate management of interest beyond flood defence. However, these issues clearly have a significant bearing on the strategy, and the strategy has thrown up areas open to interpretation.**

**Furthermore, it has to be appreciated that higher level policy may change with time and with circumstance. It is essential that the strategy recognises this and is developed in such a manner as to maintain adequate flexibility into the future.**

It is, therefore, felt to be helpful to discuss the main issues raised and to examine how these might possibly influence the strategy development on how the integrated approach promoted by the strategy potentially opens fresh interpretation of some of these higher level policies.

**This addendum provides this discussion and is divided into three main subject areas; those of defence policy (legislation, compensation and private investment), environment ( legislation, mitigation and management) and economic (PAGN, asset evaluation and sensitivity to variations). These discussions are not intended to be definitive but rather to highlight questions, provide guidance and primarily to set the context of strategy recommendations within the higher level framework. Whether having a critical bearing on the strategy or not, it is felt that further investigation of these issue will be necessary in the medium to long term if correct overall management (management over and above flood defence) of the estuary is to be achieved and if detailed project appraisals are to be successfully accomplished.**

## 2. FLOOD DEFENCE POLICY

Defence policy has a fundamental impact on virtually all aspects of use and interest within the estuaries; from agriculture and other land use, recreation, water quality, ecological function and interest, to the way in which the estuary behaves, and hence the interaction with other areas or other defences within the estuary.

This is in addition, of course, to the actual role of defence in protection of life and assets.

Reflecting this is a plethora of legislation both directly relating to duties and functions of those responsible for defences and drainage works and indirectly relating to impacts associated with management of defences. **The confusion surrounding this has generated one of the main areas of concern during consultation.**

The Environment Agency ("the Agency") has permissive powers to undertake flood defence works. The Agency also has a mandatory duty to exercise a general supervision over all matters relating to flood defence. In this latter regard, the Agency performs its duty through its "consenting" powers, either directly, as in the case of its statutory consultee role under the Coast Protection Act, or through the planning consent procedures.

A consent to a person undertaking works on a defence cannot reasonably be withheld, but in judging this the Agency must be guided by its principle aim to contribute towards attaining the objective of achieving sustainable development.

In addition to the above aim, the Agency is guided in the performance of its permissive powers, to undertake defence, by the need for economic worthwhileness, and for the scheme to be technically sound and environmentally acceptable.

Against this background, principal areas of concern raised by consultees relate to:

- what constitutes positive action in relation to the Agency performing its permissive role?
- what powers does the Agency have to prevent a private person undertaking works to protect their own land?
- what compensation would be available in the event of the Agency's actions, inaction or prevention of action?
- How would compensation be determined, and would equitable payments be available to address both strategic and non-strategic area defence recommendations?

Although tested to a degree on individual schemes, these questions in relation to strategies and strategic management of estuaries are still unresolved. The intention, therefore, is to highlight some of the issues so as to provoke further discussion, rather than provide definitive answers.

A strategy may comprise several elements but provides, overall, a coherent approach to the management of defence to all assets and interest within the estuary. As such, it could be argued that the strategy, if it involves any works, could, in its entirety, be taken as an active works scheme. Any damages arising from undertaking, or locally not undertaking, works could result in compensation being payable for injury, loss or damage sustained as a result of the strategy as a whole. Such an attitude seems extreme, potentially creating unacceptable precedent well beyond estuary management and therefore is likely to be unacceptable.

However, there is a general principle within this which should arguably be considered; that the strategy anticipates loss to the individual for the benefit of better management of the estuary in

general. In particular, it allows the Agency to perform its duties, under such legislation as the Habitats Directive, and in achieving a more economically acceptable solution to the problems of defence.

From this it becomes more sensible to examine individual elements making up the strategy. Four cases may be considered:

- i) & ii) relating to individual flood compartments that are either justifiable or unjustifiable economically;
- iii) & iv) relating to estuary-wide strategic decisions which result in local loss to benefit the estuary as a whole or result in conflict between lengths of defence.

These are discussed in detail in Sections 2.1 and 2.2 below.

## 2.1 Individual Flood Compartments

The strategies have identified that **there are some areas where there is little strategic interaction with other areas of the estuary**, whether the defence is maintained or not.

In the traditional situation; the unit is evaluated in terms of the cost of defence compared to potential loss of assets. Two cases, apart from hold the line, may arise.

- i) There is no economic justification for defence. The Agency has a discretion whether or not to protect a particular area and if protection were shown not to be in the nation's benefit, it would be reasonable to abandon the defence. In exercise of this discretion, if the Agency decides to abandon or no longer maintain an existing defence, it would generally not be liable for any damages.
- ii) There is economic or environmental justification in defending only part of an existing flood compartment. If the action were taken to protect the residual area, rather than actively to cause flooding of the area between the new and existing defences, then it seems probable to assume that damages would not occur as a result of action taken by the Agency. This would assume that the front line defences were not actively breached; set back or retreat would have been for local reasons not for strategic benefit.

In this local situation there would, under normal procedures, be a need to compensate landowners for land taken or damaged in association with the construction of the new defences.

In both cases i) and ii), since there is no strategic benefit in abandoning or retreating defences, it would be arguably inappropriate for the Agency to withhold consent if a landowner wished to undertake private defence works. (This would presume that such proposals were environmentally and technically sound). This then raises the question as to whether a contribution offered by the landowner balancing the economic disadvantage between abandoning and maintaining the existing defence should reverse the decision to abandon the defence.

## 2.2 Strategic Decisions

**In general there is a high degree of physical interaction and interdependence throughout the estuaries, and a need to maintain the overall ecological integrity and comply with the Habitats Directive.** Decisions are being made for the national benefit, not on a purely local level.

- iii) One of the most difficult areas is where it is proposed to abandon defences specifically to

meet the strategic needs of the strategy to maintain the favourable conservation status of the estuary. It may be argued that, in such a case, regardless of whether physical action is taken or not, the Agency is actively causing the abandonment of the defence in that consent for private works to maintain the defences might be withheld. On the basis that in implementing such abandonment, the Agency is exercising its powers under the Water Resources Act 1991, compensation would be payable for any injury, loss or damage sustained. This is certainly not Government Policy at present, although grants are being made available through set aside projects, ESAs and Countryside Stewardship Schemes to encourage such decisions.

Consultation responses indicate that, while such initiatives are welcomed in many circumstances to encourage or facilitate co-operative enhancement of the environment, they are seen as inadequate to cover enforced retreat. This resistance reflects the concern over possible irretrievable loss of ownership (eg. land reverting to Crown ownership as sea level rises), possible loss of irrigation sources and the potential result in inefficient use of existing plant and facilities due to the reduction of farmed land area. On this latter point it is argued that landowners have made investments based on their existing areas of land, which could not be justified if the total area of land was substantially reduced.

- iv) **Conflict Between Defences.** The strategies identify interdependence between the cost of defence of two or more flood compartments. In many areas the transferred defence burden actually justifies, in economic terms, the continued defence of compartments, which at a local level are indicated as being uneconomic.

The Agency's powers, and the nation's subsequent responsibilities to individual landowners, is really, however, called into question where holding the line in one area places additional burden onto other defences.

In the extreme situation, and following the MAFF guidance in properly assessing whole life costs, this can result in a decision to abandon or retreat one line of defence so as to create a sustainable condition with respect to another defence line. This is potentially more complex where, assessed individually, both areas might be economically defensible but where viewed together a more sustainable and economic solution is to retreat one line.

This situation cannot be equated to the situation on the open coast, where work on an updrift area may deprive an area downdrift of sediment. In an estuary the economic argument results from a conflict between two sides of a channel and the combined impact on flows resulting in increased pressure. **Decisions relating to both defence lines must arguably be seen as one scheme. The decision to retreat one side, but maintain the defence opposite is, therefore, logically all part of an active exercise of the Agency's powers.**

Furthermore, the Agency would, in attempting to implement the strategy, logically withhold consent to any private landowner proposing to undertake defence work.

Any attempt by a landowner to maintain his defence, where it can be demonstrated to cause damage to another defence could be construed as a nuisance. Especially in the case where the physical regime is altered in such a way that the other defence no longer becomes economic to maintain and is subsequently abandoned.

The above attempts to outline the key issues raised by the consultees, setting them in the context of the strategy. Clearly there are no definitive answers at present and there is an urgent need for matters to be considered further.

The real option must be for all those with a stake or interest in the estuary to recognise the need for a strategy providing the basis for more detailed examination of these and other issues.



At present the general expression of consultees is that compensation, by way of environmental improvement grants, is based on too short a timescale and does not truly relate to the loss that may occur.

Concern has been expressed that the economic damages evaluated in the main report, reflecting as they do only the loss to the nation also fail to recognise the true value of land and assets to the landowners. Other opinion considers that substantial benefit has already been gained by landowners at considerable expense to the nation over many years through the provision of defences and that there should therefore now be no compensation for loss.

Finally, two aspects which have been raised several times are those of EU human rights and social benefit. The former is due to be addressed by legislation in the near future, and certainly the strategies will need to be reviewed in light of this.

The latter relates to the unevaluated damages to the local communities and regional (as opposed to national) economy. There is recognised to be little guidance on this matter and it is strictly outside the scope of the strategy study. It is, however, clearly important and must be considered when examining, in more detail, the implementation of the strategy framework.

### 3. ENVIRONMENTAL ISSUES

#### 3.1 Implications Of The Habitats Directive

All three of the estuaries considered as part of this strategy are of international importance for nature conservation, with the Deben, Alde-Ore and Blyth being designated as Special Protection Areas (SPAs) under the Birds Directive and much of the Alde-Ore designated as a Special Area of Conservation under the Habitats Directive. The Conservation (Natural Habitats etc.) Regulations 1994, transpose the Habitats Directive into UK law and also apply specific provisions to existing and future SPAs. The Regulations impose restrictions on development likely to significantly affect a SPA or SAC, and which is not directly connected with or necessary to the management of the site. These restrictions apply to plans or projects, including those that would be implemented through a strategic approach, and therefore in effect the strategies themselves have to be compliant with the Habitats Directive.

Concerns have been raised during consultation from various organisations and individuals including English Nature, RSPB and the Suffolk Wildlife Trust regarding the implications of some of the proposed strategic options with respect to nature conservation interests and compliance with the Habitats Directive. These concerns essentially revolve around proposed retreat or Do Nothing options that would result in the loss of freshwater grazing marsh designated as SPA. Specific examples include Tinkers Marsh on the Blyth Estuary and Hazelwood Marsh on the Alde-Ore. Implementation of these options would result in the loss of these freshwater habitats, which could constitute an adverse effect on the ecological integrity of the designated site. Without adequate compensation to offset these potential losses it is considered that the strategies run counter to the Habitats Directive. The line presently taken by MAFF with regard to the protection of internationally designated habitats from flooding or erosion is that the feature should be maintained *in situ*. However, the alternative of habitat re-creation could be entertained where to maintain a feature *in situ* would either:

- Cause damage or loss to other European or other internationally important features; OR
- Require a scheme that failed to pass one or more of the following tests: that it be either technically, economically or environmentally sustainable in the long term.

As stated in the Strategies the overall aim is to maintain or improve the overall balance of the estuaries in terms of both the natural and human environment. To do so requires that future flood defence policy (and works) take account of, and work with, the dynamic environment that the estuary itself creates. This is reflected in the view put forward in the Strategies that where the maintenance of defences to flood compartments is not sustainable in the long term then alternative solutions to defence should be sought e.g. managed realignment or do nothing. In some cases this approach leads to the situation where the most sustainable option is to realign the estuary over existing areas of nature conservation interest in order to enable dynamic change in the form of the estuary to occur. In other cases realignment over agricultural land is clearly the most suitable option. Tinkers Marsh, in particular, is located within a particularly dynamic section of the Blyth Estuary that is under intense and increasing pressure from estuarine processes and the likely effects of sea-level rise. In addition, the marsh surface occurs below mean high water level and is already prone to saline seepage and occasional overtopping. The habitats present at Tinkers Marsh could be sustained within their present location. However, to do so would be economically unjustified, the works themselves to provide the level of protection required to the existing habitat could be damaging in their own right and perhaps most importantly, this policy would continue to support the maintenance of a habitat that is ecologically 'isolated' from the rest of the estuary system, and clearly unsustainable in the longer term (over 50 years)

In isolation realignment over existing SPA designated grazing marsh at Tinkers, or other sites, would constitute significant effect with regard to the Habitats Directive and could be viewed as an adverse affect on the integrity of a European site. However, Strategic policies have been proposed that provide a defence framework that can accommodate for the loss of existing freshwater habitat and

which could promote its creation in more ecologically fitting and sustainable locations e.g. towards the heads of tributary rivers. It may therefore be possible to propose the loss of part of an existing European designated habitat as long as measures are taken to ensure its replacement within an estuary system. As such the interests for which the European site was designated would be maintained, and possibly enhanced, and therefore integrity would not be compromised. This approach is being advocated through the production of Coastal Habitat Management Plans for coastal, dynamic sites of European interest. In some cases, the Strategies indicate potential areas where habitat recreation or enhancement could be undertaken in order to offset habitat loss e.g. replacement for Tinkers Marsh on the Blyth Estuary could be undertaken upstream of the A12. For some potential areas where SPA habitat could be lost e.g. Hazelwood Marsh, suitable areas for habitat re-creation have not been identified. However, the Strategies provide a defence policy framework that would allow the establishment of new habitat to take place within locations that are sustainable from a physical process and economic perspective.

Realignment or do nothing policies within the estuaries also enables the issue of 'coastal squeeze' to be dealt with. This represents the effect whereby existing flood defences prevent lateral saltmarsh migration in response to sea-level rise. With no scope for compensatory development landwards, the width of saltmarsh is becoming progressively narrower as the seaward edge of the marsh is eroded. Under the Habitats Directive, the loss of saltmarsh through maintaining the existing line of defence in its entirety could constitute a significant effect and potentially have an adverse affect on the integrity of the SPAs. If this is the case then realignment within the estuaries would be required in order to compensate for saltmarsh loss. Undertaking such realignment specifically in relation to the needs of the Habitats Directive would constitute a piecemeal approach to flood defence and habitat recreation. The Strategies, as proposed, provide the means to offset saltmarsh habitat loss, and therefore meet the requirements of the Habitats Directive, within a strategic framework for flood defence.

**At the present time, there is a danger that interpretation of the Habitats Directive will lead to the protection of valued sites for nature conservation in locations within the estuaries where their maintenance is clearly ecologically and economically unsustainable.** Taking this approach could have two significant consequences. Firstly, the dynamic evolution of the estuary system could be hindered resulting in adverse effects elsewhere in the estuary and secondly opportunities for habitat creation could be missed or become economically less viable. Maintaining and enhancing the overall ecological interests of the estuaries and ensuring compliance with the Habitats Directive is a difficult and complex task. The entire issue has to be viewed as an integral part of the long term management of the wide range of estuary uses and interests. **As such, it should be accepted that in the face of external forcing mechanisms, such as sea-level rise, there may well have to be a redistribution of habitats through landuse change in order for ecological function to be maintained and potentially enhanced.** Adopting a static approach to the management of flood defences is not an option.

### 3.2. Coastal Habitat Management Plans

The following text represents draft guidance on the likely content, development and scope of Coastal Habitat Management Plans (CHaMPs). This information has been drawn up by English Nature and the Environment Agency. It is intended that CHaMPs will assist in the development of sustainable coastal defence strategies in those areas where coastal defence measures have implications for internationally important wildlife sites. The guidance has been prepared in consultation with MAFF and the Department of the Environment, Transport and the Regions and will be revised following comments received from consultation with various organisations and interest groups.

Coastal Habitat Management Plans (CHaMPs) are intended to provide a framework for managing sites of European importance and Ramsar sites that are located on or adjacent to dynamic coastlines, including estuaries. They are intended to provide a way of fulfilling the UK Government's obligations under the Habitats and Birds Directives to avoid damage and deterioration to Natura 2000

sites, and its obligations under the Ramsar Convention, where the conservation of all the existing interests *in situ* is not possible due to natural or quasi-natural changes to shorelines. Their two primary functions are:

- to act as an accounting system to record and predict losses and gains to the Habitats and Species of European or international importance within a Natura 2000 or Ramsar site subject to shoreline change
- to set the direction for habitat conservation measures to address net losses.

By doing this they will ensure that damage to or deterioration of Natura 2000 sites from either changes to estuaries and the open coast or, from the sea/flood defence response to such changes, is avoided or compensated for. The plans will therefore contribute to maintaining the coherence of the Natura 2000 and Ramsar site network.

### 3.2.1 Scope of Coastal Habitat Management Plans

It is intended that each CHaMP will cover a site complex. This will normally consist either of a single coastal SAC or SPA, or more commonly a complex of overlapping or contiguous coastal SACs and/or SPAs and Ramsar sites. However, in order to encompass areas where replacement habitats can be created and sustained, CHaMPs will often also have to take in areas immediately adjacent to those currently designated as of international interest e.g. coastal or estuarine flood plain, and which could reasonably be predicted to achieve a similar ecological function with appropriate management.

CHaMPs will provide a framework for managing site complexes over a relatively long period. It is anticipated that this would normally be between 30 and 100 years depending on the type of coastline involved. Habitat creation and other works should however be planned with a view to their sustainability for the foreseeable future.

### 3.2.2 Application of CHaMPS to the Suffolk Estuarine Strategies

The Strategies as developed are not a CHaMP or replacement for a CHaMP. However, the basic sentiments and ideas that CHaMPs will cover have been considered and where appropriate incorporated into the Strategies.

As with CHaMPs, the basis for the development of the strategies is the physical processes operating within each of the estuaries and consideration of the likely evolution of the estuary systems in response to sea-level rise and continued operation of these processes. The proposed defence options have been put forward to enable the estuary to respond to the pressures which it is currently experiencing and to enable a more sustainable approach towards the management of defences to be advanced. In all three of the estuaries taking this approach requires that decisions have to be made about the sustainability of existing defence policies in relation to the likely evolution of the system and the habitats that the system supports. In certain instances it is clear that the defences currently protecting some areas of habitat are under pressure either due to processes, likely change in processes (e.g. sea-level rise) or strategic location. Continuing to protect such sites, whilst enabling obligations under the Habitats Directive to be met, does not enable dynamic evolution of the system to take place, is economically unjustified and perhaps most significantly is ecologically unsustainable.

### 3.2.3 Predicted changes to estuaries and the shoreline

CHaMPs will be based upon a 'best guess' model for how the shoreline within each management plan area is likely to change over the next 30 to 100 years. This will be informed by, review of coastal processes, the preferred defence options set out in the Shoreline Management Plans, detailed strategic

plans for flood and coastal defences, but also building in other available data and expert opinion. This review of predicted changes to the shoreline will in turn feed back into the next revision of SMPs and to any strategies produced subsequently. The aim will be to integrate CHaMPs into Estuary and Shoreline Management Plans.

From consideration of likely estuary and shoreline changes for each CHaMP a list of the European and other internationally important features and parts of features which can be maintained *in situ* under conditions of dynamic coastal change and a list of those which are unlikely to be sustainable in the face of coastal change over a 30 to 100 year period will be derived. Maintenance of a feature *in situ* will be the choice of preference (existing MAFF policy). The alternative option of habitat re-creation will only be entertained where to maintain *in situ* would either:

- a. Cause damage or loss to other European or other internationally important features.
- Or b. Require a scheme that failed to pass one or more of the following tests: that it be either technically, economically or environmentally sustainable over a 30 to 100 year period. Technical and economic sustainability are not easy to define, but a working definition of where maintenance *in situ* might be unsustainable might be where this course of action would require continued, excessive and increasing input of natural resources and money.

### 3.2.4 Assessment of effect on site integrity

The list of features which cannot sustainably be maintained *in situ* will be used to inform an assessment of whether or not the scope and scale of habitat loss and/or change likely to result from shoreline change and the management response to it over a 30 to 100 year period has the potential to cause adverse effect on site integrity.

### 3.2.5 Programme of measures

Where it is predicted that an adverse effect on integrity would occur, the CHaMP would then go on to set out the targets to, either avoid an adverse effect on integrity, or to compensate for it. There would then be a programme consisting of the measures considered essential to meet these targets through the development of replacement habitats. These should be located within or immediately adjacent to the site complex wherever possible, though it may sometimes be necessary to look more widely within the natural area. The CHaMP would also assist this part of the process by identifying potential sites for replacement habitat within the proposed rolling five year time frame.

### 3.2.6 The iterative nature of the plan

It is recognised that the targets for habitat replacement will initially be set on the basis of some fairly broad assumptions, both on the likely scale of habitat loss, and on the likely response. The plan will therefore need to be a living document. The figures for anticipated habitat loss, and the targets for habitat replacement derived from them will need to be adjusted each time a scheme goes forward, after detailed consideration of the different options for that scheme, or as and when other new information becomes available. The CHaMP will need to identify monitoring requirements to keep the inventory of habitat losses and gains up to date.



### 3.2.7 Anticipatory replacement of habitat

Once plans have been prepared and agreed, it will be desirable to start to replace the habitats and the habitats of species of international importance in advance of the loss occurring. The ability to replace in advance also offers the pragmatic and ecological advantages of economies of scale that may be achieved by combining several smaller habitat replacement schemes.

However, bearing in mind the uncertainties surrounding the prediction of future changes, and the need for an iterative approach within CHaMPs, it is proposed that the loss predictions and the habitat replacement targets should be profiled as best as is possible within the 30 to 100 year life of the plan. Advance habitat replacement should then normally be limited to that predicted as necessary within a rolling five year time horizon, though this limit will need to be applied with a considerable degree of flexibility so as not to preclude otherwise sensible and economic solutions.

### 3.2.8 Legal basis for the Coastal Habitat Management Plan

It is proposed that a CHaMP will be a Management Plan as mentioned in Article 6.1 of the Habitats Directive. Where the site complex includes or overlaps with a European marine site, the CHaMP will be written so that it can be integrated with the Scheme of Management provided for in the 1994 Habitats Regulations, so that they can together fulfill the requirement in the Regulations for a single Management Plan for each Natura 2000 site. A CHaMP is viewed as an aid to the application of the Habitats Regulations to particular schemes. It is envisaged that they will be particularly helpful in making the judgements required by the Habitats Regulations in relation to the assessment of effects in combination with other plans and projects and in relation to whether there will be an adverse effect on the integrity of a site. It must be stressed that a CHaMP does not offer an alternative regulatory pathway to the Habitats Regulations.

Because the purpose of a CHaMP is essentially to manage long term natural or quasi-natural changes to the coast it may be the case that works required to maintain site integrity are 'necessary for or connected with site management for nature conservation'. As such they need not be subject to the tests of significant effect and adverse effect on integrity required under the Habitats Regulations for 'plans or projects'. Such a view would be most likely to be applicable where the habitat modification took place within the existing boundaries of the site or sites and was essentially facilitating a natural process.

Where a plan or project is envisaged, habitat conservation may not be possible within the current boundaries of a European or Ramsar Site. In such a case, where an adverse effect on integrity is unavoidable, the CHaMP is intended to provide the context for a subsequent decision which could lead to the conclusion that the scheme was required for imperative reasons of over-riding public interest. Each case will have to be decided individually, but it could be considered that the action was necessary for environmental as well as flood defence reasons, ie the action being the best environmental solution which allows coastal habitats to adapt to changes in the coastline. The plan will be so constructed that the flood defence management responses, combined with the habitat replacement measures set out in the plan, will demonstrate the environmental justification for the project and set out what compensatory measures would be taken to ensure that overall the network of Natura 2000 and Ramsar sites in the area remained coherent.

### 3.2.9 Management of site boundaries

CHaMPs will need to include a procedure for adjusting the formally designated boundaries of the European sites making up the site complex. This is necessary to ensure that the provisions of the Directive are complied with, and that areas of recreated habitat receive legal protection against development and other man-made threats. Formal adjustment of boundaries to include areas of

recreated habitat will need to wait until the appropriate interest has developed. The plan will however need to set at the outset a 'Site Envelope' within which habitat replacement works are likely to be required during the lifetime of the plan. Local Authorities will need to be given a policy steer to integrate the management plan, and the implications for these 'Site Envelopes' in structure and local plans.

### **3.3. Mechanism for Saltmarsh Creation**

The development of Saltmarsh vegetation can be seen within all of the estuaries where former flood defences have been abandoned. However, it cannot be guaranteed that saltmarsh would develop within any one particular area, particularly given the potential implications of sea-level rise. As such if realignment is viewed as a means of creating a specific quantity of saltmarsh, either to maintain overall site integrity or possibly to contribute towards biodiversity targets then detailed consideration will need to be given as to how this is achieved. This would require engineering, timing and potentially modelling to ensure that the aims can be achieved and that the process itself does not have adverse effects elsewhere in the estuary system.

Currently, the MAFF Habitat Scheme pays landowners to undertake saltmarsh creation through the realignment of existing flood defences. This scheme is presently under review and it is likely that intertidal habitat creation rather than just the creation of saltmarsh habitat will be eligible for payment. Payment levels are being considered as part of the review. However, there has been criticism in the past that the scheme does not provide for the loss of the capital value of any land and that the overall payment levels are below that which agricultural production might achieve. There has therefore been a reluctance to enter into the scheme, as evidenced by the rate of uptake, particularly by landowners with agricultural rather than nature conservation interests. Further details of the scheme, once the review process has been completed, should be available from MAFF.

### **3.4 Recreation and Tourism**

Tourism and recreation are now the main economic providers in the Suffolk Coast and Heaths area. The landscape of the estuaries and their recreational use is viewed as of critical importance in ensuring that the overall interest of the area to tourism is maintained. There are increasing demands on the area from this sector that have implications with regard to the flood defence strategies and several issues have been raised through consultation.

#### **3.4.1 Public Rights of Way**

This issue specifically relates to potential managed realignment and do nothing options for flood compartments where existing rights of way are routed along the tops of flood defences or through areas likely to be affected by inundation. It is considered that the implementation of these options could lead to the loss of access to certain areas or changes to existing routes that currently provide aesthetic views or form part of the Suffolk Coast and Heaths long distance footpath. There are legal obligations against damage to or loss of public rights of way. In most instances the loss of part of a footpath would not affect the ability to utilise the existing network to obtain access to the estuaries or as through routes to other sections of the coastline. However, there would be a reduction in the overall extent of available rights of way and changes in the accessibility to particular areas e.g. Aldeburgh Marshes. The legislation with regard to public rights of way is complex, but essentially, and with reference to the proposed Estuarine Strategies, the issue of loss or need for diversion can be addressed through existing legislation.

By virtue of Section 130(1) of the Highways Act 1980, county councils have a duty, as highway authorities, to assert and protect the rights of the public to use and enjoy those public rights of way for

which they are responsible. This applies to the vast majority of the footpath network apart from those that are privately maintainable. The Highway Authorities also have a similar duty to prevent, as far as possible, the stopping-up or obstruction of those public rights of way for which they are responsible and to safeguard public enjoyment of those highways for which they are not responsible.

The Town and Country Planning Act 1990 enables local planning authorities to make orders to stop up or divert footpaths to enable either development for which planning permission has been granted or development by a government department to be carried out. In the case of the loss of a footpath due to the implementation of a managed realignment scheme it is likely that planning permission would be required and therefore issues related to footpath diversion or stopping-up would fall to the local authority. In addition to enabling a footpath or bridleway to be diverted along another route the Act also enables orders to include provision for the creation of an alternative highway, or the improvement of an existing one, for use as a replacement for one being stopped up or diverted. Where the diversion or alternative right of way is proposed to be provided and dedicated over land not owned by the developer, the consent of the landowner(s) to the proposed dedication should be obtained before an order is made.

Section 26 of the Highways Act 1980 empowers local authorities to make orders for the creation of footpaths and bridleways if it appears to them that there is a need for such facilities in their area. Under the same Act it is also possible for a local authority to make orders to extinguish footpaths and bridleways or divert routes in the interest of the public. The diversion or creation of a right of way may require consent from other statutory undertakers. Consultation with these organisations and the general public is therefore viewed as an integral and important part of the process.

Based on this information the following points can be made with relation to the Strategies:

- Implementation of the proposed policies contained within the Strategies requires further and detailed consideration including assessment of how rights of way may be potentially affected. The local authority, Environment Agency, landowner(s) and general public will need to be closely involved in the assessment of rights of way issues and the required decision making process.
- Where a Do Nothing option is proposed that could result in the loss of part of a right of way the local authority has powers to create a new footpath or enhance part of the existing network to replace the loss. Consent from other statutory bodies may be required as could compensation for any loss of interest in the land affected by diversion or creation of a path.
- Under a re-alignment option where planning permission was required the diversion or stopping-up of a footpath would be a material consideration as part of the planning process. Through this process it may be determined that a replacement footpath or diversion is required and the gaining of orders to undertake this would have to be considered as part of the overall scheme.
- Where defences are set back on a new line then the new defences could provide the route for a new right of way.

### 3.4.2 Navigation

The maintenance of navigable channels for boating activity within all three estuaries, but in particular the Alde-Ore and Deben is a key issue. One area of concern is that through policies of realignment and/or do nothing the tidal volume and current velocities within the estuaries will increase to the extent that moorings and navigation will be adversely affected. For all three estuaries, implementation of the Strategies would lead to an increase in tidal volume. However, it is considered that this increase could be accommodated within the estuaries without adverse impacts on boating and navigation interests. **The increase in tidal volume due to realignment or do nothing policies has to be viewed in relation to potential volume increase due to sea-level rise.** Within the existing estuary form an increase in tidal volume due to sea-level rise would result in increased current velocities in some sections of the estuaries with potential adverse impact on navigation and boating

activity. However, realignment may actually enable any increase in velocities due to sea-level rise to be offset through an increase in the tidal cross section of the estuary. This would be most apparent at existing pressure points within an estuary e.g. the neck of the Alde just upstream of Aldeburgh Marshes.

Siltation within the upper estuaries, notably the Deben and parts of the Alde-Ore may well be a function of response to sea-level rise. While it is unlikely that the defence policies put forward in the strategies would alleviate this natural response, it is not considered that implementation of the Strategies would contribute further to this problem.

### **3.4.3 Landscape and Aesthetics**

Whilst not a central driver behind the production of the Strategies, it is clear, given the location of all three estuaries within an Area of Outstanding Natural Beauty, that maintaining the aesthetic qualities of the estuarine landscape is an important issue. This is particularly so in relation to the role that the estuaries and the general coastal landscape have in attracting visitors and tourists to the area.

The flood defence strategies if implemented as presented would lead to change within the estuaries. Inundation of some areas of land that are currently in agricultural production or former flood plain grazing marsh would lead to the creation of areas of intertidal habitat. Some of these would be created through a do nothing option and would therefore not require any additional construction works to be undertaken. Re-alignment would probably involve the construction of new defences, which could be viewed as having an impact on the landscape. However, as they would invariably be replacing existing structures this is not considered to represent a significant issue at the strategic level. In addition, the creation of additional intertidal areas by realignment could offset the potential loss of saltmarsh habitat through coastal squeeze. There may also be a requirement, through the Habitats Directive to create additional areas of freshwater grazing marsh to replace any areas lost through realignment. Without these proposed measures there could be a general degradation in the overall quality of the estuarine landscape through the loss of significant amounts of saltmarsh vegetation. Taking into account these habitat creation opportunities, it is considered that implementation of the proposed policies would maintain the overall character and balance of the existing estuarine and coastal landscape.

## 4. ECONOMIC ISSUES

### 4.1 Introduction

The aim of the Suffolk Estuarine Strategies is to provide a long term strategy for the management of flood defences within the estuaries of the Rivers Blyth, Alde/Ore and Deben. Inherent to this is the need to examine the potential economic benefits from and costs of defence for a number of different scenarios. The economic assessments for the estuaries has been carried out in accordance with MAFF's Project Appraisal Guidance Notes (PAGN). Some of the basic premises upon which the assessments have based are discussed below:

The normal approach to the initial comparison of options set out in PAGN is through their respective benefit cost ratios. This does not, however, reflect the fact that increased investment may result in substantially better benefits and hence the need to consider incremental benefit cost analysis (PAGN decision rule step III) especially when examining whole life strategies. Nor does the benefit cost ratio provide a simple means identifying the transfer of cost, which is fundamental in taking an integrated view of the estuary defences.

The approach, therefore, adopted is to compare options on the basis of their Net Present Value (NPV). This is both a measure of incremental benefit and highlights the deficit or overall economic benefit which may be derived from a specific approach to defence. For each option considered, the NPV is a measure of either the economic advantage or disadvantage in adopting that option compared to a Do Nothing approach.

The calculation of the NPV for each option is:

$$NPV = PV_{(\text{damage avoided})} - [PV_{(\text{capital costs})} + PV_{(\text{maintenance costs})} + PV_{(\text{residual damage caused})}]$$

For a scheme to be economically viable, the NPV must be greater than zero.

The decision to abandon, or hold, a defence in one area may result in additional cost or damage elsewhere. This may be due to an increase or redirection of the flow, more rapid erosion, and the need to install more costly forms of protection or the need to extend the defended length. Equally, it may create an opportunity for, or cause the loss of, habitat or use, which may detract from, or add, to the value of the estuary as a whole. Underlying the strategic analysis of the estuary is the need to add together these costs, benefits and other impacts across the whole area of the estuary. The mechanism that has been set up enables this process of transfer to be assessed.

### 4.2 Asset Evaluation

The assets generally comprise the inherent value of the land within the flood plain, specific assets such as individual properties and, in some cases, the added economic value of land supported by irrigation using freshwater supplies within the flood zone. A detailed identification of assets has been undertaken on a field by field basis. However, average values have been used in attributing value.

#### Agricultural land within the flood compartment:

This category considers land that has being identified as lying within the estuary's flood plain. It includes land which is, or may potentially in the future be, used for agricultural production. The value of the land is assessed in accordance with PAGN Annex G. PAGN identifies three categories of land, the first of which (Scenario I) considers agricultural land that will be permanently under water, or sufficiently affected so as to prevent any future agricultural production. Such would be the case in the flood plains of the Suffolk Estuaries. In this scenario, the prevailing market price of the land is taken and multiplied by a factor of 0.4, to indicate the value of the land to the nation.



For the Suffolk estuaries, a market value of £8,065 per hectare was ascertained from Nix's Farm Management Pocketbook (1999 edition). This value is towards the top of the acceptable range of values, and recognises the general high quality of land in the Suffolk area. This market value is then multiplied by a factor of 0.4 to give an adjusted value of £3225 per hectare.

Agricultural land remote from the flood compartment:

This category considers land that is influenced by flooding of the low-lying land in the flood compartments. Throughout the estuaries there are a large number of licences allowing the abstraction of water from specified points such as wells, boreholes, surface streams, for the purpose of irrigating the surrounding higher land. This irrigated highland typically produces a high crop output, and so must be considered in assessment of the economic assessment. Flooding of the lowland would result in the saline contamination of these abstraction points, and therefore greatly reduce the agricultural output from the highland.

Two possible methods of assessing the impacts of lowland flooding on the adjacent higher land, may be considered, depending on the degree of information available – based on either a proportion of lowland impacts, or gross margin of specific crops.

For an holistic strategic study such as the Suffolk Estuarine Strategies, detailed information on crop types, land quality and irrigation rates throughout the estuaries may not be obtainable on a wide scale. In this case, it is more practical to apply a factor to the cost of flood damage to the lowland which has been calculated in accordance with Scenario I of PAGN. Considering the great reliance which is placed on irrigation around the Suffolk estuaries, a multiplication factor of 2 was adjudged to be appropriate. This models a situation where gross margins achieved on the higher land may be double those in the flood plain, but the areas affected by individual abstraction points will not be as great as the areas of the flood plains. It also makes allowance of the fact that non-irrigated high land will not be lost but merely have a reduced gross margin imposed on it.

Properties and other structures:

Damage to properties due **frequent flooding or surrender** was based on typical property values obtained from local land valuers and landowners.

**Table D.2 Valuation of Assets**

| Asset   | Degree of flooding | Frequent flooding OR surrender of land       |
|---|--------------------|--|
| <b>Land</b>                                       |                    |  |
| Agricultural – direct flooding                    |                    | £ 3,225 / Ha                                 |
| Agricultural – contamination of abstraction point |                    | £ 3,225 / Ha of adjacent flood compartment # |
| Forest, scrub or woodland                         |                    | £ 3k / Ha                                    |
| Residential or industrial                         |                    | Up to £ 10k / Ha                             |
| <b>Properties</b>                                 |                    |  |
| Residential or public                             |                    | £ 96k / property                             |
| Industrial  |                    | £ 100k / property                            |
| Agricultural                                      |                    | £ 144k / property                            |
| Other   |                    | Varies                                       |

Note: # this assumes that the land irrigated by the low lying abstraction points is similar in area and gross margin productivity to the flood compartment containing the abstraction points

Using these evaluations an assessment of assets within each estuary was made, on a FC basis.

#### 4.3 Defence Costs

In all cases, apart from the case of "Do Nothing", the cost of defence includes an element of maintenance and an element of reconstruction. Reconstruction may be required because maintenance has become too onerous, because the pressure on the defence is such that more substantial defences would be required or because the level of the defence will need to be raised to match sea level rise.

The derived costs are based on discussion with the Environment Agency's operational staff and upon recent works undertaken within the region. They are, however, necessarily averaged over a period of time for each defence length.

The cost of future works carried out on existing defences is largely dependant on the form of these defences. For the purposes of this assessment it is envisaged that, in most cases, defences will be replaced 'like with like' at the end of their residual life, unless changes in estuarine processes would make this impractical.

It is recognised that, in reality, entire lengths of defence are unlikely to be totally reconstructed or be the subject of minor repairs. A more realistic scenario at the end of a residual life will involve the building up or reinforcement of discrete lengths of the existing defence. Similarly, maintenance is more likely to occur at different discrete locations each year. For the purposes of this study, however, both of these costs can be equated to values per metre run of defence.

For the majority of the Suffolk Estuaries the primary flood defence consists of earth embankments. There are also short lengths of blockwork, concrete wall and sheet piling throughout the estuaries. Standard costs have therefore been developed for each of these types of construction, based on typical values taken from a number of recent projects and schemes of a similar nature.

It is recognised that variations to the cost of defence re-construction and maintenance may also occur, depending on the forces against which such a structure must be designed. Reducing the pressure on an embankment will result in less onerous design requirements on future works, allowing a relative reduction in capital costs. Similarly, an increase in pressure will necessitate higher capital costs. A range of costs for specific structures has been determined. The costs calculated are summarised in Table D.3:

**Table D.3 Typical Defence Re-construction and Maintenance Costs**

| Defence Type     | Re-construction                 |                | Maintenance                     |                |
|------------------|---------------------------------|----------------|---------------------------------|----------------|
|                  | Standard Costs<br>(£ per m run) | Range of Costs | Standard Costs<br>(£ per m run) | Range of Costs |
| Earth embankment | 500                             | 300 – 900      | 10                              | 5 – 20         |
| Concrete wall    | 1000                            | -              | 10                              | -              |
| Sheet pile wall  | 900                             | -              | 10                              | -              |

#### 4.4 Application Of Costs

The costs of damage to assets and of rebuilding defences are generally incurred as a single sum at the end of the residual life of the defence. Maintenance costs will occur throughout the life of the defence – both existing and future – as long as an option of Do Nothing has not been adopted.

Damages with a scheme are always related to the damages which would occur for the Do Nothing case, and so the cost of a defence scheme may be compared with the value of damages avoided.

For the purposes this assessment, it is assumed that currently active farmland will only become un-

workable, and currently occupied properties will only become uninhabitable at the end of the residual life. Damage occurring before this time is deemed to be temporary. "Do Nothing" damages may, therefore, consist of a series of discounted single sums representing loss of, or damage to, land, crops or property.

#### 4.5 Sensitivity

The economic assessments in the strategy reports represent a "best estimate" of the costs and benefits throughout the estuary. It is, however, recognised that there are a number of potentially significant factors within the calculations which could influence the outcome of the assessment. It is therefore necessary to carry out sensitivity studies on some of the main components of the assessment, as follows:

- Agricultural value
- Irrigation value
- Defence costs

Individual option and cost estimate "sensitivities", and hence overall strategy assumptions, were requested by several of the major stakeholders and their representatives as part of the consultation feedback. The following observations address these requirements:

##### 4.5.1 Sensitivity to Agricultural value

These are considered to be robust. Values are taken from Nix's Farm Management Pocketbook (1999 edition), which is a well used source of information. The range of values obtained from Nix is not dependent on land quality or grading. However, use of the higher values within it reflect the high quality of the Suffolk land. Values used in the assessment, before adjustments in accordance with PAGN, correspond well with values obtained from landowners around the estuaries during the consultation period.

##### 4.5.2 Sensitivity to Irrigation value

The calculation of the value of irrigated land at a strategic level considered a broad approach, applying a multiplication factor of 2 to the value of land within the flood plain. If more detailed information is available, it is possible to develop this assessment. With data obtained during the consultation period, a sensitivity analysis may be carried out.

A review of abstraction licences, crop production and irrigation requirements around the Suffolk estuaries allows the development of a more detailed assessment procedure. **An average value for the gross margin of a unit volume of abstracted water for irrigation may be assigned to all abstraction points throughout the estuaries.**

For such a detailed study at a local level, PAGN identifies a category of land (Scenario III) in which agricultural output falls, as would be the case in the contamination of irrigation sources. In such a case it is necessary to calculate the difference in gross margins before contamination and after. This net margin is then multiplied by a factor of between 0.1 and 0.35 depending on the type of commodity being produced. The production of cereals and vegetables has an associated factor of 0.1. This factor allows for the fact that the land in question is not lost as is the case in PAGN's Scenario I. Instead, the use of the land will be changed. It also recognises the fact that repositioning of the abstraction point may be possible.

For the Suffolk estuaries, a number of crops were investigated in terms of their gross margin (obtained

from Nix Farm Management Pocketbook 1999 edition) and their irrigation requirements (obtained from the Environment Agency). The location and permitted volumes of licensed abstraction points was then used to determine the area of land, and therefore the gross margin it produces, which is affected by each abstraction point. From this calculation, gross margins per unit volume of abstracted water ranging from £0.43 (carrots) to £3.93 (early potatoes) per m<sup>3</sup> per year were arrived at, and an average gross margin of £0.96/Ha/year carried forward. A multiplier of 0.1 was applied to the average, to arrive at an adjusted gross margin of £0.096/Ha/year. For assessment purposes it was conservatively assumed that no gross margin would be achieved once irrigation has been contaminated.

Loss of output due to contamination of irrigation sources will only occur after the defences currently defending the lowland fails. The majority of flood defences throughout the estuaries have a residual life of over ten years. The average loss of £0.096/Ha/year may therefore be applied annually between years 10 and 50 of the strategy life. Using Treasury discount rates at 6% interest, this gives a discount factor of 8.4. The final adjusted gross margin was therefore taken as £0.80/Ha/year. Taking the highest irrigation value of £3.93 for early potatoes, the final adjusted gross margin would be £3.30/Ha/year. It can be seen, therefore, that a detailed knowledge of farming practices in the area is essential if this approach is to be used.

A sensitivity study, comparing the strategic and the detailed approaches for the three Suffolk estuaries produces the following results:

If the highest value of the range is taken, then net present values will be increased. However, applying the higher value throughout each estuary gives a similar relationship between the various strategy options, as demonstrated in the table below:

Sensitivity of Net Present Values of Strategy Options to Irrigation Rates

| Estuary  | Irrigation Assessment | Net Present Value of Strategy Options |       |        |               |               |        |
|----------|-----------------------|---------------------------------------|-------|--------|---------------|---------------|--------|
|          |                       | S1                                    | S2    | S3     | S4            | S5            | S6     |
| Blyth    | Strategic             | 0                                     | 3,011 | 3,444  | 3,352         |               |        |
|          | Detailed (average)    | 0                                     | 2,233 | 2,267  | 2,161         |               |        |
|          | Detailed (max)        | 0                                     | 2,642 | 2,784  | 2,678         |               |        |
| Alde/Ore | Strategic             | 0                                     | 6,939 | 9,356  | 10,412        | <b>10,701</b> | 10,368 |
|          | Detailed (average)    | 0                                     | 3,365 | 5,815  | 7,341         | <b>7,630</b>  | 7,225  |
|          | Detailed (max)        | 0                                     | 6,486 | 8,794  | 10,083        | <b>10,372</b> | 10,101 |
| Deben    | Strategic             | 0                                     | 7,008 | 8,052  | <b>8,181</b>  |               |        |
|          | Detailed (average)    | 0                                     | 5,643 | 6,721  | <b>7,031</b>  |               |        |
|          | Detailed (max)        | 0                                     | 9,234 | 10,079 | <b>10,381</b> |               |        |

Notes: All NPVs in £1,000s

Preferred strategy (in economic terms) shown in bold

From the above table it can be seen that, although the net present value varies in the detailed assessments, the relationship between strategy options remains the same. **This indicates that, whilst, the strategies must make allowance for irrigation value, they are not solely dependent on irrigation for their justification.**

### 4.5.3 Sensitivity to Defence Costs

The cost of maintaining and replacing defences throughout the estuaries has been based on a standard cost per unit length (related to the nature and location of the defence) derived from previous experience and discussions with the Environment Agency. These basic costs for particular defence types have then been adjusted to model changes in physical conditions and erosional forces throughout the estuaries. It is recognised that these costs are estimated only, and indeed one of the findings of the strategies has been that detailed records of defence costs are required if the strategies are to be used to their full potential.

The economic assessment of strategy options is carried out on a zone-by-zone basis. Various options are then carried forward for combination with options in subsequent zones. There is therefore a possibility that variations in defence costs could change the preferred option for a specific zone, and thereby radically change the subsequent development of the estuary-wide strategy.

This potential impact on the overall strategy may be illustrated by considering the Blyth estuary:

- The strategic assessment concludes that holding the existing defences upstream of the A12 (Zone 1) is not economically viable. This immediately influences the directions of the strategy development. The possibility of abandoning the zone 1 defences must be considered when assessing the costs and economic viability of defence in the rest of the estuary. If, however, holding the existing defences in zone 1 was made economically viable – due to a reduction in defence costs – then their abandonment need be considered no further.
- The strategic assessment also concludes that construction of a barrage at the A12 (together with a reduced standard or level of defence upstream) is only marginally unjustified considering zone 1 in isolation, and in fact becomes justifiable when considering the estuary as a whole. If, however, the cost of defence increase dramatically then the option of a barrage may not be justifiable, even when considering the estuary as a whole. In this case, the only option for zone 1 that would be carried forward would be that of Do Nothing. Further down the estuary this would significantly reduce the viability of holding the line, regardless of local variations in defence costs within industrial zones.

The sensitivity of defence costs has therefore been assessed separately for each estuary, with the **key zones being considered on an individual basis, before the overall strategy options are compared.** For this exercise, variations in defence costs of +20% and -20% have been considered.

#### Blyth Estuary:

##### *Zone 1*

The strategic assessment highlighted that it is not economically viable to hold the existing defences when considering the zone in isolation (option 2). This is still the case if defence costs are increased or reduced. The alternative of constructing a tidal barrier at the A12 road bridge (Option 7) would, however, become viable if costs were reduced. This option is, however, sensitive to variations in cost. In strategic terms, the main sensitivity, however, is whether the benefits of minimising the increase of tidal volume on other areas of the estuary are still sufficient to warrant the defence of Zone 1 through the construction of a tidal barrier. The following table shows the variation in NPV for each option for Zone 1 discussed in the strategy report:

| Zone 1<br>Defence Costs | Net Present Value of Zone Options |        |     |     |     |     |      |
|-------------------------|-----------------------------------|--------|-----|-----|-----|-----|------|
|                         | 1                                 | 2      | 3   | 4   | 5   | 6   | 7    |
| Strategic               | 0                                 | -747   | 110 | 92  | 252 | 353 | -146 |
| Reduced 20%             | 0                                 | -199   | 161 | 205 | 309 | 438 | 282  |
| Increased 20%           | 0                                 | -1,295 | 59  | -21 | 195 | 268 | -574 |

Notes: All NPVs in £1,000s



### Zone 3N

The strategic economic assessment concluded that holding the line along the whole of the Zone 3N frontage (Reydon Marshes) is fundamentally sustainable. It is, however, sensitive to the management options adopted in Zones 1 and 3S (Tinkers Marsh). This is extended to the point where, by abandoning Zone 1 and holding Tinkers Marsh, then the continued defence of Reydon Marshes is no longer economically justifiable. The sensitivity study shows a similar pattern of option outcomes, regardless of variations in defence costs. Therefore there is no fundamental change in the zone options taken forward in developing the strategy options. The following table shows the variation in NPV for each option for Zone 3N discussed in the strategy report:

| Zone 3N<br>Defence Costs | Net Present Value of Zone Options |     |     |      |      |      |     |     |
|--------------------------|-----------------------------------|-----|-----|------|------|------|-----|-----|
|                          | 1                                 | 2   | 3   | 4    | 5    | 6    | 7   | 8   |
| Strategic                | 0                                 | 160 | 252 | -109 | -302 | -109 | 185 | 309 |
| Reduced 20%              | 0                                 | 182 | 425 | 136  | -38  | -11  | 382 | 482 |
| Increased 20%            | 0                                 | 138 | 79  | -354 | -566 | -207 | -12 | 136 |

Notes: All NPVs in £1,000s

### Zone 3S

The strategic assessment identified that there is no justification, in economic terms, for holding the defences at Tinkers Marsh. This is still the case, even allowing for variations in defence costs. As with Zone 3N, there is therefore no fundamental change in the zone options taken forward in developing the strategy options. The following table shows the variation in NPV for each option for Zone 3S discussed in the strategy report:

| Zone 3S<br>Defence Costs | Net Present Value of Zone Options |      |      |    |      |      |      |
|--------------------------|-----------------------------------|------|------|----|------|------|------|
|                          | 1                                 | 2    | 3    | 4  | 5    | 6    | 7    |
| Strategic                | 0                                 | -331 | -180 | 37 | -110 | -106 | -55  |
| Reduced 20%              | 0                                 | -185 | -64  | 61 | -47  | -47  | -3   |
| Increased 20%            | 0                                 | -477 | -296 | 13 | -173 | -173 | -107 |

Notes: All NPVs in £1,000s

### Zone 4S

The strategic assessment of Zone 4S concluded that, on economic grounds, the preferred solution was to retreat the line of defence at Robinsons Marsh. Varying the cost of defence does not change this preference for retreat, although if costs were to be less then there would be an economic argument for holding defences to minimise other social impacts – albeit reduced compared to that for the retreat option. The following table shows the variation in NPV for each option for Zone 4S discussed in the strategy report:

| Zone 4S<br>Defence Costs | Net Present Value of Zone Options |    |      |     |      |      |     |     |
|--------------------------|-----------------------------------|----|------|-----|------|------|-----|-----|
|                          | 1                                 | 2  | 3    | 4   | 5    | 6    | 7   | 8   |
| Strategic                | 0                                 | 75 | 2    | 126 | -185 | 2    | 233 | 380 |
| Reduced 20%              | 0                                 | 75 | 133  | 242 | -27  | 133  | 284 | 413 |
| Increased 20%            | 0                                 | 75 | -129 | 10  | -343 | -129 | 183 | 347 |

Notes: All NPVs in £1,000s

### Overall Estuary Strategy

From this study of the sensitivity of the individual zones, it is apparent that variations in defence costs do not change the component elements of each strategy option. The four Strategy Options identified in the strategy therefore remain applicable. The variation of defence costs throughout the whole estuary, as illustrated below, has no effect on the selection of preferred the Strategy Option, or on the ranking of the remaining options. The following table shows the variation in NPV for each Strategy Option for the Blyth discussed in the strategy report:

### Sensitivity of Net Present Values of Strategy Options to Defence Costs

| Blyth Estuary<br>Defence Costs | Net Present Value of Strategy Options |              |              |              |
|--------------------------------|---------------------------------------|--------------|--------------|--------------|
|                                | S1                                    | S2           | S3           | S4           |
| Strategic                      | 0                                     | <b>3,011</b> | <b>3,444</b> | <b>3,352</b> |
| Reduced 20%                    | 0                                     | <b>3,531</b> | <b>4,296</b> | <b>4,233</b> |
| Increased 20%                  | 0                                     | <b>2,491</b> | <b>2,592</b> | <b>2,473</b> |

Notes: All NPVs in £1,000s

Preferred strategy (in economic terms) shown in **bold**

### Alde/Ore Estuary

Zones 1 and 2 have relatively little influence on the rest of the estuary, in terms of physical processes and changes thereto. The estuary may therefore be considered to be independent to variations in defence costs in these zones.

#### Zone 3

The strategic assessment identified that, at the zone level, the preferred economic option for Zone 3 is to hold the line at High Street (FC10b), and retreat at Aldeburgh Marshes and the northern tip of Sudbourne Marshes (FC16 and FC8a respectively), shown by Option 5. There is an overwhelming economic benefit in doing this compared to holding all the defences in the zone, amounting to some £1,449,000 (Option 5 compared with 2). The sensitivity study confirms that a similar situation exists if defence costs are varied, with an NPV differential of between £1,074,000 if defence costs are less, and £1,802,000 if defence costs are more. Similarly, the strategic assessment indicated that there is a benefit of £654,000 in retreating at Aldeburgh Marshes whilst holding High Street and retreating Sudbourne (Option 5 compared with 3). This remains the case in the sensitivity study, with the NPV differential ranging between £453,000 to £833,000. Thus the fundamental impracticality and unsustainability of continuing to defend Aldeburgh Marshes is clearly shown to be robust. The following table shows the variation in NPV for each option for Zone 3 discussed in the strategy report:

| Zone 3<br>Defence Costs | Net Present Value of Zone Options |        |      |       |       |
|-------------------------|-----------------------------------|--------|------|-------|-------|
|                         | 1                                 | 2      | 3    | 4     | 5     |
| Strategic               | 0                                 | -481   | 314  | 817   | 968   |
| Reduced 20%             | 0                                 | 215    | 836  | 1,177 | 1,300 |
| Increased 20%           | 0                                 | -1,177 | -208 | 457   | 636   |

Notes: All NPVs in £1,000s

#### Zone 4

The strategic assessment concluded that, solely considering the impacts within Zone 4, economic benefits are maximised by either retreating or merely delaying the abandonment of King's and Lantern Marshes (FCs 6 and 7), shown in Options 10 and 11. It was observed, however, that the exact manner and timing of what is effectively managed retreat is sensitive to standards of protection required to control the retreat process. This clearly affects defence costs. The sensitivity study confirms that it is only economically justifiable to hold the west bank of this zone, along Sudbourne Marshes and the Orford frontage, regardless of variations in defence costs. The following table shows the variation in NPV for each option for Zone 4 discussed in the strategy report:

| Zone 4<br>Defence Costs | Net Present Value of Zone Options |       |       |       |       |       |       |       |
|-------------------------|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|
|                         | 1                                 | 2     | 3     | 4     | 5     | 6     | 7     | 8     |
| Strategic               | 0                                 | 2,714 | 2,523 | 2,321 | 2,865 | 2,388 | 2,369 | 2,736 |
| Reduced 20%             | 0                                 | 3,792 | 3,639 | 3,478 | 3,835 | 3,454 | 3,498 | 3,750 |
| Increased 20%           | 0                                 | 1,636 | 1,407 | 1,164 | 1,895 | 1,322 | 1,240 | 1,722 |

| Zone 4<br>Defence Costs | Net Present Value of Zone Options |       |       |       |
|-------------------------|-----------------------------------|-------|-------|-------|
|                         | 9                                 | 10    | 11    | 12    |
| Strategic               | 2,712                             | 2,891 | 2,958 | 2,569 |
| Reduced 20%             | 3,561                             | 3,839 | 3,816 | 3,652 |
| Increased 20%           | 1,863                             | 1,943 | 2,100 | 1,486 |

Notes: All NPVs in £1,000s

### Zone 6

The strategic assessment identified that, although the continued defence of Gedgrave Marshes is fundamentally justifiable on economic grounds, that the probability is that Boyton Marshes is not. The sensitivity study demonstrates that, should costs be reduced, the case for retreating Boyton is weakened but not overturned. Under the strategy values, and taking into account the additional defence to Zones 5 and 7, the NPV deficit of defending Boyton is in the order of £300,000. If defence costs were less, then this deficit would be in the order of £80,000. Conversely, increased defence costs would increase the deficit to some £500,000. The analysis, therefore, demonstrates the robustness of the economics at a strategic level, but highlights the need for local consideration prior to implementing strategy recommendations. The following table shows the variation in NPV for each option for Zone 6 discussed in the strategy report:

| Zone 6<br>Defence Costs | Net Present Value of Zone Options |        |      |     |      |      |      |      |
|-------------------------|-----------------------------------|--------|------|-----|------|------|------|------|
|                         | 1                                 | 2      | 3    | 4   | 5    | 6    | 7    | 8    |
| Strategic               | 0                                 | -2,175 | -133 | 344 | 204  | 204  | 64   | -168 |
| Reduced 20%             | 0                                 | -1,081 | 538  | 764 | 652  | 652  | 539  | 354  |
| Increased 20%           | 0                                 | -3,269 | -804 | -75 | -243 | -243 | -412 | -689 |

Notes: All NPVs in £1,000s

### Overall Estuary Strategy

From this study of the sensitivity of the individual zones, it is apparent that variations in defence costs do not change the component elements of each strategy option. The six Strategy Options identified in the strategy therefore remain applicable. The variation of defence costs throughout the whole estuary, as illustrated below, has no effect on the selection of preferred the Strategy Option, or on the ranking of the remaining options. The following table shows the variation in NPV for each Strategy Option for the Alde/Ore discussed in the strategy report:

### Sensitivity of Net Present Values of Strategy Options to Defence Costs

| Alde/Ore Estuary<br>Defence Costs | Net Present Value of Strategy Options |        |        |        |        |        |
|-----------------------------------|---------------------------------------|--------|--------|--------|--------|--------|
|                                   | S1                                    | S2     | S3     | S4     | S5     | S6     |
| Strategic                         | 0                                     | 6,939  | 9,356  | 10,412 | 10,701 | 10,368 |
| Reduced 20%                       | 0                                     | 10,690 | 12,592 | 13,088 | 13,296 | 13,021 |
| Increased 20%                     | 0                                     | 3,188  | 6,119  | 7,735  | 8,105  | 7,715  |

Notes: All NPVs in £1,000s

Preferred strategy (in economic terms) shown in bold

### Deben Estuary

Zones 1 and 2 have relatively influence on the rest of the estuary, in terms of physical processes and changes thereto. The estuary may therefore be considered to be independent to variations in defence costs in these zones.

### Zone 3

The strategic assessment concluded that, although it is economically viable to hold the line throughout the majority of the Lower Reaches (FCs 1, 7, 8, 9, 10 and 11), the optimum solution is to hold the line along the east bank (Option 10) and retreat defences along Nursery Wood (FC10) on the west bank

(Option 16). The sensitivity study indicates that if defence costs vary, there is still a massive economic argument for holding the east bank. On the west bank a reduction in costs would reduce the burden imposed by defending Nursery Wood, with retreat still being marginally preferable (Option 16 compared to Option 14). It may be seen that even at the strategic level of examination, there is a degree of robustness in the economic argument. However, it also highlights the level of confidence within which the strategies are defined, and the consequent need for detailed appraisal prior to implementing the strategy recommendations. The following table shows the variation in NPV for each option for Zone 3 discussed in the strategy report:

| Zone 3<br>Defence Costs | Net Present Value of Zone Options |       |       |       |
|-------------------------|-----------------------------------|-------|-------|-------|
|                         | 9                                 | 10    | 11    | 12    |
| Strategic               | 0                                 | 1,497 | 1,631 | 875   |
| Reduced 20%             | 0                                 | 1,758 | 1,865 | 1,054 |
| Increased 20%           | 0                                 | 1,236 | 1,397 | 696   |

| Zone 3<br>Defence Costs | Net Present Value of Zone Options |       |       |       |       |       |       |       |
|-------------------------|-----------------------------------|-------|-------|-------|-------|-------|-------|-------|
|                         | 13                                | 14    | 15    | 16    | 17    | 18    | 19    | 20    |
| Strategic               | 0                                 | 2,963 | 3,022 | 3,092 | 2,907 | 2,249 | 2,213 | 2,027 |
| Reduced 20%             | 0                                 | 3,402 | 3,449 | 3,427 | 3,299 | 2,516 | 2,487 | 2,453 |
| Increased 20%           | 0                                 | 2,524 | 2,595 | 2,757 | 2,514 | 1,982 | 1,939 | 1,689 |

Notes: All NPVs in £1,000s

#### Overall Estuary Strategy

From this study of the sensitivity of the individual zones, it is apparent that variations in defence costs do not change the component elements of each strategy option. The four Strategy Options identified in the strategy therefore remain applicable. The variation of defence costs throughout the whole estuary, as illustrated below, has no effect on the selection of preferred the Strategy Option, or on the ranking of the remaining options. The following table shows the variation in NPV for each Strategy Option for the Deben discussed in the strategy report:

#### Sensitivity of Net Present Values of Strategy Options to Defence Costs

| Deben Estuary<br>Defence Costs | Net Present Value of Strategy Options |       |       |              |
|--------------------------------|---------------------------------------|-------|-------|--------------|
|                                | S1                                    | S2    | S3    | S4           |
| Strategic                      | 0                                     | 7,008 | 8,052 | <b>8,181</b> |
| Reduced 20%                    | 0                                     | 8,567 | 9,306 | <b>9,331</b> |
| Increased 20%                  | 0                                     | 5,449 | 6,798 | <b>7,031</b> |

Notes: All NPVs in £1,000s

Preferred strategy (in economic terms) shown in **bold**

#### 4.5.4 Sensitivity to Maintenance Costs

The above section illustrates the robustness of the strategies in terms of sensitivity to variations in defence costs. A further facet of defence costs which must be reviewed is the degree of maintenance undertaken. The strategies have made an allowance for the progressive increase in the cost of maintaining all defences, and earth embankments in particular. A sensitivity analysis shows that, should the required maintenance effort be considerably less than expected in the Blyth estuary (taking a typical cost of £1 per metre per year instead of £10), the viability or order of preference of the strategy options is not significantly affected. On the Alde/Ore such a reduction would, on first inspection, strengthen the case for holding Aldeburgh marshes. However, this is clearly the most vulnerable and unsustainable length of defence in estuary, and so the likelihood of a reduction of maintenance costs along it is extremely low. On the Deben, a reduction in maintenance costs would increase the argument for holding Nursery Wood (FC10) to the extent that it is preferable to retreating these defences. This once again highlights the level of confidence within which the strategies are defined, and the consequent need for detailed appraisal prior to implementing the strategy recommendations.

Sensitivity of Net Present Values of Strategy Options to Maintenance Costs

| Option   | Defence Costs | Net Present Value of Strategy Options |        |               |              |               |               |
|----------|---------------|---------------------------------------|--------|---------------|--------------|---------------|---------------|
|          |               | S1                                    | S2     | S3            | S4           | S5            | S6            |
| Blyth    | Strategic     | 0                                     | 3,011  | <b>3,444</b>  | 3,352        |               |               |
|          | Reduced       | 0                                     | 3,870  | <b>4,291</b>  | 4,139        |               |               |
| Alde/Ore | Strategic     | 0                                     | 6,939  | 9,356         | 10,412       | <b>10,701</b> | 10,368        |
|          | Reduced       | 0                                     | 12,014 | 13,655        | 13,897       | 14,280        | <b>14,312</b> |
| Deben    | Strategic     | 0                                     | 7,008  | 8,052         | <b>8,181</b> |               |               |
|          | Reduced       | 0                                     | 9,682  | <b>10,385</b> | 10,310       |               |               |

Note: all NPVs in £1,000s

Preferred strategy (in economic terms) shown in **bold**



## CONSULTATION DETAILS

| Organisation   | Contact             | Consulted on |       |       |          | Written Response | Meeting Held |
|--|---------------------|--------------|-------|-------|----------|------------------|--------------|
|  |                     | Alde/Ore     | Blyth | Deben | Exec Sum |                  |              |
| 127 Hendslow Road, Ipswich                           | Mr R Davies         | ✓            |       |       |          |                  |              |
| 19 Lee Road, Aldeburgh                               | Mr D Andrews        | ✓            |       |       |          |                  |              |
| 27 Broadley Terrace, London                          | Sir Michael Hopkins | ✓            |       |       |          |                  |              |
| 4 Nightingale Mews, Netley Abbey                     | Mrs V Fenwick       | ✓            | ✓     | ✓     |          | ✓                |              |
| 4 Thellusson Lodge, Aldeburgh                        | Mr M Good           | ✓            |       |       |          |                  |              |
| 40 St Andrews Place, Melton                          | Mrs P Bond          |              |       | ✓     |          |                  |              |
| 52a Chelsea Park Gardens, London                     | Mrs F Herford       | ✓            |       |       |          |                  |              |
| 82 Seaton Road, Felixstowe                           | Mr Naulls           |              |       | ✓     |          |                  |              |
| Alde & Ore Association                               | Nicholas Bushill    | ✓            |       |       |          | ✓                | ✓            |
| Alde & Ore Wildfowlers Association                   | Mr P Litten         | ✓            |       |       |          | ✓                |              |
| Aldeburgh Gazette                                    | Mrs J McNeill       |              |       |       | ✓        |                  |              |
| Aldeburgh Golf Club                                  | Mr Simpson          | ✓            |       |       |          | ✓                |              |
| Aldeburgh Library                                    | Mrs Wiseman         | ✓            |       |       |          |                  |              |
| Aldeburgh Productions                                | Mr J Reekie         | ✓            |       |       |          | ✓                |              |
| Aldeburgh Town Council                               | Mr A Harris         | ✓            |       |       |          | ✓                |              |
| Aldeburgh Yacht Club                                 | Mr Michael Steen    | ✓            |       |       |          |                  |              |
| Aldeburgh Yacht Club                                 | Mr V N Bromage      |              |       |       |          |                  |              |
| Alderton Hollesley and Bawdsey IDB                   | Mr P Mann           | ✓            |       | ✓     |          | ✓                |              |
| Anglian Water plc                                    |                     | ✓            | ✓     | ✓     |          |                  |              |
| Anglian Wildfowler's Association                     | Mr A S A Judge      |              |       | ✓     |          | ✓                |              |
| Anglian Wildfowler's Association                     | Mr D W Algar        |              |       |       |          |                  |              |
| Barker Gotlee  | Mark Horvath        | ✓            | ✓     | ✓     |          | ✓                |              |
| Barker Gotlee  | R E Barker          |              |       |       |          | ✓                |              |
| Bawdsey Haven Yacht Club                             | Mr N Rose           |              |       | ✓     |          | ✓                |              |
| Bawdsey Parish Council                               | Mr R F Hazell       | ✓            |       | ✓     |          | ✓                | ✓            |
| Bawdsey Parish Council                               | Mrs A J I Mawford   |              |       | ✓     |          | ✓                |              |
| Bawdsey Quay   | Mr P Wain           |              |       | ✓     |          |                  |              |
| Bawdsey Quay Water Sports Centre                     | Ms Heather Patrick  |              |       | ✓     |          |                  |              |
| Bell House, Orford                                   | Mr Allen            | ✓            |       |       |          |                  |              |
| Bidwells   | Ruth Lamb           |              |       | ✓     |          | ✓                | ✓ 4          |
| Blois Farms  | Sir Charles Blois   |              | ✓     |       |          | ✓                |              |
| Blyth Fishing Society                                | Mr Purdy            |              |       |       | ✓        |                  |              |
| Blythburgh Parish Council                            | Mr G Newson         |              | ✓     |       |          |                  |              |
| Boyton Hall Farms                                    | Richard Pipe        | ✓            |       |       |          | ✓ 1              | 3            |
| Boyton Parish Council                                | Mrs R Clarke        | ✓            |       |       |          | ✓                |              |
| British Ass <sup>n</sup> for Shooting & Conservation | Helen Doe           | ✓            | ✓     | ✓     |          |                  |              |
| British Canoe Union                                  | C E Quaife          |              |       |       | ✓        | ✓                |              |
| Broadside Farms                                      | Mr D Ball           |              | ✓     |       |          |                  |              |
| Bromeswell Parish Council                            | Mrs Joan Richold    |              |       | ✓     |          |                  |              |
| Butley Parish Council                                | Mrs M Allen         | ✓            |       |       |          |                  |              |
| c/o County Highways Depot                            | Simon Hooton        | ✓            | ✓     | ✓     |          |                  |              |
| Capel St Andrew Farm                                 | Mrs Greenwell       | ✓            |       |       |          | ✓ 1              | 3            |
| CEFAS  | Dr S Lockwood       |              |       |       | ✓        |                  |              |
| Chair Alde & Ore Users' Association                  | Alan Coombes        |              |       |       |          |                  |              |
| Chillesford Lodge                                    | Mr M Watson         | ✓            |       |       |          | ✓                |              |
| Chillesford Parish Meeting                           | Mr A J Massey       | ✓            |       |       |          | ✓                |              |

| Organisation                                 | Contact                   | Consulted on |       |       |          | Written Response | Meeting Held |
|--|---------------------------|--------------|-------|-------|----------|------------------|--------------|
|  |                           | Alde/Ore     | Blyth | Deben | Exec Sum |                  |              |
| Church Farm                                  | Mr D A Glossop            |              |       | ✓     |          |                  |              |
| Country Landowners Association               | Mr P Long                 | ✓            | ✓     | ✓     |          | ✓                | ✓            |
| Countryside Commission                       | Sarah Skinner             | ✓            | ✓     | ✓     |          |                  |              |
| Crag Farm                                    | Mrs Black                 | ✓            |       |       |          |                  |              |
| Crag Farm                                    | Mr C M Rope               | ✓            |       |       |          | ✓                |              |
| Dairy Farm                                   | Mr & Mrs Cole             |              |       | ✓     |          | ✓                |              |
| Deben Farms                                  | Mr Douglas Inglis         |              |       | ✓     |          | ✓ 1              | 3            |
| Deben Farms Estate Office                    | James Adeane Esq          |              |       | ✓     |          | 1                | 3            |
| Decoy Farm                                   | Mr D J Bye                |              |       | ✓     |          |                  |              |
| Defence Estate Organisation                  | Mr A C Hawkins            |              |       |       | ✓        |                  |              |
| Dunwich Parish Meeting                       | Mr Charles Barnett        |              | ✓     |       |          | ✓                | ✓            |
| Dunwich Town Trust                           | Mr Michael Clark          |              | ✓     |       |          | ✓                | ✓            |
| Durrants                                     | Mr Rudge                  |              | ✓     |       |          |                  |              |
| East of England Tourist Board                | Mr N Warren               |              |       |       | ✓        | ✓                |              |
| East Suffolk Water Ski Club                  |                           | ✓            | ✓     | ✓     |          |                  |              |
| Eastern Electricity                          | Mr McCarthy               | ✓            | ✓     | ✓     |          | ✓                |              |
| Eastern Sea Fisheries Joint Committee        | S C Amos Esq.             | ✓            | ✓     | ✓     |          |                  |              |
| English Heritage                             | Ronni Bridgett            | ✓            | ✓     | ✓     |          | ✓                |              |
| English Nature                               | Helen Smith               | ✓            | ✓     | ✓     |          |                  | ✓ 2          |
| English Nature                               | Nick Sibbett              |              |       |       |          |                  |              |
| English Nature                               | Tim Collins               | ✓            | ✓     | ✓     |          |                  |              |
| Environment Agency                           | Merle Leeds               | ✓            | ✓     | ✓     |          |                  | ✓ 2          |
| Environment Agency                           | Mr P Marjoram             |              | ✓     |       |          | ✓                | ✓ 2          |
| Falkenham & Kirton Parish Council            | Mr C A Shaw               |              |       | ✓     |          | ✓                |              |
| Felixstowe Ferry Boatyard                    | Mr R Dutton               |              |       | ✓     |          |                  |              |
| Felixstowe Ferry Fairways Committee          | Mr W J Barr               |              |       | ✓     |          |                  |              |
| Felixstowe Ferry Preservation Society        | Mrs A J Ratcliffe         |              |       | ✓     |          | ✓                |              |
| Felixstowe Ferry Sailing Club                | Mr Guy Pearce             |              |       | ✓     |          | ✓                |              |
| Felixstowe Ferry Yacht Club                  | Mr G. M. Henderson        |              |       | ✓     |          |                  |              |
| Felixstowe Society                           | Mrs B Reid                |              |       | ✓     |          |                  |              |
| Felixstowe Town Council                      | Mrs S Robinson            |              |       | ✓     |          |                  |              |
| Ferry Farm                                   | Mr R B Skepper            | ✓            |       |       |          | ✓ 1              | ✓ 3          |
| Fir Tree Farm                                | Mr P Waring               |              |       | ✓     |          |                  | 3            |
| Fisheries Office                             | Nr Neil Welham            | ✓            | ✓     | ✓     |          |                  |              |
| FRCA   | Mr Alan Bullivant         | ✓            | ✓     | ✓     |          |                  |              |
| FRCA   | Tim Sloane                | ✓            | ✓     | ✓     |          |                  |              |
| Friston Parish Council                       | C D Edwards JP            | ✓            |       |       |          |                  |              |
| Frostenden, Eccles                           | Mr J N Holmes             |              |       |       | ✓        |                  |              |
| GH and JP Paul                               | Mr Michael Paul           |              |       | ✓     |          | 1                | 3            |
| Granary Yacht Harbour and Leisure Centre Ltd |                           |              |       | ✓     |          |                  |              |
| Great Glemham House                          | The Countess of Cranbrook |              |       |       | ✓        |                  |              |
| Green Lane House                             | Mr Flint                  | ✓            |       |       |          | ✓                |              |
| Hall Farm                                    | Mr Andrew Haiste          | ✓            |       |       |          |                  |              |
| Harwich Area Sailing Association             | Mr L P Catton             |              |       |       | ✓        |                  |              |
| Hasketon Grange                              | Mr Cambridge              |              |       |       | ✓        |                  |              |
| Hemley Parish Meeting                        | Mr P D H Bowden-Smith     |              |       | ✓     |          |                  |              |
| Hill Farm                                    | Mr J A Symes              |              |       | ✓     |          |                  |              |

| Organisation                                 | Contact                   | Consulted on |       |       |          | Written Response | Meeting Held |
|--|---------------------------|--------------|-------|-------|----------|------------------|--------------|
|  |                           | Alde/Ore     | Blyth | Deben | Exec Sum |                  |              |
| Hill Farm                                    | Mr N G Mayhew             |              |       | ✓     |          | ✓                |              |
| Hill Farm                                    | Mr R W Mann               | ✓            |       |       |          | 1                | 3            |
| Hollesley Bay Colony                         | Mr J Forster              |              |       | ✓     |          |                  |              |
| Hollesley Parish Council                     | Mrs K Davies              | ✓            |       |       |          | ✓                |              |
| Horsey Island, Essex                         | Mr J L Backhouse          | ✓            |       |       |          |                  |              |
| House of Commons                             | The Rt Hon John Gummer MP | ✓            | ✓     | ✓     |          |                  | 4            |
| Iken Parish Council                          | Mrs L Lloyd               | ✓            |       |       |          | ✓                |              |
| Iken Parish Council                          | P N R Cooke               | ✓            |       |       |          |                  | 3            |
| Ipswich                                      | Mr Davis                  | ✓            |       |       |          |                  |              |
| Jesters, Woodbridge                          | Mrs Healey                |              |       | ✓     |          |                  |              |
| Kings Fleet                                  | Mr Frank Brown            |              | ✓     | ✓     |          | ✓                |              |
| Knoll Fairways Committee                     |                           |              |       | ✓     |          |                  |              |
| Kyson Fairways Committee                     | Mrs S Maystom             |              |       | ✓     |          |                  |              |
| Lime Kiln Farm                               | Exors G Stammers Decd     |              | ✓     |       |          |                  |              |
| Little Haugh                                 | Mr I Hooper               |              |       | ✓     |          | ✓                |              |
| Long Reach                                   | Mr T Wilkinson            | ✓            |       |       |          | ✓                |              |
| Long Reach, Aldeburgh                        | Mr Wilkinson              | ✓            |       |       |          |                  |              |
| Low Farm, Bromeswell                         | Mr James Foskett          |              |       | ✓     |          |                  |              |
| Lower / Middle Alde & Lower Deben IDB's      | Ian Hart                  | ✓            |       | ✓     |          | ✓                | ✓            |
| Marine Estates                               | Tauhid Rahman             | ✓            | ✓     | ✓     | ✓        |                  |              |
| Marine Estates                               | Mr N Jacobson             |              |       |       | ✓        |                  |              |
| Marsh Hill                                   | Col Besly                 |              |       |       |          |                  | 3            |
| Martlesham Parish Council                    | Mrs Lynne Lodge           |              |       | ✓     |          | ✓                |              |
| Melton Lodge Farm House                      | Mr P W Warburg            |              |       | ✓     |          | ✓                |              |
| Melton Parish Council                        | Mr T C D Brown            |              |       | ✓     |          | ✓                |              |
| Mils and Reeve                               | Mr T Brainbridge          |              | ✓     | ✓     |          |                  |              |
| Ministry of Agriculture, Fisheries and Food  | Dr Lindsey Murray         | ✓            | ✓     | ✓     |          |                  |              |
| Ministry of Agriculture, Fisheries and Food  | Geoff Bowles              | ✓            | ✓     | ✓     |          |                  |              |
| Ministry of Agriculture, Fisheries and Food  | Mr David Collins          | ✓            | ✓     | ✓     |          |                  |              |
| Ministry of Agriculture, Fisheries and Food  | Mr G Sexton               | ✓            | ✓     | ✓     |          |                  |              |
| Mssrs R Desborough & Sons                    | Sirs                      |              | ✓     |       |          |                  |              |
| National Farmers Union                       | Mr J A Hodge              | ✓            | ✓     | ✓     |          |                  | ✓            |
| National Farmers Union (East Anglian Region) | Paul Hammett              | ✓            | ✓     | ✓     |          |                  | ✓            |
| National Monuments Record Centre             | Mr B Ferrari              |              |       |       | ✓        |                  |              |
| National Trust                               | Mr K Turner               | ✓            |       | ✓     |          | ✓                |              |
| Naunton Hall                                 | Sir Michael Bunbury       |              |       |       | ✓        |                  |              |
| New Oak Tree Farm                            | Mr D E Parken             |              |       | ✓     |          |                  |              |
| Newbourne Parish Council                     | Mr Joe Finch              |              |       | ✓     |          |                  |              |
| Norfolk & Suffolk LFDC                       | Mr Ben Steward            | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                       | Mr David Price            | ✓            | ✓     | ✓     |          | ✓                | 2            |
| Norfolk & Suffolk LFDC                       | Mr Ian Battey             | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                       | Mr Richard Rockcliffe     | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                       | Mr David Adams            | ✓            | ✓     | ✓     |          | ✓                | ✓ 2          |
| Norfolk & Suffolk LFDC                       | Mr David Bracey           | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                       | Mr David Papworth         | ✓            | ✓     | ✓     |          | ✓                | 2            |
| Norfolk & Suffolk LFDC                       | Mr Graham Gouldby         | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                       | Mr Henry Cator            | ✓            | ✓     | ✓     |          | ✓                | 2            |

| Organisation   | Contact                   | Consulted on |       |       |          | Written Response | Meeting Held |
|--|---------------------------|--------------|-------|-------|----------|------------------|--------------|
|  |                           | Alde/Ore     | Blyth | Deben | Exec Sum |                  |              |
| Norfolk & Suffolk LFDC                                 | Mr James Stansfield OBE   | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                                 | Mr John Sheppard          | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                                 | Mr Neville Chapman        | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                                 | Mr Peter Baldwin          | ✓            | ✓     | ✓     |          |                  | 2            |
| Norfolk & Suffolk LFDC                                 | Mr Peter Monk             | ✓            | ✓     | ✓     |          |                  | ✓ 2          |
| Norfolk & Suffolk LFDC                                 | Sir Edward Greenwell      | ✓            | ✓     | ✓     |          |                  | ✓ 2          |
| Old Rookery House                                      | Capt R Sheepshanks CBE DL |              |       |       | ✓        |                  |              |
| Old School Farm  | Mr Hayward                | ✓            |       | ✓     |          |                  |              |
| Orford & Gedgrave Parish Council                       | Mr S Caley                | ✓            |       |       |          | ✓                |              |
| Orford Town Trust                                      | Mr R Roberts              | ✓            |       |       |          |                  |              |
| Orwell Settlement Trustees                             | R. A Gosling              |              |       | ✓     |          |                  |              |
| P Adams & Sons (Farms) Ltd                             | D C Adams                 |              |       | ✓     |          | ✓                |              |
| Plunketts Farms  | Mrs V French              | ✓            |       |       |          |                  |              |
| Potash Farm  | Mr H J Chapman            |              |       |       | ✓        |                  |              |
| Ramsholt Fairways Committee                            | Mrs P R Doran             |              |       | ✓     |          |                  |              |
| Ramshot Parish Meeting                                 | Mr & Mrs R Simper         |              |       | ✓     |          | ✓                | ✓            |
| River Blyth & Southwold Harbour Users Ass <sup>n</sup> |                           |              | ✓     |       |          |                  |              |
| River Deben (Lower) IDB                                | K A Buckley Edq.          |              |       | ✓     |          | ✓                |              |
| River Deben Association                                | Mr A H Mason              |              |       |       | ✓        |                  |              |
| River Deben Association                                | Mr Denzil Cowdry          |              |       | ✓     |          |                  | ✓            |
| Round Hill, Aldeburgh                                  | Mr Wheeler                | ✓            |       |       |          | 1                | ✓ 3          |
| Royal Yachting Association                             | Mr F Power                | ✓            |       |       |          |                  |              |
| RSBP   | John Sharpe               | ✓            | ✓     | ✓     |          |                  | ✓ 2          |
| Shingle Street Association                             | Mr D Williams             | ✓            |       |       |          | ✓                |              |
| Shottisham Parish Council                              | Mrs C Bax                 |              |       | ✓     |          |                  |              |
| Simper Agricultural                                    | Mr J. R. Simper           |              |       | ✓     |          | 1                | 3            |
| Sluice Farm  | Messrs Johnson            |              |       | ✓     |          |                  |              |
| Smear Farm Ltd   |                           |              | ✓     |       |          |                  |              |
| Snape Parish Council                                   | Mrs Melanie Thurston      | ✓            |       |       |          |                  |              |
| Snape, Saxmunden                                       | Mr Jonathan Gooderham     | ✓            |       |       |          |                  |              |
| Sole Bay Cottage                                       | Mr Shurman                |              | ✓     |       |          |                  |              |
| Southwold Town Council                                 | Mrs J L Hursell           |              | ✓     |       |          | ✓                | ✓            |
| Spring Farm  | Mr G H Steele             |              |       | ✓     |          |                  |              |
| Srutt and Parker                                       | Mr Fiddes                 | ✓            |       |       |          |                  |              |
| Sudbourne Parish Council                               | Mr H J Nash               |              |       | ✓     |          |                  |              |
| Sudbourne Parish Council                               | Mr Parker                 | ✓            |       |       |          | ✓                |              |
| Suffolk Coastal District Council                       | Mr J Schofield            | ✓            | ✓     | ✓     |          | ✓                |              |
| Suffolk Coastal District Council                       | Mr R Stoddard             | ✓            | ✓     | ✓     |          |                  | ✓            |
| Suffolk County Council                                 | Mr Don Ayre               | ✓            | ✓     | ✓     |          |                  |              |
| Suffolk County Council                                 | Mr J T Hindle             | ✓            | ✓     | ✓     |          |                  |              |
| Suffolk Preservation Society                           | R Whittaker               | ✓            | ✓     | ✓     |          |                  |              |
| Suffolk River Valleys ESA                              | Tim Sloane                |              |       |       |          |                  | ✓            |
| Suffolk Underwater Studies Group                       | Mr Stuart Bacon           |              |       |       | ✓        |                  |              |
| Suffolk Wildlife Trust                                 | Julian Roughton           | ✓            | ✓     | ✓     |          |                  |              |
| Sutton Hall Farms                                      | Mr Guy Quilter            |              |       | ✓     |          | ✓ 1              | ✓ 3          |
| Sutton Parish Council                                  | Mrs J R King              |              |       | ✓     |          |                  | ✓            |
| The Aldeburgh Society                                  | Mrs P Vernon              |              |       |       | ✓        | ✓                |              |



| Organisation                           | Contact             | Consulted on |       |       |          | Written Response | Meeting Held |
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|  |                     | Alde/Ore     | Blyth | Deben | Exec Sum |                  |              |
| The Bungalow, Sutton Hoo               | K Drury             |              |       | ✓     |          |                  |              |
| The Cloisters                          | Mrs Alderson        | ✓            |       |       |          |                  |              |
| The Ramblers Association               | Anne Moore          |              |       |       | ✓        | ✓                |              |
| The Woodbridge Society                 | Mrs P Austin-Brown  |              |       | ✓     |          |                  |              |
| Valley Farm                            | Mr T Darby          |              |       |       |          |                  | 3            |
| Walberswick                            | Mrs Edwards         |              | ✓     |       |          |                  |              |
| Walberswick Common Lands Charity Trust | Mrs Priestman       |              | ✓     |       | ✓        | ✓                | ✓            |
| Walberswick Parish Council             | Mrs Vivien J Hunt   |              | ✓     |       |          | ✓                |              |
| Waldringfield Fairways Committee       | Mr F A Brown        |              |       | ✓     |          |                  |              |
| Waldringfield Parish Council           | Miss Jackie Townley |              |       | ✓     |          | ✓                | ✓            |
| Waldringfield Parish Council           | Mr Mace             |              |       | ✓     |          | ✓                | ✓            |
| Water Mill Farm                        | J E B Hill          |              | ✓     |       |          | ✓                | ✓            |
| Waveney District Council               | Mr R Bell           |              | ✓     |       |          |                  |              |
| Waveney District Council               | Mr J Walker         |              | ✓     |       | ✓        |                  |              |
| Woodbridge Cruising Club               | R.A.S. Sampson      | ✓            |       | ✓     |          | ✓                |              |
| Woodbridge Town Council                | Mrs C B Walker      |              |       | ✓     |          |                  |              |

- Key:
- 1 Contributed to a joint response with other consultees
  - 2 Consulted as a Steering Group Committee or Local Flood Defence Committee member
  - 3 To be represented in a meeting
  - 4 Meeting to be arranged

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## LIST OF ABBREVIATIONS

|      |   |                                 |   |
|------|---|---------------------------------|---|
| AGHV | Area of Great Historic Value                | RNLI                            | Royal National Lifeboat Institution                   |
| AGLV | Area of Great Landscape Value               | RSPB                            | Royal Society for the Protection of Birds             |
| AONB | Area of Outstanding Natural Beauty          | RIGS                            | Regionally Important Geological/Geomorphological Site |
| BAP  | Biodiversity Action Plan                    | pSSSI                           | Proposed Site of Special Scientific Interest          |
| BGS  | British Geological Society                  | SAC                             | Special Area of Conservation                          |
| CCA  | Coastal Conservation Areas                  | SAM                             | Scheduled Ancient Monument                            |
| CEWP | Classification of Estuaries Working Party   | SMA                             | Sensitive Marine Area                                 |
| CMP  | Catchment Management Plan                   | SMP                             | Shoreline Management Plan                             |
| CPA  | Coastal Protection Area                     | SMR                             | Sites and Monuments Register                          |
| CWS  | County Wildlife Site                        | SNCI                            | Site of Nature Conservation Importance                |
| cSAC | Candidate Special Area of Conservation      | SPA                             | Special Protection Area                               |
| DDN  | Delay Do Nothing                            | SRVESASuffolk River Valleys ESA |   |
| DN   | Do Nothing                                  | SSSI                            | Site of Special Scientific Interest                   |
| EA   | Environment Agency                          | VMCA                            | Voluntary Marine Conservation Area                    |
| EC   | European Community                          | WRA                             | Water Research Council                                |
| EMP  | Estuary Management Plan                     |                                 |   |
| EN   | English Nature                              |                                 |   |
| ESA  | Environmentally Sensitive Area              |                                 |   |
| EU   | European Union                              |                                 |   |
| FC   | Flood Compartment                           |                                 |   |
| FCDD | Flood and Coastal Defence Division of MAFF  |                                 |   |
| FEPA | Food and Environment Protection Act (1985)  |                                 |   |
| GCR  | Geological Conservation Review              |                                 |   |
| GDO  | General Development Order                   |                                 |   |
| HMIP | Her Majesty's Inspectorate of Pollution     |                                 |   |
| HR   | HR (Hydraulics Research) Wallingford        |                                 |   |
| HTL  | Hold The Line                               |                                 |   |
| IPCC | Intergovernmental Panel on Climate Change   |                                 |   |
| LEAP | Local Environment Agency Plan               |                                 |   |
| LNR  | Local Nature Reserve                        |                                 |   |
| MAFF | Ministry of Agriculture, Fisheries and Food |                                 |   |
| MNR  | Marine Nature Reserve                       |                                 |   |
| NCC  | Nature Conservancy Council                  |                                 |   |
| NCZ  | Nature Conservation Zone                    |                                 |   |
| NPV  | Net Present Value                           |                                 |   |
| NNR  | National Nature Reserve                     |                                 |   |
| NT   | National Trust                              |                                 |   |
| NRA  | National Rivers Authority                   |                                 |   |
| OD   | Ordnance Datum                              |                                 |   |
| PAGN | Project Appraisal Guidance Notes            |                                 |   |
| POL  | Proudman Oceanographic Laboratory           |                                 |   |
| PPG  | Planning Policy Guidance                    |                                 |   |
| pSAC | Possible Special Area of Conservation       |                                 |   |
| PV   | Present Value                               |                                 |   |



