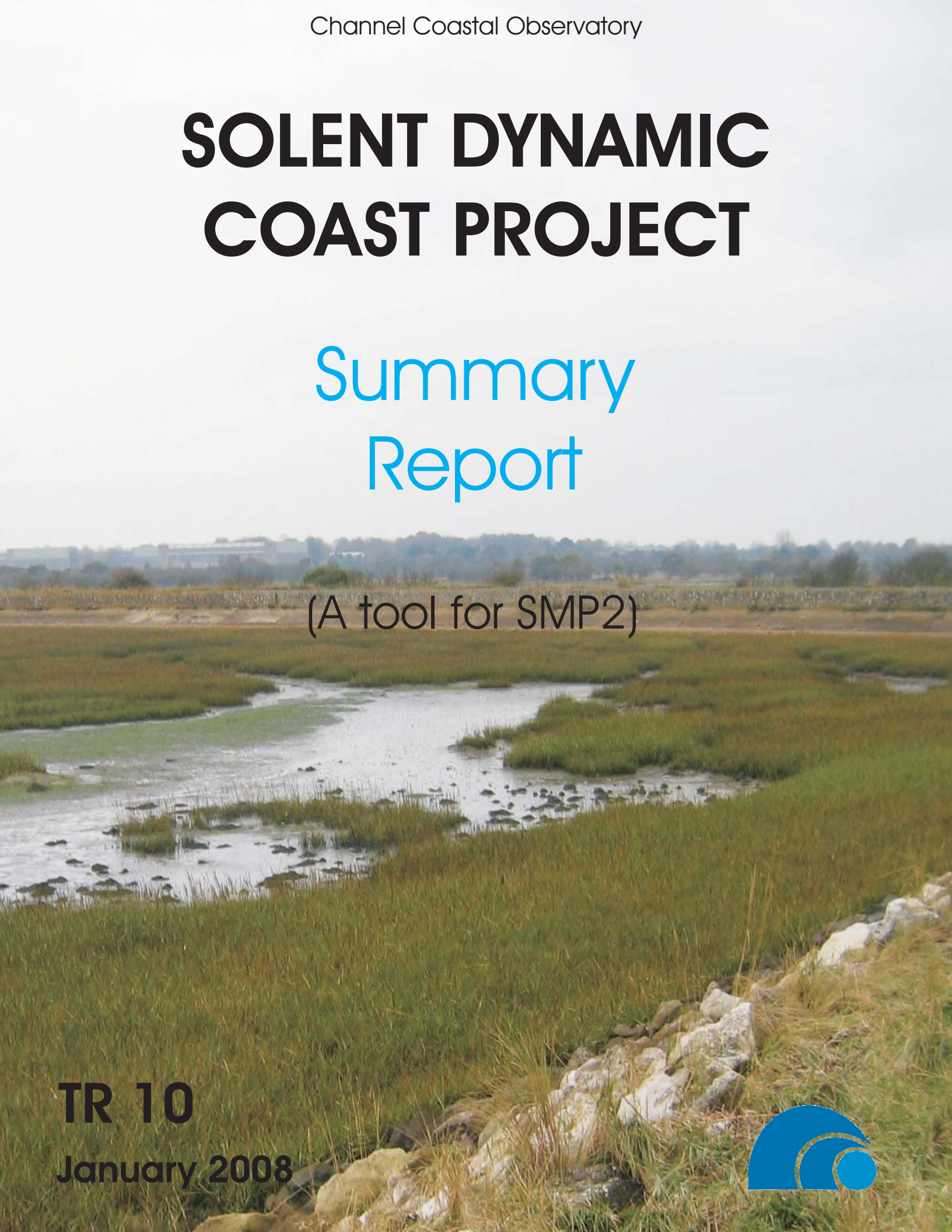
Channel Coastal Observatory

SOLENT DYNAMIC COAST PROJECT

Summary Report

(A tool for SMP2)



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Solent Dynamic Coast Project: *Summary report*

A tool for SMP2

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Please note that the Solent Dynamic Coast project is purely a desktop study, focusing on inter-tidal habitats, designed to inform the North Solent Shoreline Management Plan (SMP). It is essentially a precursor to the SMP Appropriate Assessment.

The main objective of the project was to quantify inter-tidal loss and identify potential for re-creation at a strategic level across the north Solent. In doing so, a method was devised based on approximate benefit-cost calculations to categorise potential inter-tidal habitat creation sites into possible managed re-alignment sites, possible abandonment sites (No Active Intervention) and possible hold the line sites. The project was able to estimate a balance of inter-tidal loss versus the potential for inter-tidal gain. The requirement for replacement EU designated freshwater habitat was also quantified.

The work was undertaken by the key statutory authorities. However, this study did not involve any decision making on the part of any statutory authority. The options suggested in this study are there to facilitate future debate and decision making as part of the SMP process. No landowners or wider stakeholders were consulted as part of the project. Detailed discussions will be required with landowners before any site management changes. These views will be sought as part of the SMP process. The SMP process will integrate all aspects of sustainable development, social, economic as well as environmental, prior to any final decisions on coastal management being made. The basis of the framework applied in the Solent Dynamic Coast project was therefore technical and does not reflect a formal proposal to change the management.

Please visit http://www.defra.gov.uk/environ/fcd/policy/smp.htm for DEFRA guidance on SMPs and http://www.nfdc.gov.uk/index.cfm?articleid=6554 for more information on the North Solent SMP.

Executive Summary

The Solent Dynamic Coast Project (SDCP) was conducted to inform development of the 2nd round Shoreline Management Plan (SMP 2) in order to comply with the requirements of the European Union Habitats and Birds Directives. The focus was on mudflat and saltmarsh habitats as these form the largest expanse of coastal habitats across the north Solent that are immediately under threat from climate change and coastal management decisions. The consequent effect to coastal grazing marsh was also considered. The main objectives were to;

- quantify the amount of inter-tidal coastal squeeze over the next 100 years that requires replacement habitat
- identify sites where inter-tidal habitat creation is physically possible
- quantify the amount of inter-tidal habitat creation sites that could potentially offset inter-tidal coastal squeeze over the next 100 years
- undertake preliminary ranking and assessment of the feasibility of conducting managed re-alignment relative to other impacting variables
- develop a region-wide framework of potential inter-tidal habitat mitigation and compensation sites

The majority of defences in the north Solent are fronted and backed by European designations, such as Special Areas of Conservation (SACs) and Special Protection Areas (SPAs). Maintaining or improving these defences, must comply with European environmental legislation. Certain flood defence schemes have been delayed for over two years because replacement inter-tidal habitat could not be found to offset the projected coastal squeeze, resulting from the operational works.

As a result, the SDCP was initiated on behalf of the operating authorities within the north Solent region. The project covered the area between Hurst Spit, Hampshire and Pagham Harbour, West Sussex. The project verified mudflat and saltmarsh loss calculated by the Solent Coastal Habitat Management Plan (CHaMP, 2003) using a robust methodology of historical aerial photography interpretation (HPI) and analysis of topographic and tidal elevation data. Predicted changes to existing inter-tidal habitat across the north Solent, regardless of defences or environmental designations, was estimated to be +60 hectares (ha) for mudflat and -812 ha for saltmarsh over the next 100 years. Inter-tidal coastal squeeze resulting from maintenance of all existing defences (causing coastal squeeze) across the north Solent over the next 100 years was estimated to be approximately 5 ha of mudflat coastal squeeze and 495 - 595 ha of saltmarsh coastal squeeze. This predicted 500 - 600 ha loss provides a worse case scenario, as not all defences will be maintained.

Potential habitat creation sites across the north Solent were identified using topographic and tidal elevation data. A total potential of 3883 ha were identified. Once buildings, landfill and sites smaller than 0.5 ha were removed there were 2025 ha to be assessed further. In order to assess the viability of the potential sites (2025 ha), local coastal managers were interviewed using a questionnaire based on Government economics and environmental criteria devised by the Environment Agency (EA), Natural England (NE) and the Channel Coastal Observatory (CCO). The questionnaire categorised the sites into preferred options for, hold the line, managed re-alignment or no active intervention (abandonment)* for time epochs 0-19, 20-49, 50-100 and 100 years+.

* references to abandonment are only relevant in the context of the SDCP. The EA intend to implement a policy of withdrawal of maintenance from un-economic defences in due course.

Of the 2025 ha of potential habitat creation sites, only 552 ha were considered suitable to offset the 500 - 600 ha projected loss. Key potential habitat creation sites were West Northney, Medmerry, Gillies, Farlington Marshes, North Common, Saltgrass Lane, Lymington Reedbeds, Pagham South, Stoke, Nutbourne and West Wittering. Of the 552 ha, 135 ha counts as mitigation because the key sites are within an existing SPA. There may be a shortfall of inter-tidal habitat creation sites in the north Solent over the next 100 years unless abandonment sites (686 ha) can be used as mitigation or compensation to offset future damaging schemes. Hold the line sites (787 ha) may require further future assessment if resources are made available to re-align them. Approximately 79 ha of designated freshwater sites were identified as requiring replacement habitat as a result of potential managed re-alignment. A further 328 ha of freshwater sites would also be lost due to potential abandonment without any clear means to replace it.

The SDCP approach was innovative and has not been applied elsewhere in the U.K. The mixture of scientific data and input by local coastal managers has produced guidance for inter-tidal habitat creation that will feed into the North Solent Shoreline Management Plan (SMP). Findings are based on current environmental policies, which lack clarity and are frequently open to ambiguous interpretation. The set of rules applied to rank potential inter-tidal habitat creation sites into time epochs for potential re-alignment or abandonment was based on a suite of assumptions that are subject to change. The parallel Isle of Wight Mitigation Study (which in addition to inter-tidal habitats, assessed other coastal Biodiversity Action Plan habitats), and the SDCP will inform the EA Southern Region Habitat Creation Programme (RHCP).

The work has been undertaken by the key statutory authorities. However, this study has not involved any decision making on the part of any statutory authority. The options suggested in this study are there to facilitate future debate and decision making as part of the SMP process. No landowners or wider stakeholders have been consulted as part of the project. These views will be sought as part of the SMP process. The SMP process will integrate all aspects of sustainable development, social, economic as well as environmental, prior to any final decisions on coastal management being made.

Contents

Introduction

The Solent Dynamic Coast Project (SDCP) provides technical advice to the North Solent Shoreline Management Plan (SMP) on meeting the requirements of the EU Habitats Directive 92/43/EEC and EU Birds Directive 79/409/EEC. ***The work has been undertaken by the key statutory authorities. However, this study has not involved any decision making on the part of any statutory authority. The options suggested in this study are there to facilitate future debate and decision making as part of the SMP process. No landowners or wider stakeholders have been consulted as part of the project. These views will be sought as part of the SMP process. The SMP process will integrate all aspects of sustainable development; social, economic as well as environmental, prior to any final decisions on coastal management being made.***

The study aims to provide a strategic approach to compensating for inter-tidal coastal squeeze caused by essential flood defences, and will form the basis of the North Solent SMP's Appropriate Assessment (AA). The AA will need to show that coastal management policies are adopted that allow sufficient mitigation or compensation to generate new inter-tidal habitat to offset that lost to coastal squeeze. Where replacement habitat causes loss to landward designated habitats then there may be a knock-on requirement for replacement freshwater habitats.

1.1 Background

The first round of SMPs was produced before statutory obligations to protect the natural coastline were fully realised. With better understanding of the implications of climate change there is now an increasing trend away from coastal defence towards risk management and planning for a "sustainable" coastline. As a consequence, managed re-alignment is becoming a more environmentally and economically accepted option. Coastal managers have, however, been limited when identifying suitable sites for mitigation or compensation of coastal habitats due to lack of research into viable areas.

In an attempt to deliver the European Union (EU) Habitats and Birds Directives for SMPs and Coastal Defence Strategy Studies (CDSs), the Solent Coastal Habitat Management Plan (CHaMP, 2003) included an assessment of mudflat and saltmarsh change. It predicted between 730 to 830 ha of inter-tidal habitat loss over the next 100 years for the north Solent and Isle of Wight. The Solent CHaMP (2003) also identified potential inter-tidal habitat creation sites using a coarse resolution approach based on the 5 metre OD contour line. However, more detailed analysis of the potential sites was required to advise the second round SMPs.

The latest SMP guidance recommends that Operating Authorities (OAs) plan for a dynamic coast where it may not be sustainable to maintain habitats in their current locations. In carrying out flood and coastal defence functions, OAs should seek to further nature conservation and contribute to meeting environmental objectives, including biodiversity targets set under the EU Habitats and Birds Directives, Ramsar Convention

and DEFRA High Level Target 4 (DEFRA, 2006). Requirements include managed re-alignment for mitigation and compensation, in order to maintain favourable conservation status, and a coherent network of coastal habitats.

As a consequence, the Isle of Wight (IOW) Mitigation Study (which in addition to inter-tidal habitats assessed other coastal Biodiversity Action Plan habitats) was instigated. The SDCP was also initiated for the north Solent, to provide a strategic approach to meeting the requirements of the Habitats and Birds Directive by identifying and investigating suitable sites for inter-tidal habitat creation to offset losses from damaging schemes. Findings from both studies will inform the second round SMP's, CDSs and the EA Southern Region Habitat Creation Programme (RHCP).

1.2 Rationale

The multitude of environmental designations and targets has created added pressure for coastal managers in the north Solent. The area supports important ecological systems, which are protected by multiple international, European and national nature conservation designations. Maintaining and upgrading sea defences in the face of climate change is becoming less sustainable. At the same time, inter-tidal habitat loss is a huge problem, particularly in the north Solent, with saltmarsh losses as high as 83% in Langstone Harbour since the 1940's. This loss of inter-tidal habitat is cause for concern from both an environmental and sea defence point of view.

The north Solent comprises 354 kilometres of highly developed coastline, including open coast, harbours and rivers. Approximately 283 km are protected from flooding or coastal erosion (Figure 1.1). The majority of these defences are fronted by designated inter-tidal Natura 2000 sites, which have reduced significantly in area since the 1950's when most of these defences were built. Due to the reduction in fronting inter-tidal area, significant defence upgrade is required to provide an adequate level of protection, especially in the face of climate change. However, if a defence is to be upgraded, this study has found that approximately 178 km of defence length will require replacement inter-tidal habitat to offset the future coastal squeeze[*] to the fronting designated Special Area of Conservation (SAC) or Special Protection Area (SPA) (Natura 2000 sites) (Figure 1.2). This is so that favourable conservation status is maintained. Of the defences causing inter-tidal coastal squeeze (178 km), over half will come to the end of their residual life within the next 20 years (Figure 1.3).

Implementation of flood defence schemes that result in coastal squeeze to Natura 2000 sites have been delayed around the north Solent because of the difficulty in securing replacement habitat under the Habitats and Birds Directives. Schemes such as Eastoke and Selsmore in the East Solent were delayed for over two years because replacement inter-tidal habitat could not be found. Only 0.5 ha was required for Eastoke and 5 ha for Selsmore. In an effort to resolve the issue, the EA, NE and DEFRA agreed that if funds were put aside for replacement habitat then the Eastoke scheme could proceed. Securing and implementing replacement habitat to offset the Selsmore scheme is still ongoing.

[*] Coastal squeeze definition used in the SDCP: where a sea defence inhibits rollback of designated inter-tidal habitats

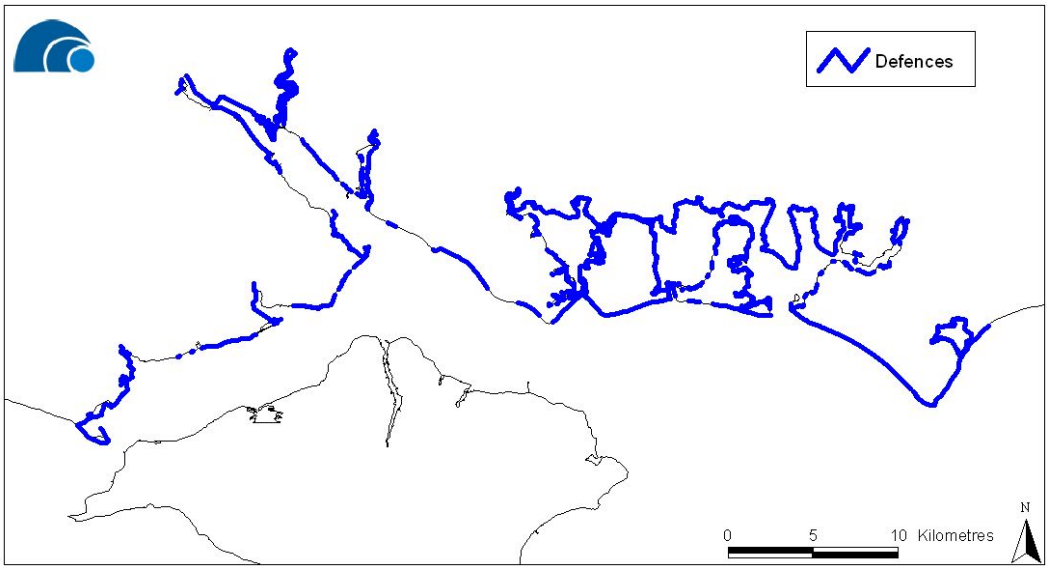


Figure 1.1: Defences across the north Solent

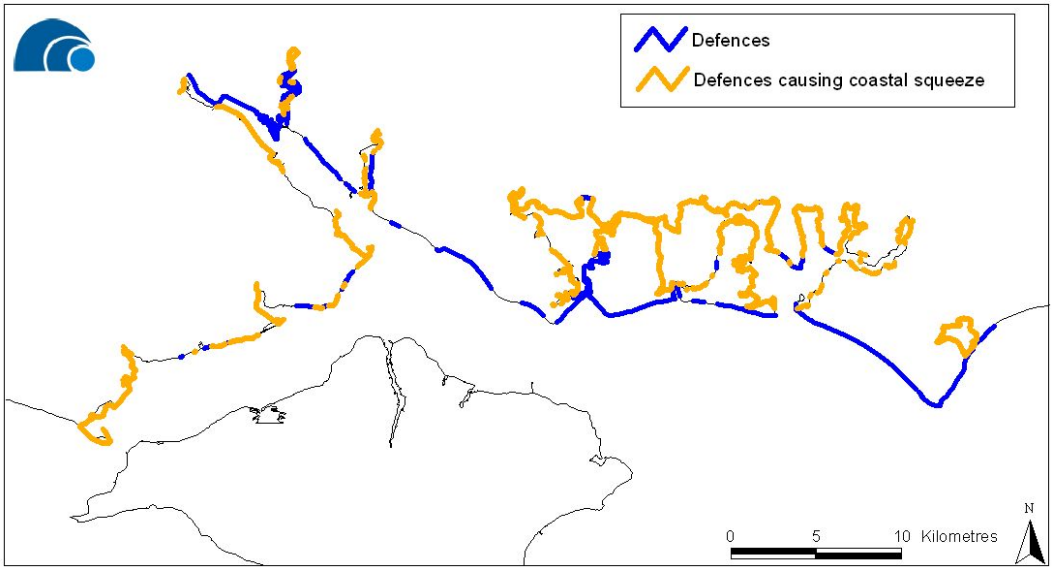


Figure 1.2: Defences across the north Solent causing coastal squeeze

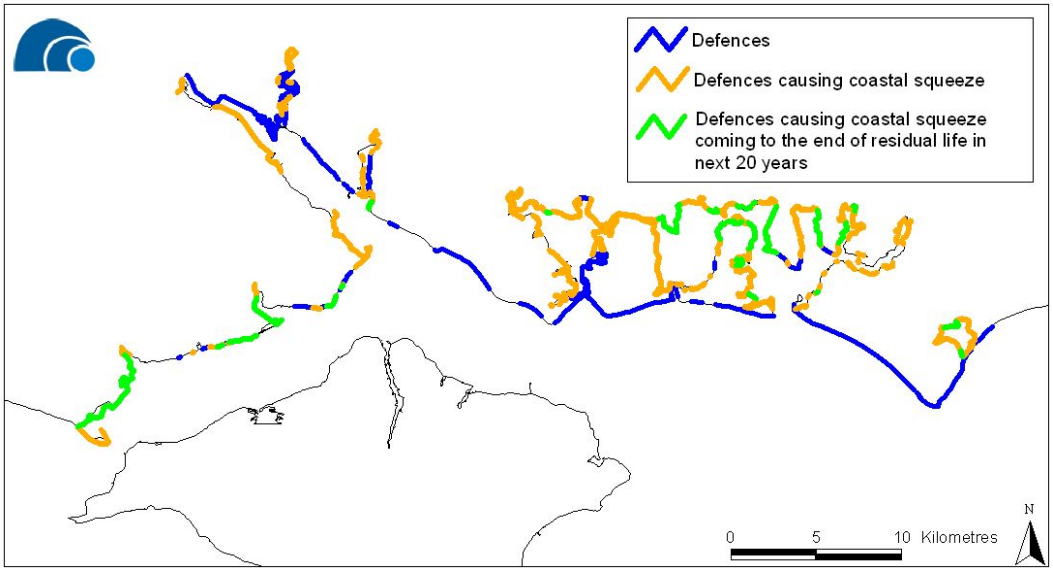


Figure 1.3: Defences across the north Solent, causing coastal squeeze, that are coming to the end of their residual life in the next 20 years

There are a number of barriers to implementing managed re-alignment for habitat creation in the north Solent. The administrative arrangements in the north Solent are more complicated than elsewhere in that the majority of sea defences are maintained by local authorities (LAs) and private landowners, rather then by the Environment Agency. It is estimated that one third of the sea defences that cause coastal squeeze across the north Solent are privately maintained. In addition, approximately two thirds of the hinterland is privately owned. Accordingly, an OA which maintains a defence may not own the hinterland. This creates two problems;

- offsetting coastal squeeze for private landowners when they upgrade their defences
- dealing with multiple key stakeholders when re-aligning a site.

Very few managed re-alignments have taken place in the north Solent because of complicated administrative arrangements and the fact the north Solent is a highly developed residential area that is a popular recreational and tourist attraction. There are, therefore, few habitat creation opportunities that may be implemented. The largest re-alignment was at Thornham Point in Chichester Harbour, in 1996. The 6.5 ha site was acquired by Chichester Harbour Conservancy when the landowner went bankrupt. The site was ideal as no inner bunds or ditching work was required; it was non-designated and a natural breach had already formed. This site was not actively breached to provide compensation for a damaging scheme. The site is now a designated Site of Importance for Nature Conservation (SINC) and hosts saltmarsh and grazing marsh. In addition, 25 ha of un-designated land were purchased at Chidham, Chichester Harbour for three times the cost of agricultural land. Secondary bunds were built and when replacement habitat is required to offset a damaging scheme, the existing defences will be breached. These opportunities are rare in the north Solent and in the case of Chidham, took three years to secure.

1.3 Project aims and objectives

The overall aim of the project is to “Inform the North Solent SMP so that it may meet requirements under the EU Habitats and Birds Directive for inter-tidal habitats, allowing a more dynamic coastline to be achieved, where coastal wildlife habitats can adapt to sea level rise whilst protecting people and property.”

More specifically, the objectives are:

- To clarify legal drivers and liabilities to provide information to planning authorities on the need to preserve inter-tidal habitat creation sites for their purpose.

- To provide information on inter-tidal habitat loss and replacement coastal habitat creation sites over 0 – 100 years that is agreed on a north Solent wide basis.

- To provide strong recommendations for the North Solent SMP and CDSs.

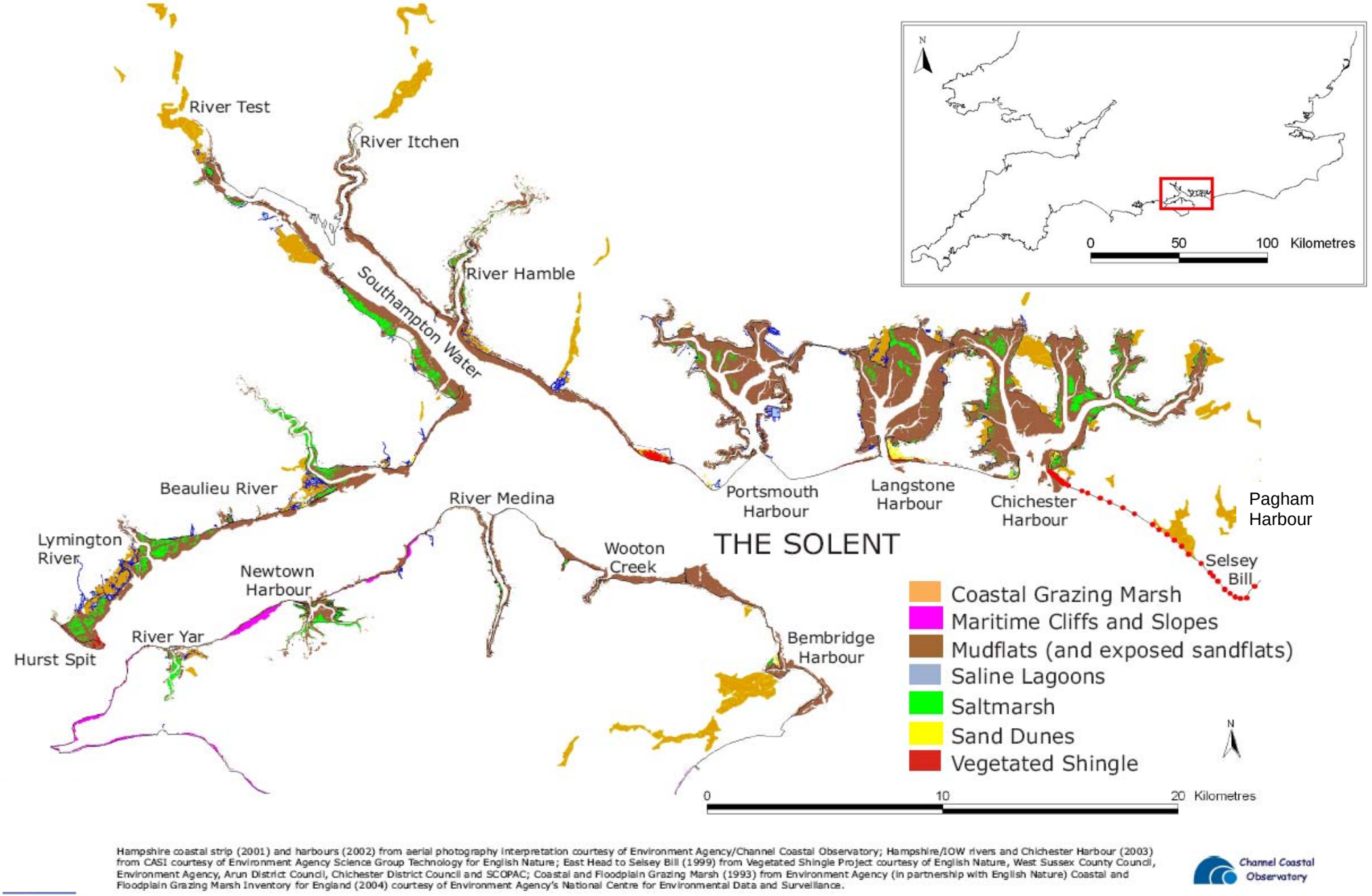
Recommendations from the SDCP and IOW Mitigation Study will also feed into the EA RHCP.

The main focus of the study was to identify potential inter-tidal mitigation and compensation sites as these form the largest expanse of deteriorating coastal habitats across the north Solent. Those habitats, such as coastal grazing marsh, that may be lost to inter-tidal habitat creation through potential managed re-alignment or abandonment of sea defences were also identified. Although estimates were made of the amount of freshwater site compensation, the potential for relocating these was not investigated. The EA RHCP will identify potential freshwater replacement sites.

1.4 Study area

The study area covers the north Solent between Hurst Spit, Hampshire and Pagham Harbour, West Sussex (Figure 1.4). The coastal fringes are floristically diverse with a large proportion fronted by inter-tidal habitats and to a lesser degree backed by coastal grazing marsh, saline and brackish lagoons. Vegetated shingle beaches are relatively prominent on the larger, more stable systems with very few sand dune systems and maritime cliffs and slopes.

Analysis was undertaken at three spatial scales: north Solent wide, European designations (Figure 1.5 and 1.6) and geographical units (Figure 1.7).



Hampshire coastal strip (2001) and harbours (2002) from aerial photography interpretation courtesy of Environment Agency/Channel Coastal Observatory; Hampshire/IOW rivers and Chichester Harbour (2003) from CASI courtesy of Environment Agency Science Group Technology for English Nature; East Head to Selsey Bill (1999) from Vegetated Shingle Project courtesy of English Nature, West Sussex County Council, Environment Agency, Arun District Council, Chichester District Council and SCOPAC; Coastal and Floodplain Grazing Marsh (1993) from Environment Agency (in partnership with English Nature) Coastal and Floodplain Grazing Marsh Inventory for England (2004) courtesy of Environment Agency's National Centre for Environmental Data and Surveillance.

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Figure 1.4: Coastal Biodiversity Action Plan habitats across the Solent

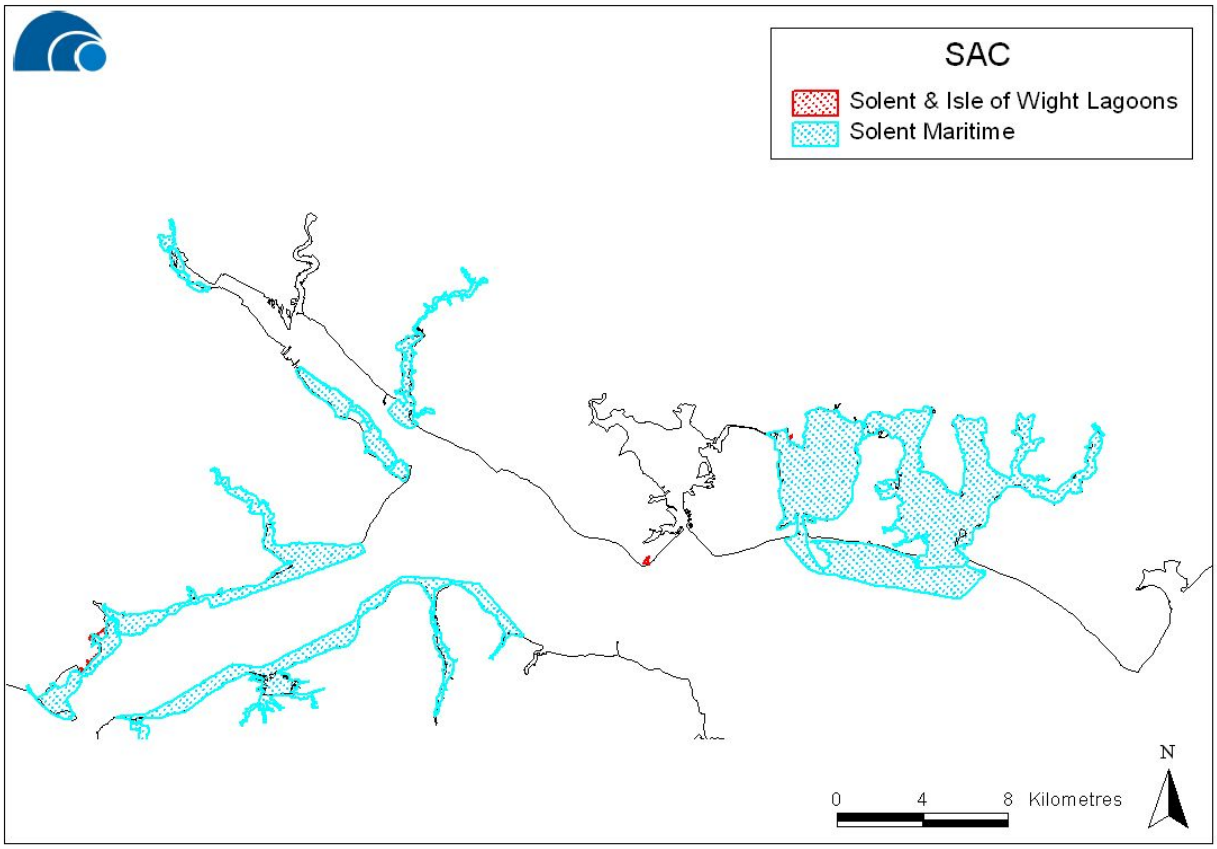

Figure 1.5: Solent SACs

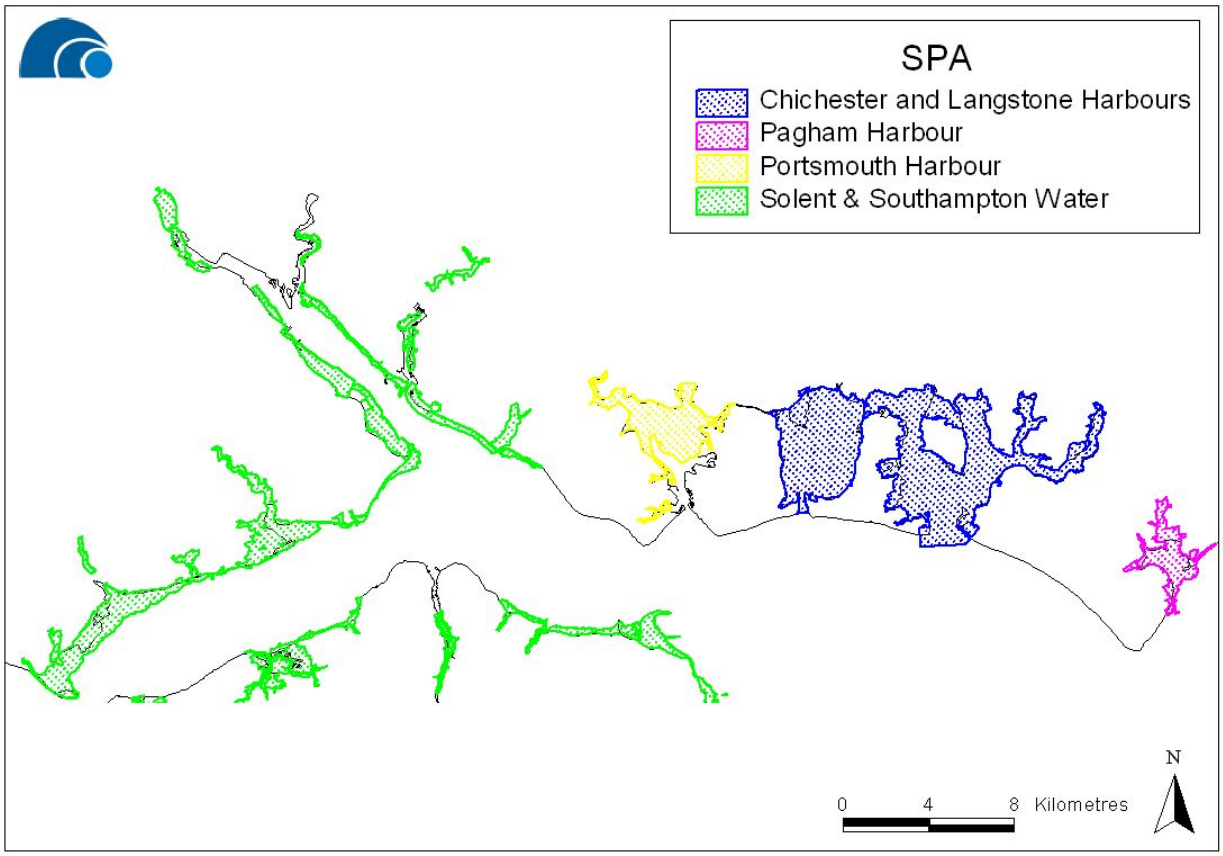

Figure 1.6: North Solent SPAs

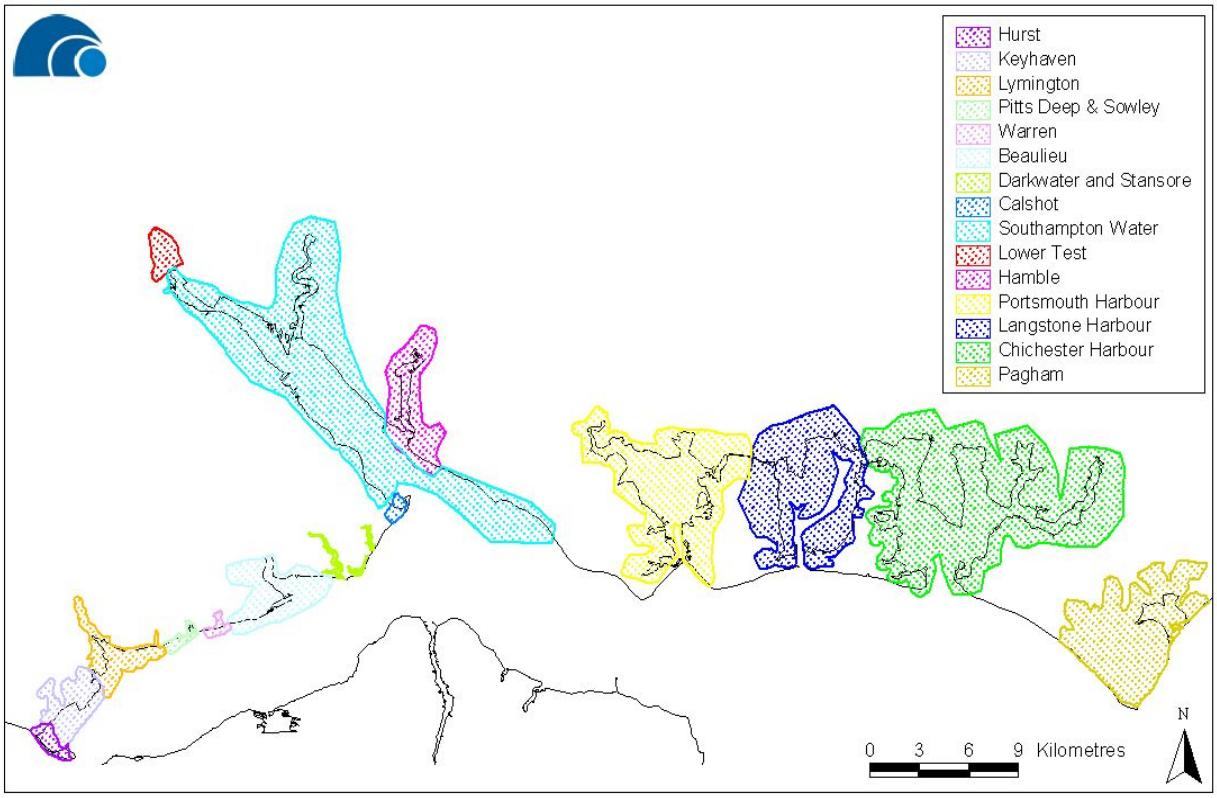

Figure 1.7: Geographical units in the north Solent

1.5 Outline of report

Both this report and the main report are divided into five further sections:

Section 2 summarizes environmental policies and legal drivers.

Section 3 outlines the method undertaken.

Section 4 presents findings for inter-tidal habitat loss and coastal squeeze.

Section 5 presents findings for inter-tidal habitat gain.

Section 6 shows the balance of coastal squeeze and inter-tidal habitat gain.

Section 7 concludes the project, providing recommendations for the North Solent SMP.

2 Summary of environmental policies and legal drivers

The north Solent encompasses a suite of international, national and local designations which are protected through the following legislation and guidance; Natura 2000 sites (Special Areas of Conservation (SACs) under the EU Habitats Directive 92/43/EEC and Special Protection Areas (SPAs) under the EU Birds Directive 79/409/EEC), Ramsar sites (Ramsar Convention, 1971) and Sites of Special Scientific Interest (Wildlife & Countryside Act, 1981) (SSSI's) (Figure 2.1).

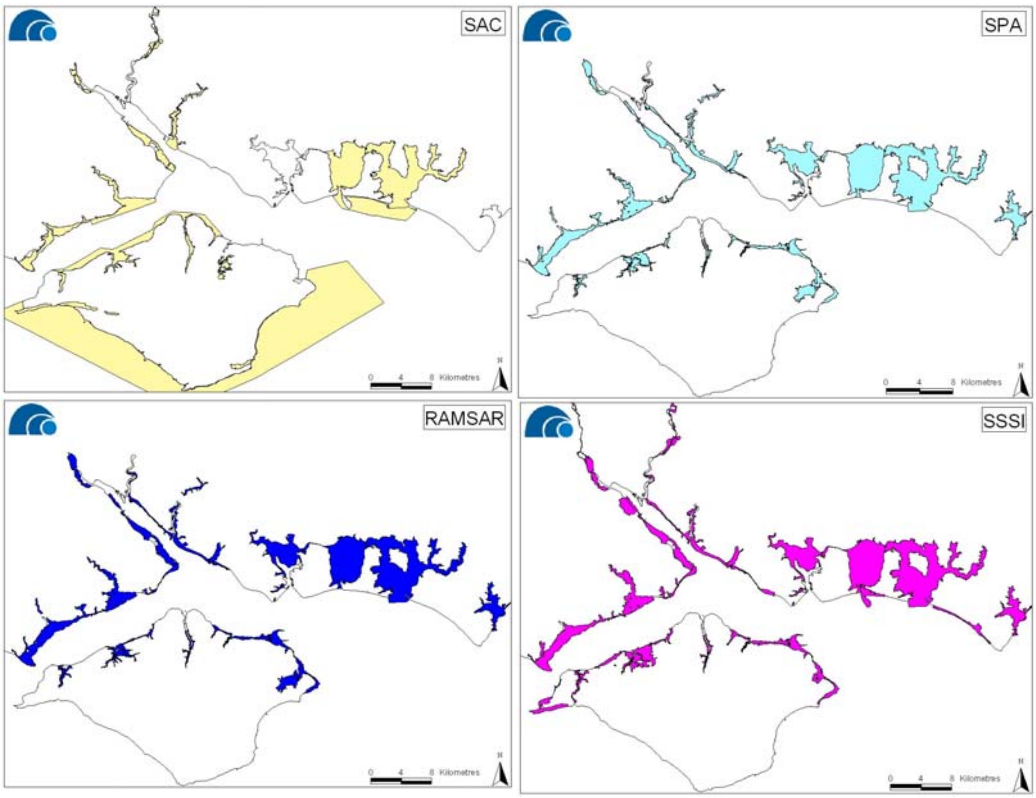

Figure 2.1: Natura 2000, Ramsar and SSSI designations across the Solent

2.1 International and European designations

The Solent has two SACs (Solent and IOW lagoons and Solent Maritime SACs – Figure 1.5) identified through the Habitats Directive and four SPA sites (The Solent and Southampton Water, Chichester and Langstone Harbours, Portsmouth Harbour and Pagham Harbour – Figure 1.6) identified through the Birds Directive. The overarching term is Natura 2000 sites.

Where possible, Natura 2000 coastal habitat should be protected in situ, where it is sustainable to do so. An Appropriate Assessment (AA) is required where a plan or project is likely to have a significant effect on a Natura 2000 site or Ramsar site. A plan

or project can include the maintenance of existing sea walls and new capital schemes. Where an AA cannot conclude that there will not be an adverse affect on the site, the scheme may only proceed if there are no alternative solutions (i.e. mitigation* within SPA), if there are imperative reasons of overriding public interest and compensation habitat is secured before the damaging works start (DEFRA, 2005, DEFRA Circular, 2005). "Adverse effects" include coastal squeeze seaward of a seawall and habitat changes caused by flooding landward of a seawall.

Replacement habitat sought within an adversely affected SPA is classed as mitigation. Replacement habitat sought outside an adversely affected SPA is classed as compensation. Replacement habitat sites are hard to implement. Securing replacement habitat is compounded by the time it takes to create new habitat. Inter-tidal habitat can take more than 10 years to create, whilst freshwater habitat can take more then 50 years. DEFRA guidance advises that the best way to secure compensation for coastal squeeze is through a strategic approach over a suitable geographical unit taking account of 'sustainable' coastal management. Ideally, compensation habitat should be sought close to the European site that is adversely affected (EU Commission guidance, 2007). Where this is not possible a regional approach may be taken (DEFRA, 2005). However this location requirement does not over-ride other 'sustainability' issues of cost, technical and physical capability and the need to defend landward designated sites as long as it is cost-effective to do so.

2.2 National nature conservation designations

There are fifteen Sites of Special Scientific Interest (SSSIs) in the Solent (including Pagham Harbour) (Figure 2.1). They were initially protected under the Wildlife and Countryside Act 1981 and later, protection was further strengthened by the Countryside and Rights of Way Act 2000 (CRoW Act). Within the Solent, large areas of SSSI's are in unfavourable condition due to coastal squeeze. DEFRA High Level Target 4 states that all OAs have a responsibility to find new coastal habitat to offset the effects of coastal squeeze and return 95% of the SSSI series to favourable condition to achieve the Public Service Agreement (PSA) target. NE must be consulted before carrying out an operation likely to damage any feature for which a SSSI has been designated (DEFRA 2001).

In the north Solent nearly all SSSI's are also EU Natura 2000 sites and so the Habitat Regulation procedures will serve to offset unfavourable condition at the same time as compensating for losses to European sites.

Following the UK Action Plan (1994), NE, the EA and other OAs were advised to achieve targets set out for BAPS. DEFRA High Level Target 4 requires all OAs to;

- avoid damage to environmental interest
- ensure no net loss to habitats covered by BAPs
- seek opportunities for environmental enhancement.

* Mitigation = to offset coastal squeeze losses within a European site. Compensation = to offset coastal losses outside of European site.

OAs are to report annually to the EA who then report to DEFRA on all losses and gains of habitats covered by BAPs as a result of flood and coastal defence operations (http 1).

Inter-tidal mudflat and saltmarsh are priority BAP habitats. National and local targets have been set to create new habitat to offset losses due to coastal squeeze (UK BAP target review).

3 Method

The work undertaken in this study comprised a mixture of technical analysis and statutory body 'expert opinion'. Table 3.1 demonstrates the different stages the study underwent to produce a spatial and temporal picture of inter-tidal coastal squeeze balanced against potential habitat gain.

Stage 1	**Inter-tidal loss and coastal squeeze** A technical analysis to confirm inter-tidal habitat loss and establish coastal squeeze for current 'hold the line' policies, using: • Historical aerial photography interpretation • LiDAR interpretation
Stage 2	**Potential inter-tidal habitat creation sites** Investigate the potential inter-tidal habitat creation sites derived from tidal elevation and topography. • Remove buildings and landfill sites • Apply "least cost assumption" through questionnaire • Apply criteria matrix to rank sites within epoch
Stage 3	**Balancing inter-tidal loss with potential habitat creation sites** Assess the inter-tidal losses and gains across the north Solent spatially and temporally.
Stage 4	**Replacement freshwater habitat** Identify the amount of potential replacement freshwater habitat required.

Table 3.1: SDCP approach

The method for stages 1 and 2 are presented below.

Historical aerial photography interpretation (HPI) was analysed to assess historical saltmarsh losses, whilst topographic data from Light Detection and Ranging (LiDAR) and tidal elevation interpretation (LTEI) were used to predict and visually demonstrate future mudflat and saltmarsh change and to identify suitable land levels for potential habitat creation sites.

3.1 Historical aerial photography interpretation

HPI was used to quantify past saltmarsh changes for each geographical unit (Figure 1.7) for bi-decadal periods from the 1940s to 2002 (Figure 3.1). This work extended the framework developed for the CHaMP (2003), by adding analysis of more recent epochs and extending the HPI back to the 1940s to better understand past and future trends.

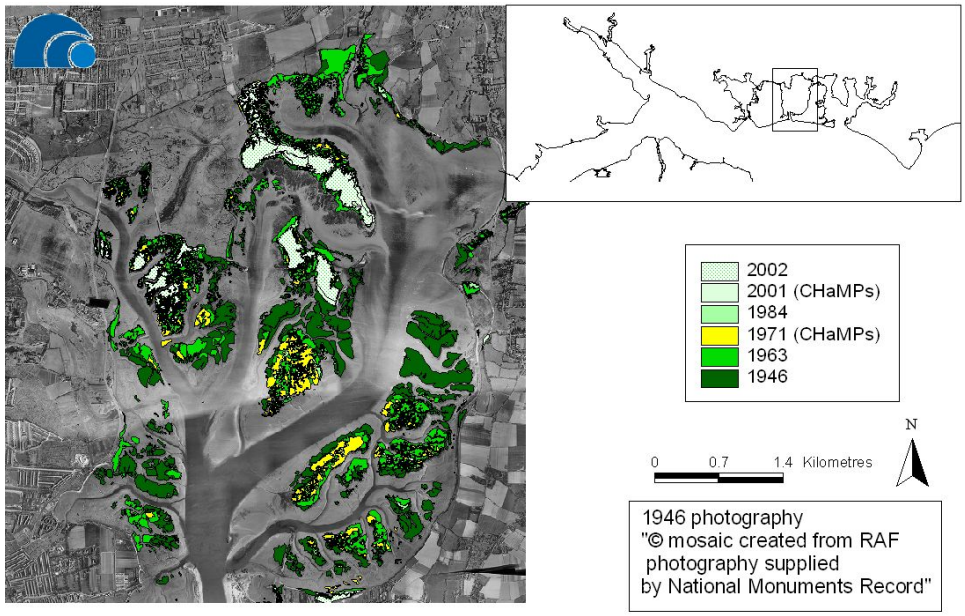

Figure 3.1: Changing saltmarsh extent in Langstone Harbour (from HPI)

Rates of saltmarsh change were extrapolated for 2025, 2055 and 2105, based on the best, worst and most recent bi-decadal periods (see Table 4.2 in main report). This provided measured historical and projected future rates, accounting for all local factors operating at each site, such as *Spartina* dieback, wave attack, sea level rise, dredging, reclamation, development and pollution. Mudflat was not digitized because the historical photography was rarely flown at sufficiently low tide periods to extend to Mean Low Water Springs (MLWS).

3.2 LiDAR and tidal elevation interpretation

One of the most crucial factors promoting mudflat and saltmarsh development is duration and frequency of tidal inundation in relation to land elevation and gradient. Mudflat exists between MLWS and Mean High Water Neaps (MHWN), whilst saltmarsh colonizes between MHWN to highest astronomical tide (HAT) (Williams, 1994). Control by tidal range accounts for 86-89% of lateral variation in *Spartina anglica* colonization for 19 estuaries in south and west Britain, when compared with local factors that potentially influence salt marsh colonization (Gray, 1992).

Based on this, a theoretical approach was applied in a Geographical Information System (GIS) whereby a digital ground model, generated using the north Solent-wide 2005 LiDAR data was "flooded" to the corresponding tidal elevations to determine the expected areas of coverage of inter-tidal habitat. Recent aerial photography was used to verify the "existing" extent of mudflat and saltmarsh suggested by the LiDAR and tidal elevation interpretation (LTEI) findings. A good correlation was found at most sites. Exceptions were noted where the LTEI over-predicted the extent of saltmarsh, but these small areas were attributed to the influence of local factors mentioned above. The high level of confidence in the LTEI enabled prediction of "potential" mudflat or saltmarsh sites based on the same criteria, in the event of removal of sea defence structures; this provided a good indicator of possible managed re-alignment sites (Cope *et al.,* 2007a). Figure 3.2 illustrates the "existing" situation (2005) in Langstone Harbour for mudflat and saltmarsh and also identifies the "potential" coverage if sea defences were removed and natural evolution occurred.

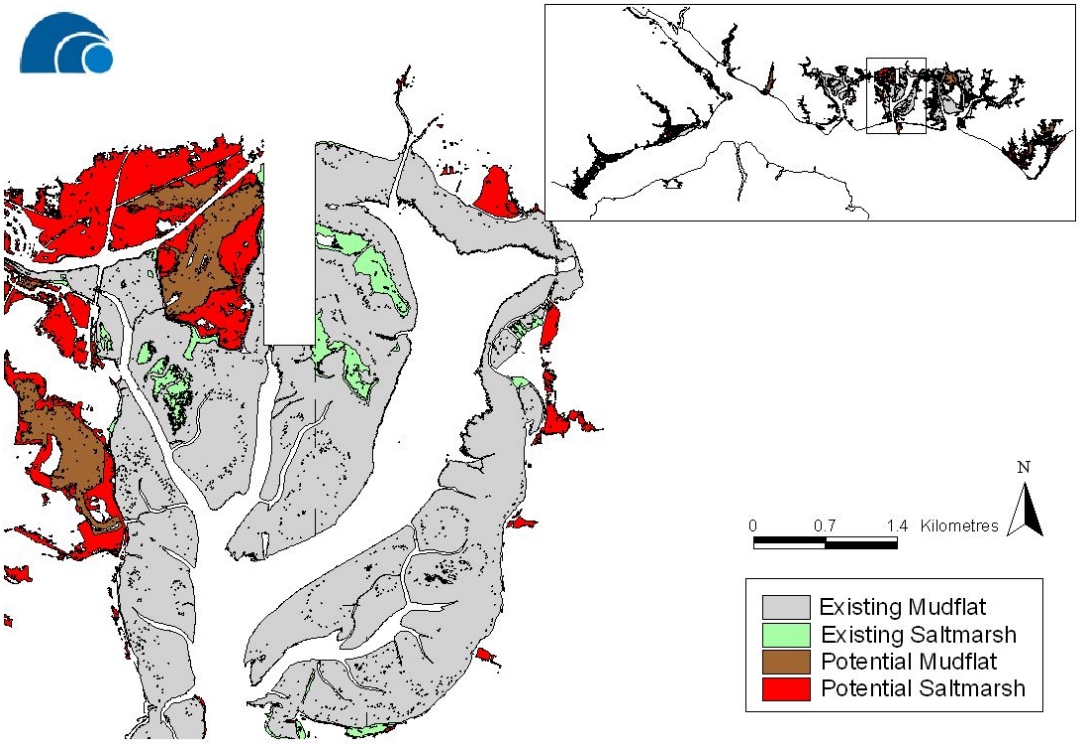

Figure 3.2: "Existing" and "potential" inter-tidal habitat at Langstone Harbour, 2005 (LTEI)

LTEI was used to predict and visually demonstrate probable future mudflat and saltmarsh evolution for 2025, 2055 and 2105 across the north Solent. Sensitivity to varying scenarios of sea level rise and vertical sediment accretion were estimated. The 2025, 2055 and 2105 epochs were flooded using 6mm per annum sea level rise (DEFRA guidance prior to 2006) assuming no vertical sediment accretion, then 3mm and 6mm sediment accretion per annum. Further details about the validation of LiDAR and tidal elevation interpretation (LTEI) are given in Section 4 of the main report.

4 Inter-tidal loss and coastal squeeze results

4.1 Historical saltmarsh change

Figures 4.1 and 4.2 show the "actual" saltmarsh extent derived from the HPI for the geographical units in the West and East Solent, respectively (see Figure 3.3).

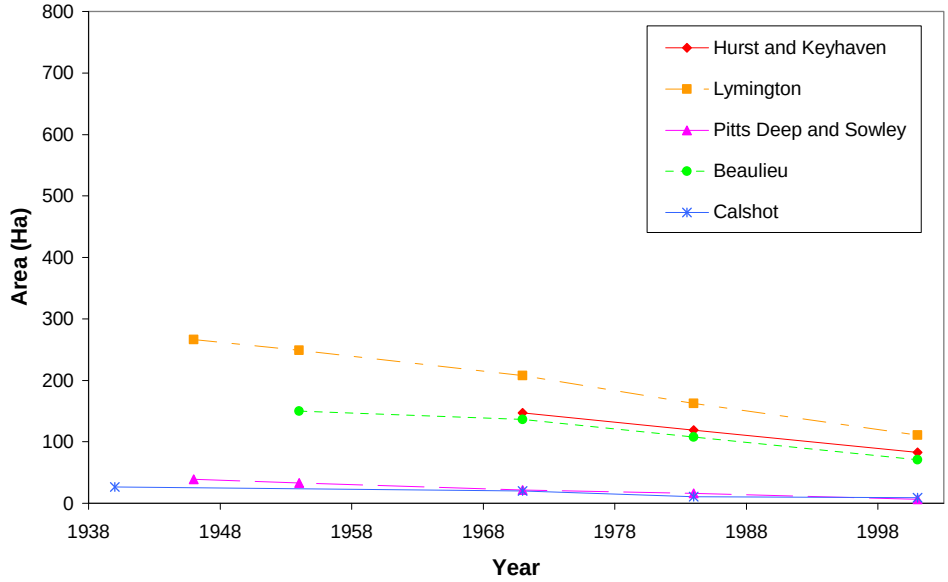

Figure 4.1: Historical change in saltmarsh extent; West Solent (HPI)

A broadly linear trend of saltmarsh loss is experienced in the West Solent (Figure 4.1). The rate of loss does not appear to be slowing down. This has worrying implications from an environmental and sea defence point of view.

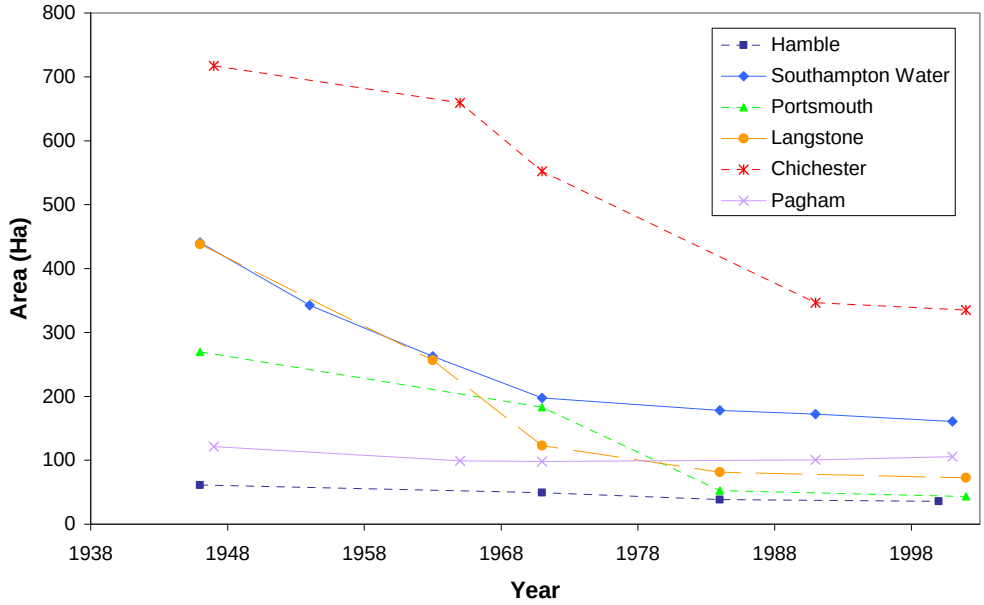

Figure 4.2: Historical change in saltmarsh extent; East Solent (HPI)

The area of loss in the east Solent, excluding the River Hamble and Pagham Harbour, have historically been much higher than those in the west Solent but appear to be slowing down since ~1984 (Figure 4.2). Future monitoring is required to confirm this. Pagham Harbour is an exception to all other geographical units in the north Solent, since it underwent a net loss of 12.9% between 1946 – 2001, but the saltmarsh area has been increasing from 1971.

The greatest percentage of saltmarsh lost across the north Solent since the first date analysed was at Pitts Deep/Sowley and Portsmouth and Langstone Harbours. These areas underwent approximately 83% loss since 1946, which averaged 1.5% loss per annum. It should be noted that Portsmouth Harbour underwent the greatest loss since 1946, but the tidal elevation in the 1946 aerial photography limited saltmarsh digitizing. In terms of the “worst bi-decadal period”, Portsmouth Harbour suffered 4.8% annual loss between 1971 - 1984, whilst Pitts Deep/Sowley and Calshot underwent 3.5% annual loss between 1984 - 2001 and 1971 - 1984 respectively.

The west Solent experienced high saltmarsh losses because of exposure to wave attack and *Spartina* dieback, which caused severe edge erosion. Further analysis revealed that both edge erosion and internal dissection were the important processes causing saltmarsh loss in Portsmouth and Langstone harbours. Edge erosion may be surprising given the sheltered nature of the harbours, but the local fetch has increased as the saltmarshes have eroded. In addition, the location of the hybrid cordgrass (*Spartina anglica),* which suffered dieback in the harbours since circa 1950, low in the tidal frame also played a role. All of these factors contributed to saltmarsh loss since 1946. Detailed analysis of each geographical unit is presented in Section 4 of the main report.

One major factor resulting in saltmarsh loss, not considered above, was reclamation of inter-tidal areas. The HPI was digitized to identify areas of reclamation for each geographical unit. Between 1940 and 2002 reclamation accounted for 1% of the saltmarsh lost at Langstone and Chichester Harbour, 8% at Portsmouth Harbour, 2% at Pagham Harbour, 24% at Calshot, 42% at Southampton Water and 18% at the River Hamble. Each geographical unit is explored in detail in Section 4 of the main report.

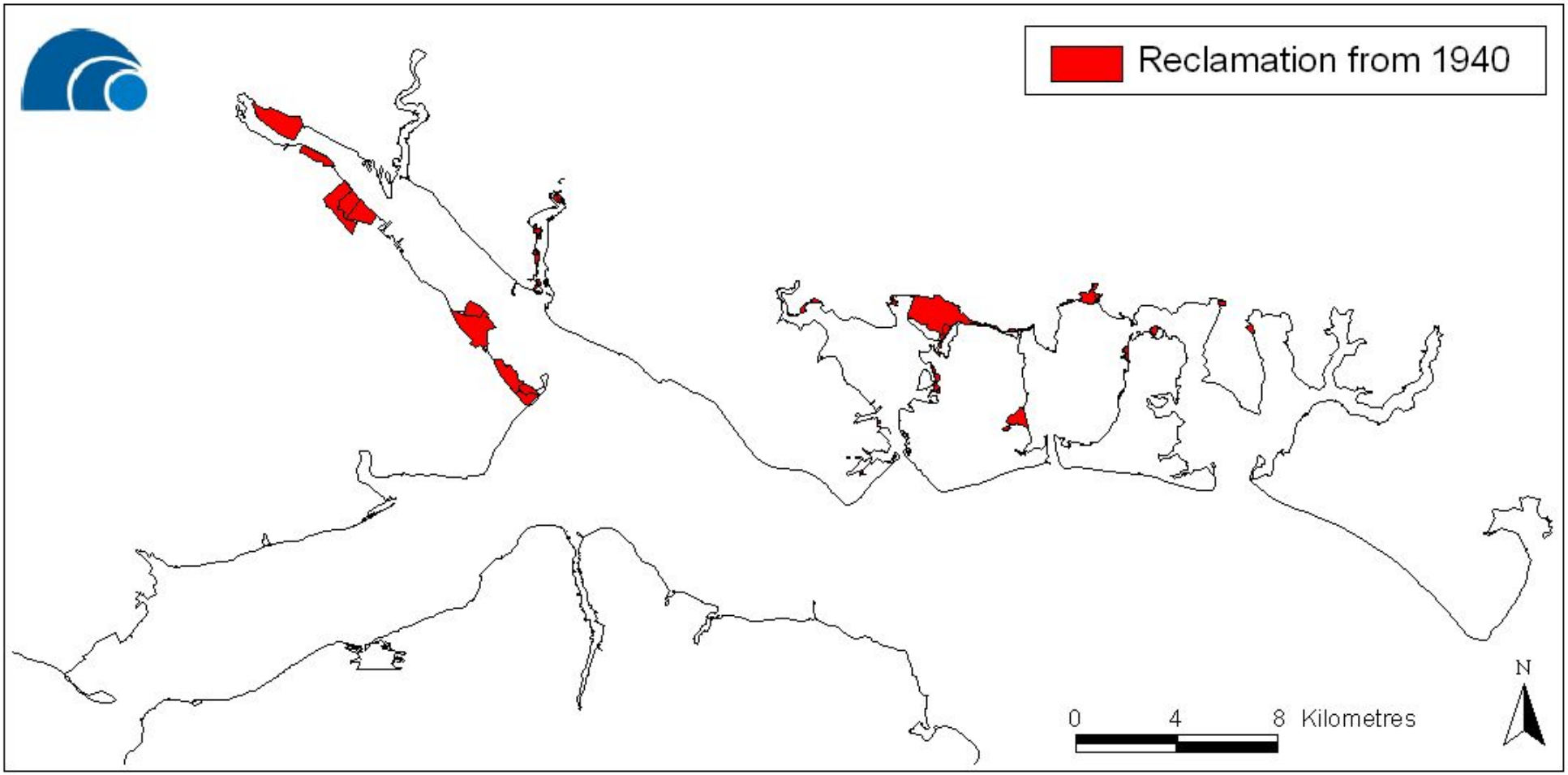

Figure 4.3: Reclamation across the north Solent since 1946

4.2 Predicted future inter-tidal change

The following predictions were based on interpretation of tidal elevations and topography. Results may therefore represent an under-prediction of inter-tidal loss because the LiDAR and tidal elevation interpretation does not take account of local factors such as wave attack, *Spartina* dieback, pollution and dredging which increase mudflat and saltmarsh erosion.

The total predicted inter-tidal change for the north Solent, regardless of sea defences or environmental designations, was an increase of 60 hectares (ha) for mudflat (+1%) and a loss of 812 ha for saltmarsh (75%). This totals 752 ha inter-tidal loss over the next 100 years (11%). The SDCP saltmarsh results matched relatively well with the Solent CHaMP (2003), which predicted 736 ha of saltmarsh loss over the next 100 years. The mudflat prediction did not correlate so well with the CHaMP (2003) (+103-179 ha), because of differing methodologies and the fact that the LiDAR data used in the SDCP did not always reach mudflat depth (MLWS).

4.3 Predicted future inter-tidal coastal squeeze

Requirements for replacement inter-tidal habitat as a result of coastal squeeze across the north Solent were calculated, for sites where there was a sea defence or landfill inhibiting rollback of inter-tidal habitat. All inter-tidal habitats in the north Solent are designated Natura 2000 sites. In order to estimate the maximum amount of replacement inter-tidal habitat required to mitigate/compensate for coastal squeeze, it was assumed that existing defences (causing coastal squeeze) and designations will be maintained over the next 100 years. This resulted in an estimation of approximately 5 ha of mudflat loss due to coastal squeeze (0.1%) and 495 - 595 ha of saltmarsh loss due to coastal squeeze (45 – 55%) requiring replacement across the north Solent. In reality not all defences will be maintained (see Section 5), hence this total estimate of 500 – 600 ha of inter-tidal coastal squeeze (8 – 9%) provides a worst case scenario.

5 Potential inter-tidal habitat creation sites

Approximately 3883 ha, within 100 individual sites, were identified as being capable of creating mudflat or saltmarsh over the next 100 years (Figure 5.1). These results were obtained from LiDAR and tidal elevation interpretation, assuming natural evolution over a 100 year period.

5.1 Buildings and landfill

From the 3883 ha, buildings (more than five), landfill and sites under 0.5 ha were excluded, leaving 2025 ha remaining (54 sites) (Figure 5.2). These 54 sites went forward to the questionnaire stage.

5.2 Questionnaire

Local coastal managers from Local Authorities (LA) and the EA were interviewed using a questionnaire (see Appendix 2), devised by the EA, NE and CCO, which sought to assign the potential 54 sites into time epochs where they were eligible for re-alignment or abandonment. Where they were not eligible for either, they were categorised as hold the line. During the questionnaire process it was necessary to make a number of assumptions. All assumptions affect the spatial and temporal pattern of potential inter-tidal habitat creation sites presented at the end of the study. Any of these assumptions can be changed in later work for SMP2 to give a different picture as required. No attempt was made to incorporate issues in relation to non-statutory bodies, land ownership and public opinion. The importance of these issues is not under-estimated and will need to be tackled when focusing on key habitat creation sites.

5.2.1 Publicly maintained defences

The initial section of the questionnaire was based on DEFRA approved economic assessment (see Appendix 2). Information was gathered on built assets and the lengths of existing flood defences. Secondary defences were proposed for those sites where re-alignment would cause potential flood risk to five or more buildings/landfill (see Section 5.3 in main report). Coastal managers assessed whether the current line of defence or any re-aligned defence would meet DEFRA ‘benefit-cost’ rules, potentially enabling an operating authority (OA) to bid for funds to defend for the necessary works. The cost of continuing to ‘hold the line’ was compared with the cost of re-aligning defences back.

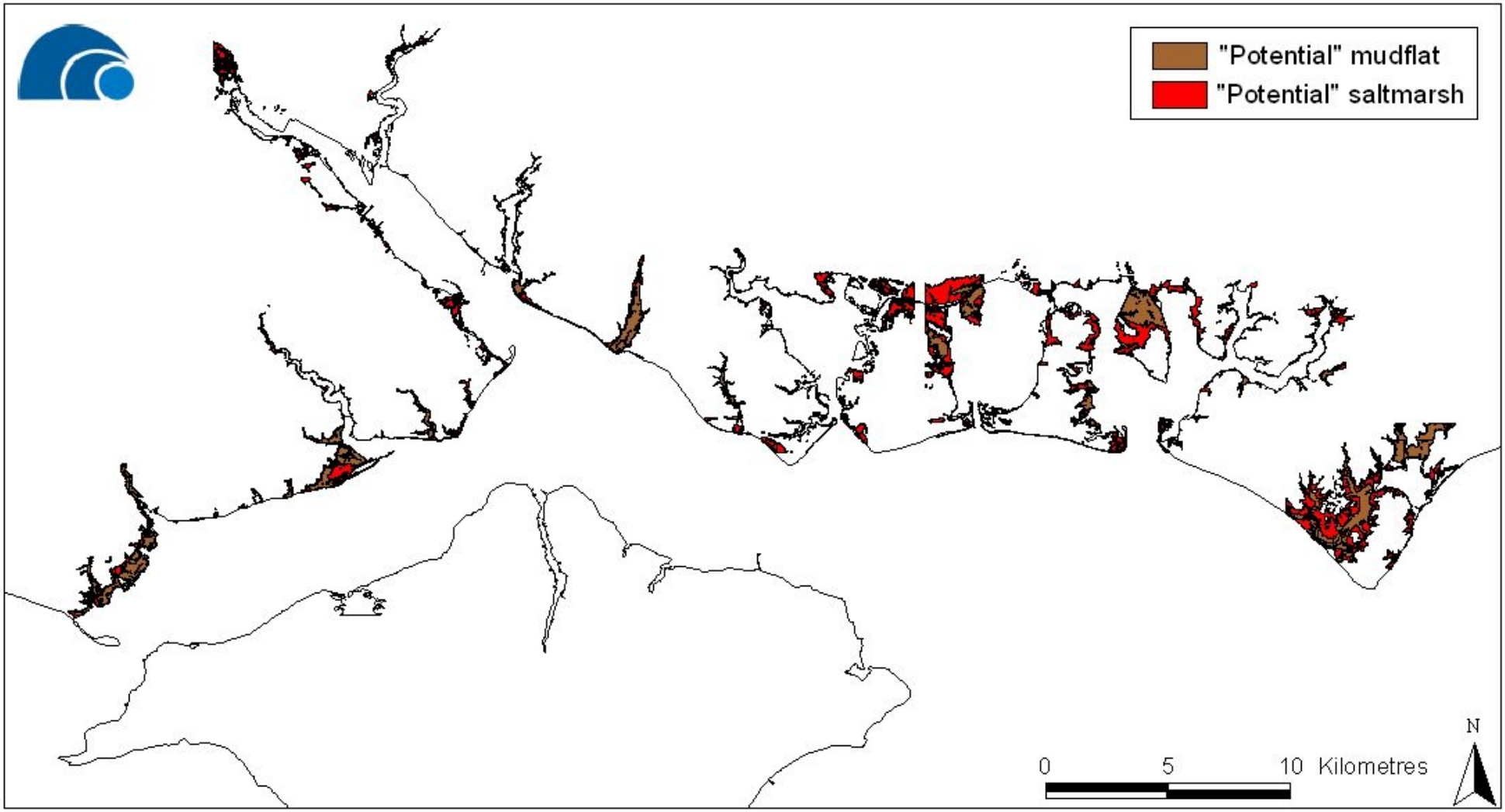

Figure 5.1: Potential inter-tidal habitat creation sites in 100 years, with re-alignment allowing natural evolution