2 Basis for developing the plan

This chapter describes the background of the Shoreline Management Plan:

- Section 2.1 - provides a technical description of the coastal processes and coastal defences.
- Section 2.2 - describes land use and the environment around the shoreline.
- Section 2.3 - illustrates the role of shoreline management by describing what would happen to the Essex and South Suffolk shoreline in two extreme management scenarios: No Active Intervention throughout the area up to 2105, or continuing present management throughout the area up to 2105.
- Section 2.4 - builds on this information to identify the ‘big decisions’ that this SMP needs to make about the management of the Essex and South Suffolk shoreline.

Management of the shoreline combines technical elements with ‘softer’ elements. The SMP aims to use coastal processes and defences to achieve the best possible balance between all relevant uses of the land and the environment.

2.1 Coastal Processes and Coastal Defences

2.1.1 Introduction

The Essex and South Suffolk SMP2 covers a length of about 550 kilometres between Felixstowe Port in the north and Southend – Two Tree Island in the south. The Essex and South Suffolk coastal frontage comprises the sediment sub-cell number 8 in the national numbering system (until recently called 3d), with a south-west to north-east orientation.

The project area has an unusual coastline formed by a series of estuaries and tidal inlets – Stour and Orwell, Hamford Water, Colne and Blackwater, Crouch and Roach and the Thames – interrupted by discrete lengths of open coast – Walton-on-the-Naze to Colne Point, the Dengie peninsula and the Maplin/Foulness shore.

Most of the estuarine areas are dominated by muddy intertidal flats and saltmarshes. In areas of open coast there are a range of coastal features including London Clay sea cliffs and shingle, sandy and muddy beaches. Many of these coastal features are designated for their national and international importance

Overall, the coastline is mainly low-lying. The land up to a level of approximately OD+5m is at risk of coastal flooding; in the vast majority of cases this is currently protected by flood defences. The ‘tidal floodzone’ is typically up to 2km wide, but it is up to about 5km wide in Dengie, Foulness and in some of the river valleys, and protected by earth clay flood embankments with seaward-facing revetment works or sea walls together with groynes. Flood embankments, revetted and unrevetted embankments, can be found in estuarine and coastal environments such as Colne, Bradwell, Dengie and Foulness. Sea walls (reinforced concrete) can be found protecting shingle and sandy beaches of the Tendring peninsula (Figure 2-1) and the coastline from the Naze and Clacton-on-Sea. Foreshore intertidal areas, including saltmarshes and mudflats, function as soft defences as they absorb incoming wave energy.

Figure 2-1 Coastal defences along the Tendring peninsula

A full assessment of the coastal processes in the Essex and South Suffolk SMP area is included as **Appendix C.** A brief summary is provided in the following sections.

2.1.2 Key processes

There are a number of key physical processes occurring around the Essex and South Suffolk shoreline. It is necessary to have an understanding of these processes throughout the development of this plan.

These processes depend on the shape of the coast (largely defined by the geology), hydrodynamic pressures (including wave pressure, tidal flows and volumes), sediment availability (mainly from the North Sea) and man-made influences (flood defences, coastal defences and dredging). The defences reduce the natural evolution of the frontages but they are also undermined by the hydrodynamic pressures.

The north-easterly waves form a prominent hydrodynamic pressure shaping exposed frontages such as the Stour and Orwell estuary mouth, Dovercourt, Hamford Water mouth, Tendring peninsula, Mersea Island and the mouth of the Colne and Blackwater. They move sediment around, which leads to accretion in front of some frontages and to erosion in front of others. Where there is accretion, this can help saltmarsh or mudflats to become established, and these can function as a ‘soft’ form of coastal defence. Where there is erosion, this can cause loss of beaches and intertidal areas (mudflat and saltmarsh) and lead to undermining of defences.

The Stour and Orwell, the Colne and the Roach and Crouch estuaries show similar behaviour with an overall loss of saltmarsh area. Those estuaries are confined by geology and flood defences that limit the landward evolution of intertidal areas. The waves and tidal flows cause erosion of the seaward edge of the intertidal areas. However, the intertidal areas are growing at the inner estuaries. The Blackwater estuary (Figure 2-2) and Hamford Water are less constrained, but they show the same trends of overall saltmarsh loss and growth of the inner estuary creeks.

Figure 2-2 Old Hall Marsh, Blackwater estuary

Tendring, Mersea and Southend are beach frontages with a mixture of shingle, sand and muddy shores. Here the main process is loss of beach material due to wave and tidal pressures (seawards) and landward constraints imposed by coastal and flood defences and higher ground. Lack of sediment availability (partly due to cliff protection, typically at the seaside towns) contributes to beach loss.

Foulness and Dengie are coastal intertidal flats. In both areas there is accretion taking place on the extensive mudflats, however, there is some erosion of saltmarsh along the Foulness and Great Wakering frontages. This is currently resulting in undermining of the coastal defences and puts the frontages at risk.

As well as these large-scale processes, there is a range of factors that determine smaller-scale processes, including anthropogenic factors such as navigation dredging and boat wash/jet ski erosion.

2.1.3 Geology and Geomorphology

This section provides a basic understanding of the geology and geomorphology of the Essex and South Suffolk SMP area. It describes the underlying geology of London clay, the deposition of sand and gravels on top of the London Clay during the Pleistocene, and finally the deposition of mud and sand during the Holocene. A more detailed overview of the geology and geomorphology of the Essex and South Suffolk coast is provided in Appendix C.

The underlying geology of the Essex and South Suffolk coast is London Clay from the Lower Eocene (49 to 56 million years ago). London Clay is a marine formation made up of stiff grey-blue clay which is weathered to brown (Figure 2-3). This formation is exposed in cliffs along the Essex and South Suffolk coast, including the Naze, Stour and Orwell.

Overlying the London Clay is a sequence of sands and gravels deposited in the Pleistocene (from 2.5 million to 12,000 years ago). The Pleistocene deposits include crag. This is characterised by shelly, friable sand and is exposed at Walton-on-the-Naze. Another example are the terrace gravels, a series of medium to coarse-grained flood plain sediments, probably deposited in the early Pleistocene covering much of the present-day nearshore zone. Those deposits and materials were generated by ice advances during the Pleistocene. There is evidence to suggest that the River Thames often switched position during the Pleistocene and may have flowed east and northeast during the late Pleistocene with a mouth at the location of the present Blackwater Estuary.

During the Pleistocene the Essex and South Suffolk coast experienced a series of sea-level changes that are largely responsible for the present-day shape of the land. Some of the present-day channel shapes, particularly estuaries, would have formed during periods of ice advance and sea level fall, when London Clay formations were severely eroded by fluvial channels through repeated ice advance.

The Holocene sediments, deposited from 12,000 years ago to the present day, are made up of the subtidal sands, intertidal sands and muds and freshwater peats overlying the London Clay or the Pleistocene sands and gravels.


Figure 2-3 London Clay formations, the Naze

The end of the last Ice Age, around 20,000 years ago, was the start of a period of rapid sea level rise. Sands and gravels were moved into the newly-formed estuarine channels and deposited as linear, sub-tidal banks, which are aligned with the dominant tidal currents (NE to SW direction).

The rise in sea level during the Holocene was not a continuous process. It has been marked by a series of transgressive (relative sea level rise) and regressive (relative sea level fall) phases. During regressive phases the inner estuaries and upper shore areas would have changed from saline to freshwater conditions in which peat would have been deposited. Throughout Essex these freshwater conditions can be traced with a marked level at around 4,500 years before present. This regressive phase does not seem to be present in the Holocene geological record of the Stour and Orwell region. This has been attributed to a more rapid tectonic sinking of this region (Brew, 1990) or low sediment supply (Brew et al., 1992).

This geology is of national importance and the following sites are designated as Sites of Special Scientific Interest for their geological interest: The Stutton Cliff (part of the Stour Estuary SSSI), The Naze, Holland-on-Sea Cliff, Clacton Cliffs and Foreshore, The Cliff, Burnham-On-Crouch, as well as The Blackwater Estuary SSSI, which is designated for both its biological and geological interest.

2.1.4 Recent geomorphological development

Post-glacial sea level rise has produced a sequence of deposits containing a wide variety of archaeological and past environmental remains. The process of sea level rise has neither been uniform nor continuous and it is these fluctuations in sea level rise that have had a considerable effect on the historic use of the Essex and South Suffolk coast (further information provided in Appendix C).

Repeated sea level changes caused widespread flooding of Iron Age settlements and agricultural lands. Consequently, in places, Romano-British inhabitants protected their land from flooding. Later reclamation was, in particular, associated with the maintenance of grazing land by monastic communities and increased markedly in scale and type through the later middle ages before reaching its peak during the 18th and 19th centuries. Over the last 2,000 years, about 42 per cent of what was originally intertidal land is estimated to have been reclaimed. The removal of such a high proportion of the intertidal area has had huge effects, including a decrease in estuarine channel area, which has led to higher water speeds and increased bed-scour. Consequently, the estuaries are deeper than naturally stable channels.

In addition to sea level rises, changes in sea level have also included regression periods (i.e. relative sea level fall). Between approx. 1650 AD and 1850 AD there was a fall in sea level associated with a phase of global cooling known as the Little Ice Age. During this period, the seaward movement of saltmarshes was at its height and it is likely that the overall area of saltmarsh increased (Figure 2-4).

Figure 2-4 Saltmarsh and mudflat formations, Blackwater estuary

A natural seaward extension of other coastal landforms also seems to have occurred during the Little Ice Age. The more prominent spits and bars, consisting of carbonate shell fragments and silica gravels, such as Landguard Point, Colne Point and Foulness Point became more exposed during this period. Previously, these spits and bars had provided shelter to saltmarsh areas during lower sea levels. Since sea levels have risen, the ridges have either eroded or have rolled landwards leaving the saltmarsh to develop on the foreshore with limited shelter. Colne Point is one of the remaining bar systems, with a series of shingle ridges extending 2.5 kilometres northwards into the Colne estuary. The spit appears to be the remains of a series of shingle ridges that originally extended from Walton to Colne Point but these probably disappeared during the 19th century as a result of ongoing sea level rise (further information provided in Appendix C).

2.1.5 Contemporary processes and geomorphology

Figure 2-7 shows that sea levels have been rising since around 1900. The most relevant contemporary geomorphological processes along the Essex and South Suffolk coast and estuaries concern the evolution of the intertidal area (saltmarsh and mudflat) in response to this sea level rise. This has been a great concern over the past couple of decades, and is a very important factor for shoreline management in the coming years. The intertidal area is a natural part of estuaries and embayments. It provides natural protection against waves and currents, which means it acts as a natural flood and erosion defence. In addition the intertidal area is an internationally important habitat, which gives it a protected status. The natural response of saltmarsh to sea level rise is to migrate in a landward direction. If this landward migration is blocked by natural high ground or by flood defences, then this is referred to as 'coastal squeeze'. If saltmarsh is being lost in an area, then a managed realignment of the flood defence can be an appropriate response: this moves the defence away from the natural pressures to a more sustainable location and can lead to re-creation of saltmarsh, with its benefits for habitats and flood defence (see Figure 2-5 for an example of this).

For these reasons, it is important for the development of the SMP to understand the ongoing losses and gains of saltmarsh and mudflat and associated uncertainties. This section sets out our current understanding, with reference to Appendix C for a more detailed explanation. Section 2.1.7 sets out how we have used this information to make predictions about future losses and gains of intertidal areas. Appendix F also contains specific information about the frontages that are under pressure as a result of intertidal developments.

Monitoring of saltmarsh change in the SMP area has taken place since 1973 using a range of techniques including aerial photographs, GIS and field calibration. For the open coast, the Environment Agency's Coastal Trend Analysis reports are an important source of information; they are based on monitoring since 1991. Appendix C provides more details on these data sources, and this shows that calculating and predicting losses and gains of saltmarsh and mudflats is not a straightforward task and the resulting numbers should be used with extreme caution.

A general conclusion is that the Essex and South Suffolk estuaries are generally losing saltmarsh. Data on mudflat losses and gains is inconclusive; however, the Coastal Trend Analysis report suggests that mudflats are accreting at Dengie and Foulness. Table 2-1 lists the average loss of saltmarsh per year based on available assessments. There are important caveats for the use of these rates, which is further explained in the Appropriate Assessment (Appendix M) and addressed in the Action Plan:

- these are measured loss rates, which may not all have been caused by coastal squeeze or the presence of defences;
- some more recent data show different trends (but these are difficult to quantify); this means there is large uncertainty;
- the data are based on the area within the designated Special Protection Areas (SPAs); there are no quantitative data for Foulness.

The majority of these figures are taken from the saltmarsh surveys completed in the 1970s, 1980s and 1990s which were conducted over number of years. This is currently the best available data regarding saltmarsh losses. Natural England began a new survey into saltmarsh extent in Essex during SMP development. When the results become available early in 2011 they will provide a new baseline for further intertidal habitat monitoring as set out in the Action Plan. Any new data will be shared with stakeholders and will feed into further decision making following completion of the SMP.

Table 2-1 Saltmarsh erosion rates based on monitoring (from Essex CHaMPS, 2003)

Area	Monitoring period	Saltmarsh area (ha)*	Average loss per year	
			ha	%
Stour and Orwell	1988–1997	161	6.3	3.9%
Hamford Water	1988–1998	614	14.4	2.3%
Colne	1988–1998	670	5.6	0.8%
Blackwater	1988–1997	670	7.0	1.0%
Dengie	1988–1998	409	2.7	0.7%
River Crouch	1998–2000	276	10.4	3.8%
River Roach	1998–2000	113	0.7	0.6%
Benfleet and Southend	1988–1998	135	1.4	1.0%
Total		**3048**	**48.5**	**1.6%**

*This is the area present in the last year of the listed monitoring period

Figure 2-5 Intertidal habitats in Wallasea, Crouch and Roach estuaries

2.1.6 Coastal Defences

The frontline of coastal and estuarine frontages throughout the Essex and South Suffolk SMP2 study area is protected by a range of defences including grassed earth embankments; earth embankments reinforced by block work, grouted stone, ragstone, so-called ‘Canewdon’ blocks and open stone asphalt; sheet piling walls and reinforced concrete seawalls. Many frontages are defended by a mixture of several of these structures. The SMP is concerned mainly with the frontline defences. However, in certain sections of the shoreline, secondary defences include counterwalls and earth embankments.

Most of the defences in Essex, Stour and Orwell are revetted earth embankments. These embankments provide protection to low-lying coastal floodplains, grazing marshes and agricultural land and also to settlements in Jaywick, Brightlingsea, Maldon, Maylandsea, St Lawrence, Burnham-on-Crouch, North Fambridge, South Woodham Ferrers, South Fambridge, Paglesham, Wakering and some settlements in Southend.

Grassed earth embankments are often placed in a sheltered position such as inner estuaries and channels, creeks or as secondary defences. Sheet piling is used in quays, marinas, ports and sections of erosional frontages such as Clacton and Southend.

Erosional frontages protecting the communities in Harwich, Frinton, Clacton, Southend and sections of Mersea Island are protected by a combination of concrete sea walls, promenades, wave return walls and beach control structures (timber and concrete groynes and breakwaters).

Currently undefended frontages include the soft cliffs in the Stour and Orwell estuaries, the Naze Cliffs and other frontages where the defences run into higher ground.

The condition of flood and coastal defences is regularly checked by those who manage them, including the Environment Agency, local authorities and private owners. Such inspections allow the determination of the condition of the defence and its ‘unmaintained estimated life’. This estimates the time it would take for the defence to fail in the extreme scenario that the defence would stop being managed (a ‘no active intervention’ scenario).

This information is needed to determine the effect that shoreline management has (elaborated in section 2.3). Furthermore, the role of the coastal processes in undermining or improving the function of the defences has also been considered. A table showing the results of this assessment is in **Appendix F**. The overall conclusions are discussed below.

The lowest unmaintained life (0 to 10 years) can be found in the continuous line of defence in Trimley Marshes, Frinton, Clacton and Mersea. This means that, if maintenance was halted on these defences in 2009, it is expected they would gradually deteriorate and become ineffective sometime between now and 2019. Defences in the Walton channel, Bradwell, Foulness, Potton and Rushley islands have an estimated unmaintained life of 11 to 20 years. They are also under pressure from coastal processes (including wave action and tidal flows).

A continuous line of defence with a relatively long unmaintained estimated life (31 to 40 years) can be found in Orwell, Hamford, the Colne, Blackwater and the inner Crouch. This means that, if they did not receive any maintenance from today (2009), they would still continue to provide some protection up to 2040 to 2049.

Figure 2.6 shows the distribution of flood defence and coast protection across the Essex and South Suffolk SMP2 area.

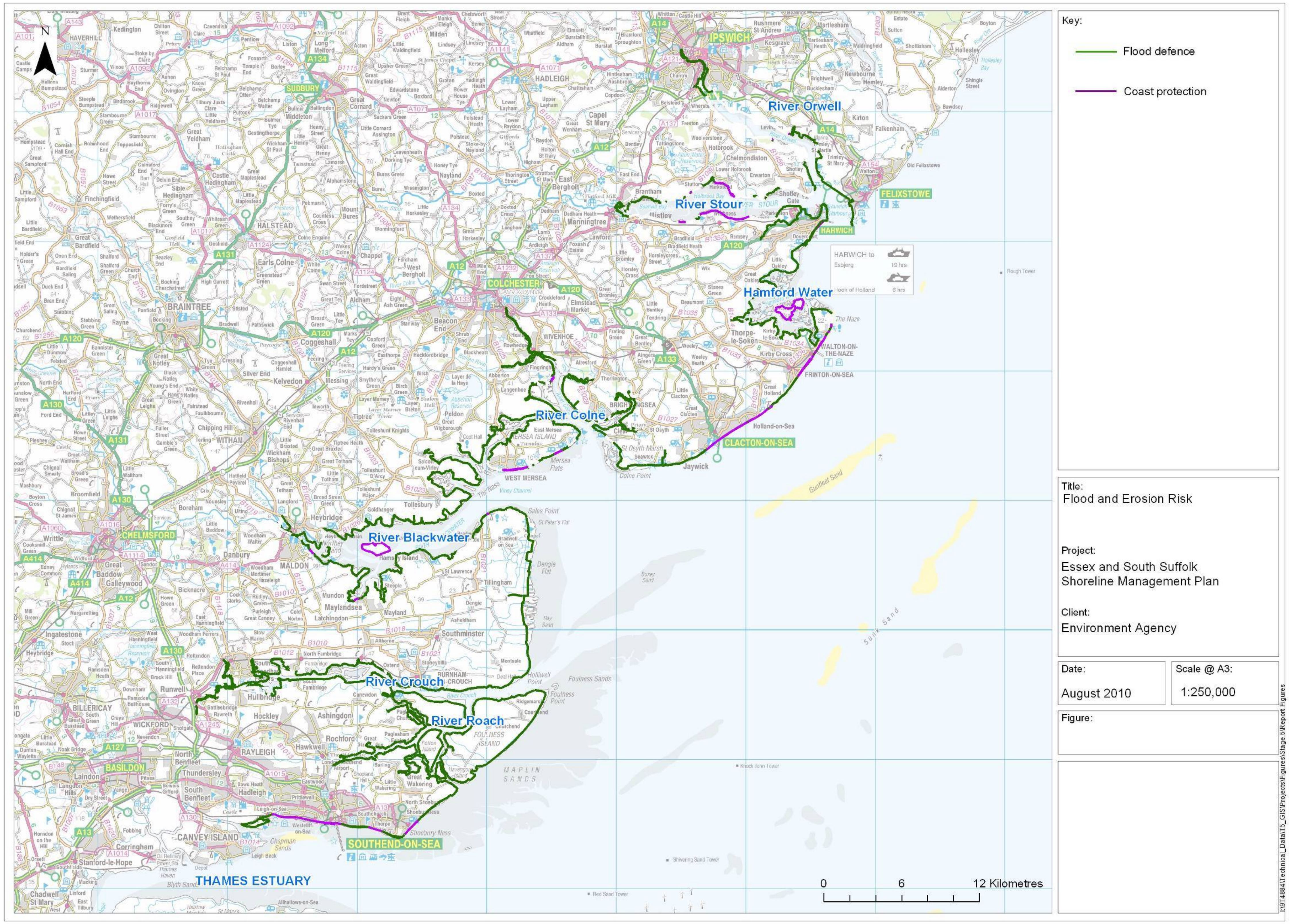

Figure 2-6 Flood defence and coast protection in the Essex and South Suffolk SMP area

Flood defences reduce the likelihood of flooding, but they cannot prevent it completely. In the recent past there have been examples of storm events that have led to damage and breach of the defences along the Essex and South Suffolk coast. The most significant event was on 31 January and 1 February 1953. This event was the greatest storm surge recorded for the North Sea. Coastal defences from Yorkshire down to the Thames were breached. Table 2-2 summarises the main historic events affecting the SMP area caused by flooding from the sea.

Table 2-2 Historic flood events

Date	Description	Areas affected	Consequences
31 Jan to 1 Feb 1953	Exceptionally high tide – combination of spring tide and a full north-westerly gale – North Sea surge	Entire coastline. Regional disaster	Canvey Island – whole island inundated, 58 people died. West Thurrock and Purfleet – most large industrial sites flooded. Tilbury – 2,500 houses and a fire station flooded. Jaywick – 37 people drowned, 700 made homeless. Ipswich – 700 homes and more than 580 commercial properties affected.
1978	Minor tidal event	Eastwick Battery	Sea wall failed and farmland flooded.
February 1983	Minor tidal event	Ipswich	Highest level since 1953.
November 2005	Minor tidal event	Little Wakering Wherstead	Minimal damage. The Strand flooded.
16 December 2005	Tidal event	Manningtree Mersea Island South Woodham Ferrers Wherstead	Garages flooded. Car park flooded. Gardens flooded. B1456 road flooded.

Date	Description	Areas affected	Consequences
March 2007	Minor tidal event	Maldon Wherstead Ipswich	Boat yards and yacht pond flooded. The Strand flooded. Various roads around the docks affected.

The whole SMP is covered by a community based flood warning system and these warnings are provided by Floodline and Flood Warnings Direct (FWD). Following the introduction of the opt out registration to FWD take up of the warning service in the SMP area is in the region of 80%. Tidal warnings are provided 12 hours in advance of high water to allow those at risk to take appropriate action. Operation Watermark is also taking place in March 2011 which will help evaluate the flood warning system for this area.

2.1.7 Future External Development

Climate change (natural and man-made) is causing sea levels to rise. This rate has been between one and two millimetres a year since 1900. However, there is great uncertainty about the future rate. Global temperatures are rising and this is causing water to expand and land ice to melt. Also, the coast of south east England is still sinking as a rebound effect of the melting of the ice of the last Glacial. The sinking land adds to the overall sea level rise. Rates of this relative sea level rise are uncertain, but it is essential that this SMP takes into account the possibility of increasing sea level, whatever the cause. This is known as applying the precautionary principle. The Defra guidance provides values for sea level rise for the three epochs. These are the values that have been used in all SMPs when assessing future shoreline response and in the more measured assessments of intertidal habitat loss. These Defra guidance values are shown in Table 2-3. These values suggest a total sea level rise of 1.1 metres by the end of epoch 3 (2105).

The UK Climate Impacts Programme published an update of its projections in 2009 (UKCP09). This emphasised the importance of the issue, and also highlighted the uncertainty about the actual rates by presenting a range of possible futures. The rates used in the SMPs fall within the range that UKCP09 predicts. In the SMP, we have assessed the impact of slower and faster changes through sensitivity analysis, see **Appendix E**.

As well as sea level rise, it is likely that there will also be increased storminess. There are currently no long-term datasets available to identify specific trends in when storms happen, but the sensitivity of this plan to increased storminess has to be taken into account

The key to taking into account the effects of sea level rise, climate change and the associated effects and the great uncertainties associated with the values, will be to establish 'no regret' decisions for the shorter term, but at the same time emphasising the need to start preparing for change.

Figure 2-7 Recorded Sea Level Rise (Proudman Oceanographic Laboratory)

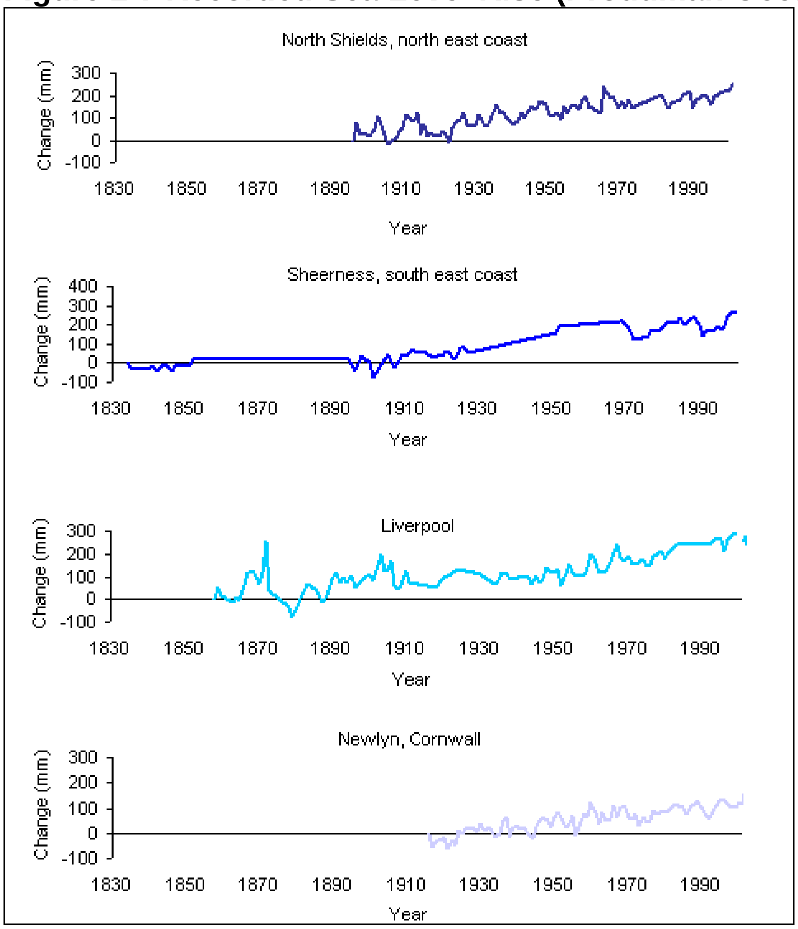

Table 2-3 Defra (2006) sea level rise guidance

Time period	Net sea level rise (millimetres a year)	Total sea level rise (millimetres)	Cumulative sea level rise (millimetres)
Epoch 1 (2009 to 2025)	4.0	64	64
Epoch 2 (2025 to 2055)	8.5	255	319
Epoch 3a (2055 to 2085)	12.0	360	679
Epoch 3b (2085 to 2105)	15.0	450	1,129

As described in section 2.1.5, the evolution of the intertidal area in the coming years is an important driver for shoreline management. The Coastal Habitat Management Plans (the Essex CHaMP from 2003, the Suffolk CHaMP from 2003 and the Thames Estuary CHaMP from 2008) contain predictions of saltmarsh evolution up to 2050, based on a range of techniques. However, given the uncertainty that surrounds the current rates (see section 2.1.5) and the important role of these rates in policy development, we only have sufficient confidence in the data to assume that the current overall rate of loss of approximately 48.5 hectares per year (see Table 2-1) will continue up to the end of epoch 1 (short term, up to 2025). This is seen as a conservative estimate. For the later epochs, rates of loss could be faster as a result of accelerating sea level rise, or could slow down due to other processes, but more information is needed to confirm this.

With the increasing drive for renewable energy, and the current construction of large wind farms, it is also important to consider the potential effect of those developments on the geomorphology and overall coastal processes functioning of the Essex and South Suffolk shoreline. Recent research has shown that effects of the construction of wind farms occur only around the foundations of the structures with some temporary effects during actual building and the laying of cables. There are no known cumulative effects with regard to the coastal or seabed processes. For offshore dredging, before a licence can be given, the potential effects are assessed in terms of sediment processes, hydrodynamics and water quality. If any effects were to be felt along the coastline, dredging would not be allowed to take place.

Finally, the possibility of a barrier or barrage in the outer Thames Estuary has been raised in the course of the development of the SMP. The Thames Estuary 2100 project reports indicate that this may be a realistic option in the long term, beyond 2070. Depending on the location of such a barrier or barrage there could be impacts on the shoreline within this SMP area. These would have to be addressed in the development of the barrier or barrage, and included in future reviews of the SMP.

2.2 Land Use and Environment

2.2.1 Introduction

This section aims to provide an overview of the land use and environment throughout the SMP area. It also discusses possible future changes. The description distinguishes 10 so-called ‘management units’. These are used throughout the SMP document and are shown in Figure 1-1.

The full theme review, on which this section is based, is in **Appendix D**. The theme review identified all features relevant to the SMP, including the benefits, issues and specific objectives associated with each feature.

2.2.2 Management Unit A: Stour and Orwell Estuaries

Most of the land surrounding the estuaries falls outside the tidal flood risk zone. Notable exceptions are parts of Ipswich town, the ports of Harwich and Felixstowe with their ferry services, cargo shipping and the Petrochem Carless refinery. Also, there are properties along the estuaries that fall within the tidal flood risk zone. Other communities include those of Shotley Gate, Brantham, Lawford, Manningtree and Mistley on the Stour. On the Orwell there is Levington, Nacton, Freston, Woolverstone and Chelmondiston. The railway line on the southern side of the Stour could become at risk at several places in the future, while the B1458 road at The Strand, Wherstead is already at risk. Most of the flood zone, however, is characterised by agricultural land. There are sewage treatment works on both the Stour and Orwell that discharge treated waste water into the rivers. Industry at Ipswich and Cattawade also falls within the tidal flood risk zone. Along the Orwell there are numerous marinas, golf courses, and camping and caravan sites that are at risk. In addition, the Royal Hospital School near Holbrook and the HMS Ganges museum at Shotley marina could be adversely affected.

Figure 2-8 Stour and Orwell estuary mouth – view from the Naze

The Stour and Orwell estuaries (Figure 2-8) are of international environmental importance, comprising extensive mudflats, low cliffs, saltmarsh and small areas of vegetated shingle on the lower reaches. The estuaries provide habitats for an important assemblage of wetland birds and internationally important numbers of wintering and passage wildfowl and waders. The site also holds several nationally scarce plants and British Red Data Book invertebrates.

In the Orwell estuary, the Nacton Cliff has the best exposures of the Harwich Formation ('London Clay') in Suffolk - with geological structures clearly visible. The Cattawade Marshes SSSI lies at the head of the Stour estuary and is situated between the freshwater and tidal channels of the River Stour. These grazing marshes – with associated open water and fen habitats – are of major importance for the diversity of their breeding bird community. This includes species that have become less common throughout lowland Britain as a result of habitat loss. The Stutton Cliff, also in the Stour Estuary SSSI, is of geological interest due to its deposits rich with fossils of mammals including lion, straight tusked elephant, horse, giant deer and bison. The Harkstead Cliff has important exposures of Harwich Formation and interglacial deposits.

The Harwich Foreshore SSSI yields the only fossil flora attributable to the lowest division of the Eocene London Clay. Its composition is typical of the formation and specimens are abundant. Association of the plants with ash bands within the clay may help correlations elsewhere in the basin as they form useful marker horizons. This is a recently-discovered site with great research potential.

The estuarine frontages of the Orwell and the northern frontage of the Stour are part of the Suffolk Coast and Heaths Area of Outstanding Natural Beauty (AONB). The AONB extends from the northern side of the Stour estuary, west to

Ipswich and north as far as Kessingland. It is likely the AONB boundary will be extended south to include the Stour estuary and its southern banks within the life of this SMP. The landscape of the AONB is an intricate mosaic of shingle beaches, crumbling cliffs, marshes, estuaries, heathland, forests and farmland (Countryside Commission 1993). There have been a number of landscape character assessments of the area since then, all of which detail the characteristic landscape types of the protected area. The Stour and Orwell estuaries together with their hinterland fringes are quintessential landscapes of the Suffolk Coast and Heaths AONB. They are different from other landscapes in the area and are very much part of what gives the AONB its sense of place and its uniqueness. It is for this reason that coastal changes will have a profound impact on the landscape character of this AONB within the Essex and South Suffolk SMP's area.

A range of finds, from worked flints to hulks and at least one Saxon timber fish-trap, which highlight the long history of human exploitation of the estuary have been recorded within the inter-tidal area of the Stour Estuary. Quays, landing places and wrecks survive clustered around the historic ports of Manningtree and Mistley; jetties and other timber structures may be found along the length of the estuary.

A project is underway to construct a tidal barrier at the New Cut in Ipswich by the Environment Agency in partnership with Ipswich Borough Council and Haven Gateway Partnership. The barrier will be a single rising radial gate, similar to the gates in the Thames Barrier. Ipswich's barrier will be 20 metres wide and will be built in the mouth of the New Cut, being the most cost effective location to build it and having the least impact on the environment. In its fully closed upright position it will provide defence against significant storm surge events.

2.2.3 Management Unit B: Hamford Water

There are some settlements within the tidal flood zone, including areas of Dovercourt, Little Oakley, Beaumont, Kirby-Le-Soken and Walton-on-the-Naze. (Figure 2-9). Most of the area within the floodplain is agricultural land, with some exceptions including the EPC Groupe UK Bramble Island and a number of individual rural properties. The B1414 crosses the tidal flood zone at Beaumont Quay and the B1043 is at risk near Kirby-le-Soken. Titchmarsh marina is also in the tidal flood risk zone.

Figure 2-9 Hamford Water

The cliffs at The Naze have the highest erosion rates in the SMP area of 1.8 metres a year. This creates a risk to the sewage treatment works, John Weston Nature Reserve and properties north of Walton-on-the-Naze. It also puts the Naze Tower at risk, an important landmark of historic value.

Hamford Water has been designated a National Nature Reserve, Ramsar site and Site of Special Scientific Interest (SSSI). It is a large, shallow estuarine basin made up of tidal creeks and islands, intertidal mud and sand flats and saltmarsh. These support rare plants and internationally important species and populations of migratory waterfowl. The site is of international importance for breeding little terns and wintering dark-bellied Brent geese, wildfowl and waders and is of national importance for many other bird species. It also supports communities of coastal plants that are rare or very local in Britain, including Hog's Fennel, *Peucedanum officinale,* which is found elsewhere only in Kent. In addition the cliffs at the Naze also have formations of Waltonian Red Crag unique to Suffolk and Essex. This section of the SSSI has the highest palaeontological diversity.

Within Hamford Water saltmarsh is being lost through erosion. Estimates suggest that approximately 25 per cent of the total area has been lost over the past 25 years.

The historic environment of the unit has numerous earthworks including current and former sea walls, enclosures, decoy ponds and the surviving historic structures of the explosives factory on Bramble Island. Other industrial works include the scheduled lime kiln and quay at the end of Beaumont Cut and the tidal mill pond of Walton mere. Jetties, quays and trackways highlight the importance of access to and from the sea and the relationship with adjacent dryland areas. The prominent tower of Trinity House is an important historic landmark at Walton on the Naze. Earlier exploitation of the area is marked by ancient buried land surfaces, particularly on the foreshore between the Naze and Stone Point and to the south of Dovercourt, which have produced much evidence for prehistoric occupation, and numerous Red Hills (salt making sites). Important areas of historic grazing marsh also survive, as on Horsey Island.

2.2.4 Management Unit C: Tendring Peninsula

There is less low-lying land along this frontage than most of the other frontages, with the exceptions being St Osyth Marsh, Seawick, Holland Haven Marshes and part of Walton-on-the-Naze. St Osyth Marsh comprises drained agricultural land with the settlements of Seawick and Jaywick to the east including a substantial caravan park and Jaywick golf club.

Figure 2-10 Holland-on-Sea towards Clacton Pier

The seafront at Clacton-on-Sea (Figure 2-10) has important recreational and tourism value with attractions including the beach and pier. Walton-on-the-Naze is another important tourist destination with its frontage and pier. Although these settlements are mostly outside the tidal flood risk zone, they are at risk from coastal erosion throughout the frontage, which is why there are coastal protection structures.

The foreshore and cliff exposures, and excavations in the Clacton district (Clacton Cliffs and Foreshore SSSI), have provided opportunities for the study of one of the most important Pleistocene interglacial deposits in Britain. The Holland-on-Sea Cliffs SSSI represents a stratigraphic site of considerable importance. These sites can be precisely attributed to the Anglian glaciation, providing a fixed dating point within the terrace sequence of the eastern London basin and a means of correlation with sequences where the Anglian is represented elsewhere in southern Britain and on the continent.

Holland Haven Marshes SSSI represents an outstanding example of a freshwater to brackish water transition and includes a number of nationally and locally scarce species. Holland Haven country park, situated on the flood plain of Holland Brook, is important both for conservation and recreational value. Part of Walton-on-the-Naze is also within the tidal flood zone, with several buildings and a caravan site at risk. There are several Martello towers along this part of the coast. Martello towers are small defensive forts built in the 19th century that are of historic significance.

Structures associated with the coastal resorts at Walton and Clacton are a feature of the area's historic built environment, as are defences including distinctive Napoleonic Martello towers and WWII pill boxes. The reclaimed Holland Haven marshes are likely to contain well preserved palaeo-environmental deposits and internationally important Palaeolithic remains are known from the Clacton Cliffs and foreshore SSSI. Areas of well preserved prehistoric land surfaces may survive in places and a number of finds of Red Hills (salt making sites) have been recorded on the coast which date from the late Iron Age/Roman period. Post medieval oyster pits, industrial features, duck decoys and extant and relict sea defences reflect the strong coastal/maritime nature of the historic environment of the area and fragments of historic grazing marsh survive in places.

2.2.5 Management Unit D: Colne Estuary

Most of the land in the tidal flood zone lies within the river flood plain and agricultural areas. There are the communities of Point Clear, Brightlingsea, Thorrington, Wivenhoe and Rowhedge. There is an active sand and gravel quarry, at Ballast Quay to the south of Rowhedge village. The Wick Marsh/Langenhoe Marsh/Fingringhoe Marsh area has military importance as a Ministry of Defence firing range and is also within the tidal flood risk zone. At Point Clear, there is a large caravan site within the tidal flood zone as well as another Martello tower, an associated battery and a museum. The camping and caravan site at Brightlingsea also provides amenity and tourist value.

The Colne Estuary is designated as a Ramsar site, SAC, SPA, SSSI and NNR because of its international importance for wintering Brent geese and black-tailed godwit and of national importance for breeding little terns and five other species of wintering waders and wildfowl. The variety of habitats which include mudflat, saltmarsh, grazing marsh, sand and shingle spits, disused gravel pits and reed beds, support outstanding assemblages of invertebrates and plants. Recently saltmarsh erosion has speeded up reflecting the ebb tidal dominance within the estuary.

The historic landscape of this unit is characterised by areas of important historic reclaimed coastal grazing marsh, such as Howlands Marsh. Relict and extant sea walls are a dominant feature of the area, as is The Strood causeway which links Mersea Island to the mainland and is of Saxon origin. Other earthworks relate to the medieval and post-medieval exploitation of the marshes, including raised trackways and enclosures. The unit is also characterised by post-medieval oyster beds, industrial and transport structures such as timber jetties, hulks and the dismantled railway from Wivenhoe to Arlesford Quarry. Earlier archaeological remains include finds of flint artefacts retrieved from possible habitation sites along the foreshore, indicating the possibility that well preserved land surfaces may be present in places. The potential for palaeo-environmental remains and deposits in the unit is high and there are significant possibilities of archaeological remains directly related to these deposits including timber structures. A large number of Red Hills (salt making sites) survive, with notable concentrations along the Strood Channel.

2.2.6 Management Unit E: Mersea Island

This frontage covers Mersea Island. Most of the properties are outside the tidal flood risk zone, including the properties in the West Mersea and East Mersea settlements as well as the Outdoors Education Centre and the Mersea Vineyard. However, there are several camping and caravan sites that are potentially at future risk where they lie within or adjacent to vulnerable frontages. The landward side of Mersea Island is comprised of drained agricultural land behind the flood defences with a small area of saltmarsh. The area around Mersea has an important oyster industry.

Two areas of foreshore at East Mersea are of geological importance. Cudmore Grove Country Park and Mersea Stone have local conservation and recreational value. The foreshore area surrounding Mersea Island is part of the Colne Estuary Ramsar site, Mid Essex SAC, SPA and SSSI.

The beach at Cudmore Grove, East Mersea overlies a peaty deposit containing the faunal remains of species dating to 300,000 years before present. Finds of flint artefacts retrieved from possible habitation sites along the foreshore suggest that prehistoric land surfaces may survive in places. A number of Red Hills (salt making sites) have been identified along the north side of the island. The Strood Causeway linking Mersea to the mainland has been dated to the 7th century and two massive timber fish-traps of Anglo-Saxon date have been recorded within the intertidal zone off West Mersea flats. Military defences include the Tudor blockhouse at East Mersea and WWII defensive structures such as pillboxes located along the sea walls.

Figure 2-11 Mersea Island (courtesy of ECC)

2.2.7 Management Unit F: Blackwater Estuary

This unit covers the low-lying land surrounding the Blackwater estuary extending inland to Maldon. The area within the tidal flood zone is mostly agricultural land with sporadic farm buildings. There are, however, several settlements within this zone: St Lawrence, Mayland, Maylandsea, parts of Maldon and Goldhanger. Sections of several B-roads, as well as numerous minor roads, are also within the tidal flood zone. The campsites at St Lawrence, Mayland Creek and Vaulty Manor provide amenity value. There are several marinas in the estuary that have recreational, amenity and economic value. The site of the Battle of Maldon and National Trust property is a valuable tourist attraction.

Figure 2-12 Maldon, inner Blackwater estuary (courtesy of ECC)

Bradwell nuclear power station is currently being decommissioned. There are, however, plans for development of a new nuclear plant on the site and flooding or undermining of this site would cause numerous issues. The site itself was built on higher ground to avoid flood risk.

Blackwater Estuary NNR and SSSI is the largest estuary in Essex north of the Thames and is one of the largest estuarine complexes in East Anglia. The mudflats are fringed by saltmarsh on the upper shores and support internationally and nationally important numbers of overwintering waterfowl. Shingle and shell banks and offshore islands are also a feature of the tidal flats. The surrounding terrestrial habitats – the sea wall, historic grazing marsh and its associated fleet and ditch systems, plus semi-improved grassland – are also of high conservation interest. This rich mosaic of habitats supports an outstanding collection of nationally scarce plants and a nationally important assemblage of rare invertebrates.

There have been four managed realignments in the recent past: Northey, Orplands, Tollesbury and Abbotts Hall. Northey Island Nature Reserve (National Trust), Ray Island Nature Reserve (National Trust) and several other local nature reserves further highlight the conservation value of much of the tidal flood risk zone.

The area includes extensive settled Neolithic land surface preserved within the intertidal zone. There are also many large timber fish weirs of Saxon Date. There are numerous Red Hills (salt-making sites) and duck-decoy ponds on the present and former marshes, and the estuary is fringed by extensive cropmark landscapes dating to the prehistoric and Roman period. Extant areas grazing marsh as at Old Hall and Tollesbury Wick are complex historic landscapes. Overall the Blackwater estuary has one of the most significant coastal wetland historic environments in England and is included on the English Heritage list of nationally-significant wetland sites as part of the Heritage Management of England's Wetlands initiative.

2.2.8 Management Unit G: Dengie Peninsula

Within this frontage the tidal flood zone is nearly all drained agricultural land with scattered farm buildings and some minor roads. Othona Roman fort, a Saxon shore fort, and the chapel of St Peter on the Wall are of important value both historically and as tourist attractions. The remains of a very large Saxon fish-trap at nearby Sales Point is also a rare example of a Scheduled Ancient Monument within the intertidal zone.

The Dengie NNR, Ramsar site, SPA and SSSI saltmarsh is the largest continuous example of its type in Essex. The foreshore, saltmarsh and beaches support an outstanding collection of rare coastal flora and internationally and nationally important wintering populations of wildfowl and waders, as well as supporting a range of breeding coastal birds in summer. Bradwell Cockle Spit Nature Reserve is made up of saltmarsh and shellbank habitats that support many species of breeding birds.

Bradwell Beach is also important to local people and visitors for its amenity value.

Earlier occupation of the marshes is marked by the survival of numerous Red Hills (salt-making sites), duck-decoy ponds, former sea-walls and World War II defensive sites. Former cheniers (beach ridges) are also buried within the marsh and these may well have served as central points for occupation and activity in the past.

2.2.9 Management Unit H: Crouch and Roach Estuaries

The settlements in the tidal flood zone include parts of Rochford, South Woodham Ferrers, Burnham-on-Crouch, Paglesham Churchend and Paglesham Eastend. Infrastructure found in the tidal flood zone includes several minor roads and the railway line between South Woodham Ferrers and Burnham-on-Crouch, along with the station at Althorne.

The marinas at Burnham-on-Crouch, Althorne and North Fambridge provide recreational and economic value, along with the campsites around Burnham-on-Crouch. Foulness and Potton islands have significant military importance as firing ranges for the Ministry of Defence.

The Crouch and Roach Estuaries Ramsar site, SPA and SSSI is of international importance for bird species, with other interest being provided by the water and land invertebrates and an outstanding collection of nationally scarce plants.

Wallasea Island is currently undergoing managed realignment. The north-east section of the Island has been realigned. The RSPB has planning approval up to 2019 for the creation of 668 hectares of new habitat, of which 457 hectares would be intertidal. The remainder is saline lagoon, engineered water vole habitat, grazing marsh, new sea walls and arable land. The north-west corner will remain protected. Completion of the project is dependent on the availability of funding and sufficient suitable material to raise the land height within the island.

A range of archaeological deposits and features, including prehistoric relict land surfaces, peats and ‘submerged forests’ survive well, within and beneath the alluvium, and in the intertidal zone There are also numerous red hills, relict seawalls, oyster pits, timber structures and military remains. The extant grazing marshes are complex and significant historic landscapes. There are important areas of surviving historic grazing marsh as at Blue House and Morris Farms. In view of its complex and important historic environment, the Upper Crouch Estuary has been included on the English Heritage list of nationally-significant wetland sites as part of the Heritage Management of England's Wetlands initiative.

2.2.10 Management Unit I: Foulness, Potton and Rushley Islands

The land in this unit is low-lying and the three islands are completely within the tidal flood zone. This includes the Ministry of Defence controlled firing ranges on Havengore and Foulness islands that extend offshore onto Maplin Sands. The associated buildings include the hamlets of Churchend and Courtsend. The Broomway public right of way across Maplin Sands has amenity value.

Foulness Ramsar site, SPA and SSSI is part of an open coast estuarine system made up of grazing marsh, saltmarsh, intertidal mudflats and sandflats which support nationally rare plants. It also supports nationally and internationally important populations of breeding, migratory and wintering waterfowl.

A range of archaeological deposits and features, including prehistoric relict land surfaces, peats and 'submerged forests' survive well, within and beneath the alluvium, and in the intertidal zone. There are also numerous red hills, relict seawalls, oyster pits, timber structures and military remains. The extant grazing marshes are complex and significant historic landscapes.

2.2.11 Management Unit J: Southend-on-Sea

Southend-on-sea is among the most populous and densely developed communities in the Essex and South Suffolk SMP area and functions as a regional coastal resort.

The whole frontage is at risk from erosion, which is why there are coastal defences along its whole length. The Southend-on-Sea seafront has important recreational and tourism value with attractions including the beach, pier, aquarium and museum.

Figure 2-13 Southend Seafront Pier

In addition to the erosion risk, approximately 9 km of the frontage is low-lying. The tidal flood zone extends up to 1.5 km inland and contains thousands of properties at Shoeburyness, Southchurch and other areas of the seafront. Sections of the B1016 and the railway line at Leigh-on-Sea are in the tidal flood zone, and so is the Thorpe Hall golf course at Southchurch. Shoeburyness is of military importance as a Ministry of Defence firing range. Some of the defences in this frontage are owned by Network rail, the Ministry of Defence and private developers.

Benfleet and Southend Marshes Ramsar site, SPA and SSSI is made up of an extensive series of saltmarshes, mudflats, scrub and grassland that support a range of flora and fauna. The south-facing slopes of the downs, made up of London Clay capped by sand, represent the line of former river cliffs with several river valleys known as re-entrant valleys because they were carved out by rivers and then filled by glaciers.

2.3 Role of Shoreline Management

2.3.1 Introduction

This section aims to illustrate how shoreline management can influence the position and nature of the Essex and South Suffolk shoreline and the activities and values around it. This is done by setting out two extreme scenarios for shoreline management and assessing the effects of these scenarios on the shoreline in terms of the development of the land and level of flood risk. These two extreme management scenarios are:

- **No Active Intervention (NAI)** – this scenario assumes that the defences are no longer maintained and will therefore fail gradually over time. NAI does not, however, involve actively removing the existing defences, so for a time the defences will provide some residual protection while they are failing.
- **With Present Management (WPM)** – this scenario assumes that all current frontline defences are maintained to provide the same level of protection as they currently do. This includes keeping up with the effects of climate change. WPM is Hold the Line for the majority of the Essex and South Suffolk coastal flood and erosion defences and NAI for the remainder.

The role of shoreline management is discussed at a high level for the whole of the SMP area. More detail, including location-specific discussion for each of the management units, is provided in **Appendix F**.

We should make clear that there is an element of uncertainty in all aspects of the analysis. Specific gaps in knowledge are highlighted in the text (section 1.5), as they need to be dealt with in developing the plan and addressed in implementing it through the action plan.

2.3.2 Background developments

In looking at future effects of the policy scenarios, it is important to determine first how the conditions will change over the short, medium and long term. Section 2.1 describes historic and ongoing developments. It sets out the predicted rates of sea level rise and indicates that storminess is also likely to increase. Based on this information it is possible to indicate how the foreshore might develop, which is essential in describing the effects of the two extreme management scenarios.

<u>For the estuaries</u>, there is a general trend of erosion throughout the middle and lower estuaries, combined with sediment accretion in the upper estuaries and their creeks systems. There is an overall net loss of saltmarsh, which is estimated conservatively at approximately 48 hectares per year. There is some uncertainty to what extent these developments are happening only in response to sea level rise or whether there are other contributing factors. The SMP's Action Plan identifies the need for monitoring and study to improve understanding. For the short term, it is likely that the ongoing trend will continue. For the medium and long term, there is much more uncertainty: the current trend may continue or could accelerate as a result of accelerating sea level rise, but it could also slow down due to other processes. It has to be noted that the processes are not fully understood; there are other factors which may cause the frontage to develop differently, which is one reason why the SMP is reviewed on a regular basis.

For the coastal frontages, there are different trends in different sections of the SMP area. At the Tendring frontage, there is a nearshore sediment divide in the vicinity of Clacton. To the south of Clacton, sediment moves along the shoreline to the southwest and accretes at Colne Point. To the north of Clacton, the net sediment drift is northwards with a sediment convergence, roughly in the vicinity of Walton, where it meets the southerly drift from the north leading to a sediment deposition at the Naze (Essex SMP1, 1996). For Mersea Island, the foreshore consists of mudflats and sandflats; these are generally eroding. For Dengie and Foulness there are indications of a general trend of saltmarsh and mudflat accretion. This is the response of the shoreline to sea level rise if there is sufficient sediment available. Finally, the Southend frontage is similar to Mersea, with a foreshore of sandflats and mudflat which are generally eroding. Generally, these overall trends are likely to continue in the short term. On the medium and long term the response to sea level rise is more difficult to predict. Where the trends are related to sea level rise (such as the accretion at Dengie and Foulness), they are likely to continue or even accelerate as the rate of sea level rise increases. However, different trends are possible as a result of the other factors that influence the processes, such as sediment availability and channel morphology. Again, the SMP's Action Plan has identified the need for monitoring and study to improve understanding to inform future shoreline management.

2.3.3 With Present Management

For most of the Essex and South Suffolk SMP shoreline, continuing present management would mean holding the flood defences in place that are present along most of the estuaries and coastline, and holding the coastal defences in the seaside towns. There are a number of frontages without current defences (mostly in Stour and Orwell plus the Naze), and these would remain undefended.

Continuing to hold the **flood defences** in their current place and to the current standard of protection would of course help sustain the existing land use behind the defences, including the communities, dwellings, businesses, infrastructure, historic and environmental features. However, climate change is likely to increase the pressure on the defences. This could become particularly problematic in locations where there is no or limited foreshore in front of the defences, where the foreshore is eroding or where the defences are of poor quality. Holding the line where the foreshore is eroding can also lead to accelerated loss of beaches and marshes. These natural features are being 'squeezed' between sea level rise and hard defences leading to the loss of valuable habitats, natural resources and heritage assets. This in turn can make the coast more vulnerable to coastal processes, lead to the loss of valuable habitats and have a negative impact on local economic activities seaward of defences such as fisheries, recreation and eco-tourism.

For the **coastal towns**, holding the defences in place would sustain the seafront which is vital for the towns' character and economy. However, for some of the towns the coastal processes are already making this difficult, and this is likely to become more difficult into the future. In addition, holding the line may reduce the availability of sediment: this could threaten the beach locally, but could also have a longshore impact on neighbouring frontages and all their features and values, which could threaten the tourist economy.

For **currently undefended areas**, continuation of this approach would sustain the natural processes and the landscape. Climate change may lead to an accelerated rate of erosion, but there is no reason to consider active intervention until erosion starts to threaten significant features. Conversely: the alternative option to start holding the line would typically have negative impacts on coastal processes, but this could be justified if it protects important features at risk.

2.3.4 No Active Intervention

For the areas that are currently defended, both against erosion and flooding, this scenario would set in motion a process of gradual and unmanaged deterioration of the defences until they no longer function. As discussed in section 2.1.6, the residual life depends on the current condition, the asset type and its exposure, and varies between very short (0-10 years) and very long (more than 100 years). In time, the probability of flooding and erosion would increase and on the medium to long term, all low-lying areas along the shoreline would revert to an intertidal state while the cliffs would progressively erode. There are significant areas in the Essex and South Suffolk SMP area where the defences protect dwellings and settlements, and these would be lost in time in this extreme and unrealistic scenario. For most areas it would also come at the expense of agricultural land and it could cause pollution from existing contaminated land, landfill sites or industrial areas. The gradual return of natural processes, although unmanaged, might in time lead to significant gains for the local economies through fisheries, recreation and eco-tourism.

For currently undefended areas, this scenario is a continuation of the current approach as described above.

2.3.5 Summary

At the broad-scale level of the SMP, the key differences between the scenarios are obvious: With Present Management would continue to sustain land use in the defended areas with all the associated benefits, but it can cause squeeze of the intertidal area and it could become more and more difficult in the future. No Active Intervention would require significant adaptation of society, at a local and regional scale and would cause an unmanaged increase of flood and erosion risk and loss of land and assets.

The assessment shows that continuing to hold the existing alignment meets the short-term aspirations for managing existing land use and infrastructure and protecting the most people and property for as long as possible. For many areas, this may be the right solution. However as time passes there will be an increasing negative impact on the seaward assets of this coast which are very important for the local economy and society as well as for the environment both locally, regionally and nationally. Therefore, for some frontages a change of approach may be needed. This change of approach will have to happen in a managed way: the assessment also shows that wherever the defences protect important features, No Active Intervention is not realistic because it will lead to an unmanaged increase in flood and erosion risk and loss of land and assets.

2.4 Sustainable Shoreline Management: Finding the Right Balance

2.4.1 The ‘big decisions’ for the Essex and South Suffolk SMP

This section builds on the conclusion of the preceding one to identify the ‘big decisions’ that this plan needs to make.

The preceding sections show that the Essex and South Suffolk shoreline poses some very particular challenges to shoreline management, which are essential for the future of the area itself and could also be significant on a regional or even national scale. Particular ways of managing the shoreline will benefit some of these values and land uses, but damage others. The aim of this shoreline management plan is to develop a plan that achieves the right balance between all these values. This is reflected in the set of principles and corresponding criteria that was agreed among all partner organisations involved in the development of this SMP (see section 1.4). Based on the principles, the SMP has worked toward three key aims:

- Protect the most people and property we can for as long as we can;
- Allow people and places time to adapt;
- Balance environmental, social and economic needs.

Section 2.2 identifies for each Management Unit the values and land uses that can be influenced by shoreline management. These findings illustrate the ‘big decisions’ that the Shoreline Management Plan has to make. The two scenarios from section 2.3 are extremes, so in reality there may be opportunities to develop a plan that benefits all values and land uses. However, there are also cases where hard decisions have to be made because the interests are conflicting. For such cases, it is essential that the plan aims to provide sufficient time for adaptation, for people, businesses and other organisations, including the mitigation of impacts on significant features.

For the Essex and South Suffolk SMP area, the ‘big decisions’ for shoreline management can be summed up as follows:

- For the coastal defences that protect the seaside towns against erosion, the question is how to sustain the vital role of the seafront for the towns’ character and economy. Holding the existing alignment protects existing features, but it can be difficult and it can have a negative impact on the beach and elsewhere along the shoreline.
- For defences that protect any settlements or important infrastructure it is not realistic to stop defending against tidal flooding. For these defences, the ‘big decision’ is not whether, but how to achieve continued defence against flooding. The best solution could be to hold the existing line, but it could also be to move the defences landward.
- For all other flood defences, the SMP does have to ask the question whether continued defence is the best solution in the face of increasing pressures and the negative impacts of coastal squeeze. Do the benefits that the defences bring outweigh their negative impacts and the effort and costs needed to sustain them?

These decisions have to take into account a range of factors:

- Some of the defences are under significant pressure. This can be from eroding channels, particularly where the estuaries’ natural evolution has been constrained in the past by land reclamation. Pressure can also come from waves where the foreshore is eroding. These pressures can lead to undermining of the defences and are likely to increase as a result of climate change. In such cases, holding the existing defence alignment will be difficult.
- Loss of foreshore does not only threaten the flood defences, it can also threaten the environment by reducing the area and quality of intertidal habitats, some of which are protected by international designations, in addition to their value for the local economy. It has been recognized that the natural environment is a valuable asset, although quantifying the value of the natural environment is extremely difficult. Moving the defence landward could mitigate for this threat of losing the natural environment as a valuable asset.
- The defended areas have important values, even if they don’t include settlements or key infrastructure. This includes agriculture, access to the shoreline and heritage assets. They also contain important freshwater habitats, some of which also have international designations and value to

the economy. Similar to above, the natural environment is recognised as a valuable asset, in some cases, the functioning of the freshwater and intertidal habitats is mutually dependent.

Finally, the SMP looks at the long term, but we only have limited knowledge about future developments. This is the case for the coastal processes, but also for the value that society will place on the different features of the area. The SMP needs to make sure that the plan is both robust and flexible in the face of these uncertainties.

2.4.2 Moving forward to solutions

These considerations have steered the development of the Shoreline Management Plan.

We have started by using these considerations to identify which of the four policies could be realistic for each of the SMP's frontages. For some of the frontages this led to the conclusion that there is only one realistic option; for other frontages this identified which options needed appraisal. These options typically represent the various sides of the arguments; they all include the provision of time for adaptation to large changes.

The process included a number of steps to refine and streamline the policy appraisal.

The full process of option development and appraisal is described in **Appendix E**, with references to more details in the other appendices. This main SMP report focuses on the Plan: chapter 3 describes the plan and its implications, while chapter 4 describes the specifics of the plan per Policy Development Zone.

STEP 1

For frontages that are currently defended against flooding, we identified which are under pressure, now and in the future, either because of the state of the existing defences or because of intertidal evolution. The maps in Appendix F4 show the results of this analysis. For these frontages, Managed Realignment was identified as a realistic option, to be appraised against Hold the Line.

STEP 2

For the currently defended frontages that are not under pressure, the economic viability was assessed to check that Hold the Line would be realistic. Where this is the case, Hold the Line was identified as the only realistic option, based on the principles and aims of the SMP. For frontages where Hold the Line is not viable, there is a need to appraise Managed Realignment against No Active Intervention.

STEP 3

For currently undefended frontages, continuation of No Active Intervention is a realistic option. However, for frontages where ongoing erosion could affect features, it could be a realistic option to start defending against erosion. We identified those frontages for which this is the case, and for these a policy of limited intervention (labelled as Managed Realignment) was appraised against continuation of No Active Intervention.

STEP 4

This process led to a list of Policy Development Zones for which there was **more than one realistic** option. We have then appraised these options against the **criteria** that are based on the **principles**, as listed in **section 1.4.** This has led to the selection of the policies suggested in this draft SMP.