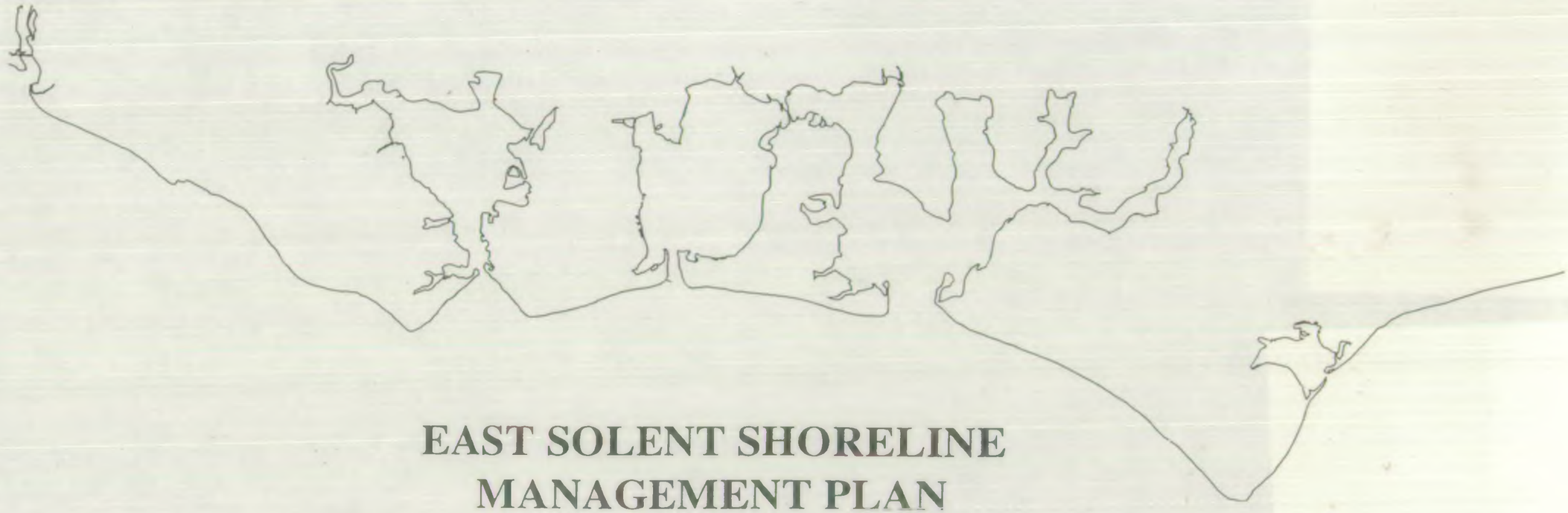

EAST SOLENT SHORELINE MANAGEMENT PLAN

STAGE 1

Volume I
The Open Coast

Report EX 3441
June 1997

HR Wallingford

High-Point Rendel

Contents

Preface

The East Solent Shoreline Management Plan is presented in four volumes. This document is Volume I. It presents background information on coastal processes, existing management operations, the natural environment, land use and the human environment that is necessary in the formulation of management plans for the open coastline between Pagham and the River Hamble, including Pagham Harbour.

The remaining three Volumes of the East Solent Shoreline Management Plan include:

- the coastal defence objectives, management units, preferred management options, recommended further studies and future review programme for the open coast (Volume II)
- the background management information for Chichester, Langstone and Portsmouth Harbours (Volume III)
- the coastal defence objectives, management approach, preferred management options, recommended further studies and future review programme for the harbours, including Pagham Harbour (Volume IV).

Chichester District Council, acting on behalf of the East Solent Coastal Group, commissioned HR Wallingford to undertake the Shoreline Management Plan in accordance with the Consultant's Brief and the Ministry of Agriculture, Fisheries and Food document "Shoreline Management Plans - A Guide for Coastal Defence Authorities". The Steering Committee for the Group comprised:

Mr D Bell - Technical Services Department - Chichester District Council (Lead Authority)
Mr A Greenhouse and Mr P Willey- Planning and Development Department - Fareham Borough Council
Mr M Wheeler - Engineering Services -Gosport Borough Council
Mr G Lloyd - Engineering Services - Portsmouth City Council
Mr M Smith - Technical Services - Havant Borough Council
Mr C Harding - Environment Agency
Dr R Ekins - English Nature
Mr D Green - Directorate of Planning and Housing - Arun District Council (Observer)

Mr Chris Harding of the Environment Agency was the Project Manager for the Group. Mr Malcolm Smith of Havant Borough Council was Chairman of the Steering Committee.

The Plan was formulated by a project team led by HR Wallingford with support from Rendel Palmer & Tritton, the RACER Group of Portsmouth University, and Ecological Planning and Research Ltd. The Project Manager was Mr Tom Coates of HR Wallingford. Contributing authors included Mr Mark Lee (RPT), Mr Jerzy Motyka (HRW), Dr Kathryn Carpenter (HRW), Mr Andrew Bradbury (RPT) and Dr Malcolm Bray (RACER). The HR Wallingford job number was CGR 2024.

Prepared by	G. Motyl	Project Engineer
	(Name)	(job title)
Approved by		Project Manager
Date	30 June 1997	

CHICHESTER
DISTRICT
COUNCIL

Havant
BOROUGH COUNCIL

Portsmouth
CITY COUNCIL

FAREHAM BOROUGH COUNCIL

GOSPORT
BOROUGH COUNCIL

ENGLISH
NATURE

ENVIRONMENT
AGENCY

East Solent Shoreline Management Plan

Volume I
The Open Coast

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HR Wallingford

Address and Registered Office: **HR Wallingford Ltd.** Howbery Park, Wallingford, Oxon OX10 8BA
Tel: + 44 (0)1491 835381 Fax: + 44 (0)1491 832233

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Glossary

Organisations

BC	Borough Council
CC	County Council or City Council
DC	District Council
MAFF	Ministry of Agriculture, Fisheries and Food
MoD	Ministry of Defence
DoT	Department of Transport

Conservation designations

AONB	Area of Outstanding Natural Beauty
CHS	Countryside Heritage Site
GCRS	Geological Conservation Review Site
LNR	Local Nature Reserve
NNR	National Nature Reserve
Ramsar	Designated under the Ramsar Convention on Wetland of International Importance especially as Waterfowl Habitat
SAC	Special Area of Conservation
SINC	Site of Importance for Nature Conservation (Hampshire)
SNCI	Site of Nature Conservation Interest (West Sussex)
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest

Tidal levels

LAT	Lowest Astronomical Tide
MLW (S or N)	Mean Low Water (Spring or Neap)
MHW (S or N)	Mean High Water (Spring or Neap)
HAT	Highest Astronomical Tide

Waves

H_s or Significant wave height	Height of 1/3 highest waves in a given event or period
Swell	Waves generated by winds outside the area
Wind sea	Waves generated by local winds including storm waves
T_m	Mean time interval between successive wave crests

Cross-shore zones

Beach head	The cliff, dune or seawall forming the landward limit of the active beach
Backshore	Area above normal maximum high water, but affected by coastal processes
Beach crest	The point representing the limit of high tide storm wave run-up
Intertidal or foreshore	Area between LAT and HAT
Nearshore	Area over which seabed transport can be caused by storm waves, including intertidal zone
Offshore	Area seaward of nearshore zone where sea bed transport is not normally driven by waves

Beach morphology and materials

Fines	Particle diameter less than 0.063mm (silt and clay)
Sand	Particle diameter between 0.063mm and 2mm
Shingle	Clast diameter between 2mm and 75mm, also gravel
Cobbles	Clast diameter greater than 75mm
Dune	Wind blown sand deposit, often vegetated
Shingle ridge	Upper beach feature with low lying backshore subject to flooding
Spit	A long narrow accumulation of sand or shingle, lying generally in line with the coast, with one end attached to the land the other projecting into the sea or across the mouth of an estuary
Foreland	Relict backshore area formed by long term seaward development of shoreline

Coastal defence structures

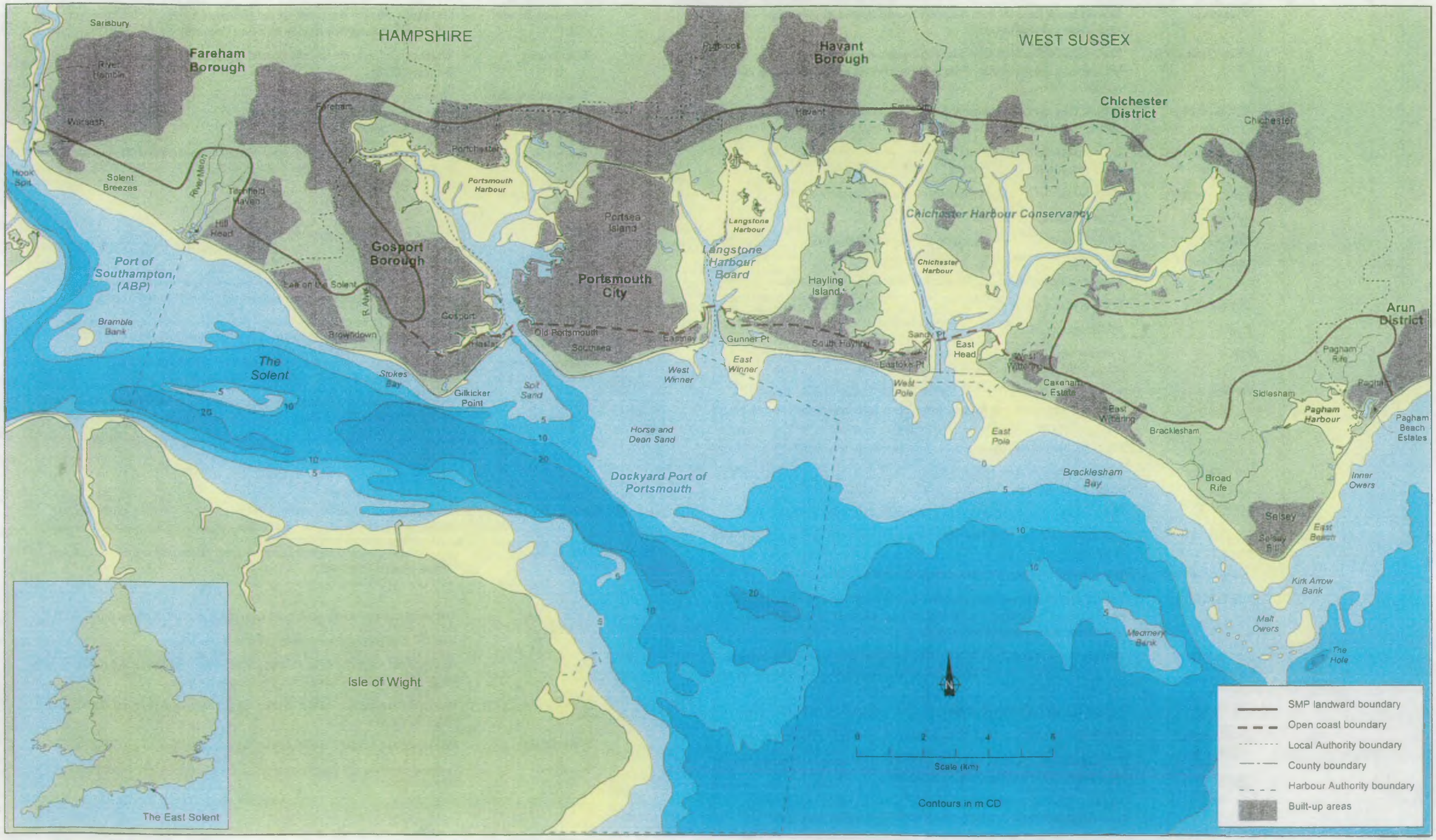
Apron	Layer of stone, concrete or other material to protect the toe of a seawall
Detached breakwater	A breakwater without a constructed connection to the shore
Embankment	Earth bank raised above low lying hinterland area to prevent flooding
Gabions	Wire mesh baskets filled with rock
Groyne	Cross-shore structure designed to reduce longshore transport by causing a reorientation of the beach
Revetment	General term for sloping, often permeable structures, providing flood or erosion protection to the backshore
Seawall	General term for vertical or near vertical impermeable structures, providing flood or erosion protection to the backshore

General glossary

Accretion	Accumulation of (beach) sediment by natural processes
BP	Before Present
Bathymetry	Spatial variability of levels on the seabed
Beach management	Management of a beach as a coastal defence with a pre-determined standard of protection, using combinations of beach recharge, recycling, reprofiling, beach control structures and a programme of monitoring
Beach plan shape	The shape of the beach in plan: usually shown as a contour line, combination of contour lines or recognizable features such as beach crest and/or still water line
Beach profile	A cross-section taken perpendicular to a given beach contour; the profile may include the face of a dune or seawall, extend over the backshore, across the foreshore, and seaward underwater into the nearshore zone
Beach recharge	Supplementing the natural volume of sediment on a beach, using material from elsewhere - also known as beach replenishment / nourishment / feeding
Bed forms	Features on a seabed (e.g. ripples and sand waves) resulting from the movement of sediment over it
Bed load	Sediment transport mode in which individual particles either roll or slide along the seabed as a shallow, mobile layer a few particle diameters deep

Bypassing	Moving beach material from the updrift to the downdrift side of an obstruction to longshore-drift
Chart Datum (CD)	The level to which both tidal levels and water depths are reduced - on most UK charts, this level is that of the predicted lowest astronomical tide level (LAT)
Coastal defence	General term used to encompass both coast protection against erosion and sea defence against flooding
Coastal processes	Collective term covering the action of natural forces on the shoreline and nearshore seabed
Coast protection	Protection of the land from erosion and encroachment by the sea
Cross-shore	Perpendicular to the shoreline
Depth-limited	Situation in which wave generation (or wave height) is limited by water depth
Diffraction	Process affecting wave propagation, by which wave energy is radiated normal to the direction of wave propagation in to the lee of an island or breakwater
Downdrift	In the direction of the nett longshore transport of beach material
Drift	See Longshore drift
Ebb	Period when tide level is falling; often taken to mean the ebb current which occurs during this period
Ebb tide delta	Area of sediment accretion formed where strong tidal currents decrease in velocity after leaving a restricted channel and entering a more open nearshore area
Fetch	Distance over which a wind acts to produce waves - also termed fetch length
Fetch-limited	Situation in which wave energy (or wave height) is limited by the size of the wave generation area
Freeboard	The height of the crest of a structure above the still water level
Frontager	Person or persons owning, and often living in, property immediately landward of the beach
Joint probability	The probability of two (or more) things occurring simultaneously
Kelp rafting	Transport of shingle and cobbles from the outer nearshore zone to the beach while attached to the foot of neutrally buoyant seaweed; rafted material is much more mobile than normal shingle
Littoral drift, Littoral transport	The movement of beach material in the littoral zone by waves and currents. Includes movement parallel (longshore drift) and perpendicular (cross-shore transport) to the shore
Longshore	Parallel and close to the coastline
Longshore drift	Movement of (beach) sediments approximately parallel to the coastline
Managed retreat	The deliberate setting back of the existing line of defence in order to obtain engineering and/or environmental advantages
Mud flat	An area of fine silt usually exposed at low tide but covered at high tide, occurring in sheltered estuaries or behind shingle bars or sand spits

Ordnance Datum (OD)	Standard reference level used by the Ordnance Survey for land survey in the UK, based on mean sea level at Newlyn, Cornwall
Overtopping	Water carried over the top of a coastal defence due to wave run-up exceeding the crest height
Potential drift rate	Theoretical longshore drift rate assuming no restriction on supply of material. Actual drift is often much less due to lack of supply or interruption due to cross-shore structures (e.g. groynes)
Refraction	The process by which the direction of a wave moving in shallow water at an angle to the contours is changed so that the wave crests tend to become more aligned with those contours
Return period	Average time between occurrences of a given event
Saltmarsh	Area of salt tolerant vegetation within the intertidal zone
Sea defences	Works to alleviate flooding by the sea
Sea level rise	The long term upward trend in mean sea level resulting from a combination of local or regional geological movements and global climate change
Sediment sink	Point or area at which beach material is irretrievably lost from a coastal cell, such as an estuary or a deep channel in the seabed
Sediment source	Point or area on a coast from which beach material arises, such as an eroding cliff, or river mouth
Shoreline management	The development of a strategic, long-term and sustainable coastal defence policy within a sediment cell
Standard of service	The adequacy of defence measured in terms of the return period (years) of the event which causes a critical condition (e.g. breaching, overtopping) to be reached
Surge	Changes in water level as a result of meteorological forcing (wind, high or low barometric pressure) causing a difference between the recorded water level and that predicted using harmonic analysis, may be positive or negative
Suspended load	A mode of sediment transport in which the particles are supported, and are carried along by the fluid
Tidal current	The movement of water associated with the rise and fall of the tides
Tidal range	Vertical difference between high and low water level
Tide	The periodic rise and fall in the level of the water in oceans and seas; the result of gravitational attraction of the sun and moon
Updrift	The direction opposite to that of the predominant longshore movement of beach material
Wave climate	The seasonal or annual distribution of wave height, period and direction
Wave rose	Diagram showing the long-term distribution of wave height and direction



The East Solent **Figure 1**

1 Introduction

1.1 Strategic background

In 1993 the Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office published their "Strategy for Flood and Coastal Defence in England and Wales" (MAFF, 1993a). This publication set out the need to manage the shoreline from the perspective of coastal process cells or sub-cells rather than in accordance with the administrative boundaries of the coastal operating authorities. Since then voluntary coastal groups comprising coastal authorities, the Environment Agency and major local interest groups have formed around England and Wales with the aim of establishing integrated regional coastal defence strategies in accordance with the MAFF guidance document "Shoreline Management Plans - A Guide for Coastal Defence Authorities" (MAFF, 1995a).

The intention of the Shoreline Management Plan (SMP) for each area is to establish a coast defence strategy that is technically, economically and environmentally sustainable. The plans for adjacent coastal areas must be compatible and they must take account of natural coastal processes, existing defences and both human and other environmental influences and needs. The SMPs are non-statutory documents intended to both inform and be supported by the statutory planning processes. As such they must take account of the diverse interests in the shoreline and must be presented in a form that is accessible to a wide audience.

The SMPs are the foundation for shoreline management, but are not definitive. They are based on existing information and will need to be reviewed as future studies modify and extend the understanding of the coastal zone. An important element of each SMP is the identification of gaps in available information and recommendation of monitoring or research programmes to improve the situation.

The SMPs are not intended to set out strategies for the broader coastal issues addressed by Coastal Zone or Harbour Management Plans, such as management of tourism, natural habitats or mineral resources, although all of these matters must be considered in shoreline management. SMPs are also not intended to appraise detailed management schemes for specific frontages as that level of planning will be undertaken at the follow up stage of strategy studies and project appraisals.

1.2 The SMP process

SMP production is separated into two stages. In Stage 1 the background information required for management is collected from existing sources, the broad objectives for the Plan area are established and the area is subdivided into Management Units based on natural processes, existing land use and planning objectives. The required information includes:

- coastal processes
- natural environment
- land use and the human and built environment
- existing coastal defences.

Consultation with a wide range of groups with an interest in the shoreline is an important part of Stage 1, in terms of obtaining information, providing an understanding of the management issues and identifying any further studies required.

In Stage 2 the strategic coastal defence options for each Management Unit are proposed, justified and selected to achieve the Plan objectives. Justification and selection of the options are based on all of the information obtained in Stage 1 and are subject to review and comment by the Consultees. The selected options must be sustainable in terms of engineering viability, economic justification and environmental impact. Possible management operations that will achieve the selected policy are proposed in outline and recommendations are

made for future monitoring, research and management review procedures to ensure that the Plan is carried into the future as a working document.

1.3 The East Solent SMP

The East Solent SMP area extends from Pagham in the east to the mouth of the River Hamble in the west, and includes the natural harbours of Chichester, Langstone, Portsmouth and Pagham (Figure 1). The landward boundary of the SMP is nominally fixed at 1km inshore or at the 5m OD contour, whichever is the greater distance from the shoreline. The seaward boundary is not defined, as all processes and factors that may influence the shoreline are considered regardless of location.

The coast varies from eroding cliffs, shingle banks and heavily defended headlands on the open coast to salt marshes, flood embankments and deepwater jetties within the large natural harbours. The open coastline extends for some 50km while the harbour coastline is over 170km. The land is generally low lying, with large areas at risk from flooding. The surface geology comprises easily erodible Tertiary and Recent deposits of sand, gravel and clay mixtures.

The wave climate and tidal regime are complex relative to other areas of the UK, due to the influence of the Isle of Wight and the constricted entrance to the harbours. The tides are particularly complex, with a rapidly changing tidal range, extended high waters and complex patterns of tidal flow including strong ebb and flood currents through the harbour entrance channels and around the major headlands.

From Pagham to Portsmouth Harbour the coast is low lying and large stretches are prone to both erosion and flooding. Selsey Bill was once one of the most rapidly eroding stretches of coast in the country prior to construction of the existing defences in 1956. West of Selsey Bill at Medmery there is much land which is low lying and would be regularly flooded were it not for the presence of a large shingle bank, artificially maintained on a regular basis. At the west end of the Selsey peninsula is the East Head spit, of great importance for coast protection, ecological habitats and amenity use.

Hayling and Portsea Islands are both low lying and liable to flooding and erosion. Much of the open coast shorelines of both islands are formed of massive shingle accumulations, influenced by a variety of coast defence structures and management operations. The nearshore zone is generally formed of wide, shallow banks divided by the deeper entrance channels to the natural harbours.

The harbours themselves are under threat of erosion and flooding with the dieback of saltmarsh causing what may be serious changes in the long term stability of the shoreline. Portsmouth Harbour is the most highly developed of the harbours. Its margins have been greatly altered by development and reclamation, although it still contains important wetland areas and long stretches of muddy shoreline little spoilt by urban development pressures.

West of Portsmouth Harbour the shoreline comprises massive shingle accumulations extending from Fort Gilkicker up to Lee-on-the-Solent. This natural frontage affords protection from the sea but this condition may change as the supply of material feeding the beaches reduces.

From Lee-on-the-Solent to Hill Head Harbour the land rises and much of the frontage is formed by seawalls protecting cliffs that were formerly subject to erosion. The construction of groyne systems and seawalls dates back to the 1950's. The condition and effectiveness of these defences varies over the frontage.

Hill Head Harbour forms a marked discontinuity in the coastline. Northwest of the harbour there are cliff exposures of easily eroded sands and gravels which provide an important supply of beach material. The cliffs are of considerable archaeological and palaeontological significance being a rich source of palaeolithic artifacts and bird fossils of the Mid-Eocene age.

These cliffs extend almost to the mouth of the River Hamble and are to a large extent unprotected. Hook Spit, formed of material eroded from these cliffs, extends northwards into the River Hamble and provides protection to low lying land behind.

The coastal strip has varied land use. Heavily developed residential, commercial and military areas coexist with large areas of farm land and undeveloped wetlands or marshes of high environmental value. The nearshore and intertidal areas are extensively used for water sports and also have a high environmental value.

This complex area presents a particular challenge to shoreline management. Changing social, economic and military priorities have begun a process of redevelopment of the built up areas while management of the open areas must resolve conflicts between the protection or enhancement of the natural environment and pressure for further recreational, commercial or residential development. These diverse interests, plus the need for economic justification, must all be considered by shoreline managers.

For the purposes of the SMP production the East Solent area was divided into two components: the open coast and the harbours. This distinction was based on the differences in coastal processes and the general independence of shoreline management activities. The open coast is subject to relatively high energy wave conditions acting over long lengths of the shore and strong interdependencies between adjacent frontages in terms of shoreline evolution and the impact of management operations. In contrast, the harbours are subject to low wave energy conditions often acting over short frontages with little interdependency, even over short distances. Although the open coast and the harbours influence each other around the harbour entrances, it was considered that the differences between the two environments were sufficient to justify separate consideration.

1.4 Report outline

The East Solent SMP is presented in four Volumes. As the issues and processes within the harbours are largely independent to those of the open coastline, the SMP has been separated into two parts. Stages 1 and 2 of the SMP for the open coastline are presented in Volumes I and II, while Volumes III and IV present the SMP for Chichester, Langstone and Portsmouth Harbours. The SMP for Pagham Harbour has been split between the Stage 1 volume for the open coast and the Stage 2 volume for the harbours. It is included with the open coast since the coastal processes dominating its form are strongly dependant on those of the shingle spits at its entrance, and, to a lesser extent, the shingle ridge at Bracklesham Bay to the south. Rom the management perspective of Stage 2 it is convenient to present Pagham Harbour in the volume with the other harbours as there are distinct differences in the management approach between the harbours and the open coast.

The present document forms Volume I of the SMP and contains the background data for the open coastline of the East Solent plus Pagham Harbour. Chapter 2 describes the consultation procedures, and includes a full list of the Consultees with a summary of their interests and concerns. Data on coastal processes, existing defences, planning, land use and the natural and human environment are presented in Chapters 3 to 6. This information is set out as maps, tables and text and is intended to act as an information source. Possible future changes affecting the SMP are discussed. It should be noted that the large scale maps only present data relevant to the open coast and not the harbours.

A glossary of terms and abbreviations is presented at the front of each Volume. References are contained in the appendices, as are data on existing defences based on the MAFF and Environment Agency coast protection and sea defence databases.

Plates 1-14 illustrate the range of shoreline situations found along the open coast of the area.

Plate 1 South shore of Pagham Harbour

Plate 2 Timber groynes and low tide banks, south of Pagham Harbour entrance

Plate 3 Seawalls and groynes, West Beach, Selsey

Plate 4 Beach regrading along the shingle ridge, Bracklesham Bay

Plate 5 Timber breastwork along private frontages, East Wittering

Plate 6 Gabions at the neck of East Head

Plate 7 Recharged shingle beach, Eastoke Point, Hayling Island

Plate 8 Open beach at Gunner Point, Hayling Island

Plate 9 Wide shingle beach and promenade, Eastney

Plate 10 Defences at Portsmouth Harbour entrance, Old Portsmouth

Plate 11 Haslar seawall

Plate 12 Stokes Bay to Gilkicker Point

Plate 13 Shingle beach with low tide mud flats, Hill Head

Plate 14 Solent Breezes holiday development and the adjacent eroding cliffs, Chilling

2 Consultation

2.1 Consultees

The involvement in the SMP of all the groups and organizations with an interest in the Solent shoreline is seen as critical to its long term success. To achieve this involvement from the outset the project team consulted widely to obtain information and to gain an understanding of the diverse issues relevant to the SMP. Table 1 presents the Consultees contacted, the level of their involvement for Stage 1 and summarizes their interests and concerns.

2.2 Consultation process

A three phase approach was adopted for consultation:

- initial contact and request for information, plus a public presentation of the SMP process (Stage 1)
- meetings with major Consultees (Stage 1)
- circulation of draft Management Unit Plans for discussion and agreement, plus an open day for discussion (Stage 2).

At the outset of the study all Consultees identified by the Coastal Group were informed that the SMP was being developed, invited to the introductory presentation and asked to provide information. The information requested included:

- areas of interest
- subjects/activities of interest
- existing or future plans and aspirations relating to the shoreline
- issues of concern
- sources/locations of published data or reports.

Responses to the first phase were received from over 60% of the Consultees, as indicated in Table 1. Follow up discussions were held where particular concerns were expressed.

Meetings with the major Consultees were undertaken, including:

- members of the Steering Committee
- Chichester Harbour Conservancy
- Langstone Harbour Board
- Defence Land Services
- Hampshire and West Sussex County Council.

Each of these major Consultees provided detailed information on areas of responsibility, existing shoreline problems, existing defences, potential conflicts of interest with other groups, plans for coastal defences and plans for development. Meetings were not held with representatives for Portsmouth Harbour as they were awaiting publication of the Portsmouth Harbour Plan, which has since been released in Draft.

The final phase of consultation related to the preparation and agreement of plans for the Management Units. This is discussed in the Stage 2 volumes of the SMP (Volumes II and IV).

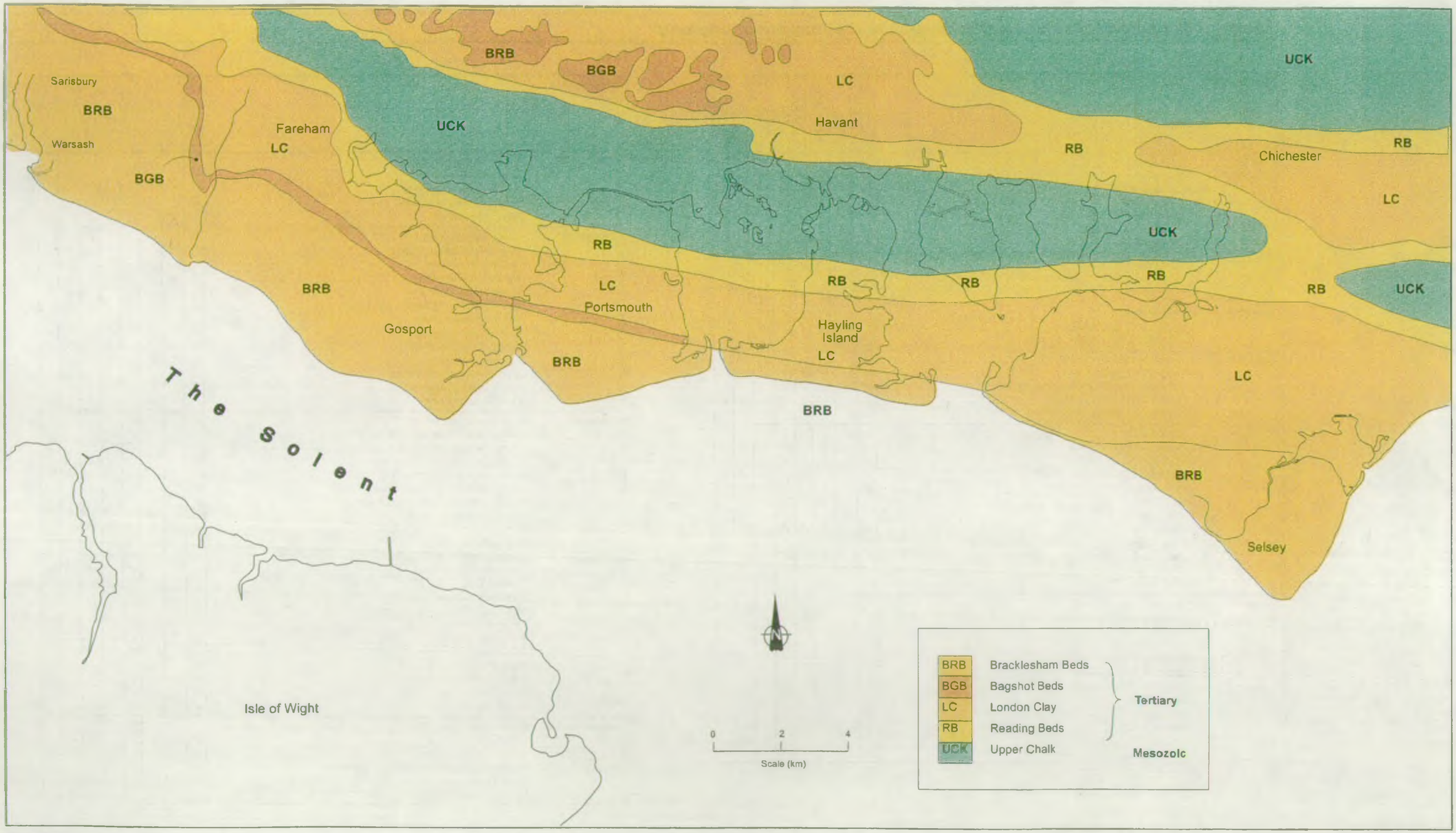
Coastal Groups representing adjacent shorelines are also preparing SMP's. The South Downs Group, to the east, are led by Arun District Council and have appointed Gifford Associated Consultants to act as consultants. The West Solent Group are led by New Forest District Council and have appointed Sir William Halcrow & Partners Ltd as consultant. The Plan areas overlap to some extent to ensure continuity of management. In the east the

overlap extends from Selsey Bill to Pagham. In the west the overlap is limited to the River Hamble frontage from Hook Spit to Warsash. Consultation between the Groups has ensured that the three plans are compatible.

Table 1 Consultees involvement in Stage 1 and summary of interests

Organization		Initial Response	Meeting	Coast Defences	Environment	Planning	Recreation	Navigation	Commerce
Steering Committee	Chichester DC	✓	✓	✓	✓	✓	✓	✓	
	Havant BC	✓	✓	✓	✓	✓	✓	✓	
	Portsmouth CC	✓	✓	✓	✓	✓	✓	✓	
	Gosport BC	✓	✓	✓	✓	✓	✓	✓	
	Fareham BC	✓	✓	✓	✓	✓	✓	✓	
	Environment Agency	✓	✓	✓	✓	✓	✓		
	English Nature	✓	✓	✓	✓	✓	✓		
County Councils	Hampshire CC	✓	✓	✓	✓	✓	✓	✓	
	West Sussex CC	✓	✓	✓	✓	✓	✓	✓	
Other Statutory Consultees	Arun DC		✓	✓	✓	✓	✓		
	Crown Estates			✓	✓	✓	✓	✓	✓
	Countryside Commission			✓	✓	✓	✓		
	Department of Transport								
Harbours	Chichester Harbour Conservancy	✓	✓	✓	✓	✓	✓	✓	
	Langstone Harbour Board	✓	✓	✓	✓	✓	✓	✓	
	Langstone Harbour Advisory Committee	✓			✓	✓	✓	✓	
	Portsmouth Commercial Port	✓						✓	✓
	Flag Officer Portsmouth (MoD)	✓			✓		✓	✓	✓
Parish Councils	Apuldram PC								
	Birdham PC	✓		✓		✓			
	Bosham PC	✓		✓		✓			
	Chidham PC	✓		✓	✓	✓	✓	✓	
	East Wittering PC	✓		✓		✓			
	Earnley PC								
	Fishbourne PC								
	Pagham PC	✓		✓	✓	✓			
	Selsey Town C	✓		✓		✓	✓		
	Sidlesham PC	✓		✓		✓			
	Southbourne PC								
	West Wittering PC								
Residents Associations	Emsworth	✓		✓	✓	✓	✓		
	Hardaway and Elson Residents Group	✓			✓	✓			
	Hayling Island	✓		✓	✓	✓	✓		
	Hill Head								
	Langstone (Residents Association)					✓			
	Langstone (Village Association)					✓			
	Lee-on-the-Solent	✓		✓	✓	✓	✓		
	Northney								
	NE Hayling	✓		✓		✓			
	Pagham Beach								
	Warsash								
	West Wittering	✓		✓		✓			

Organization		Initial Response	Meeting	Coast Defences	Environment	Planning	Recreation	Navigation	Commerce
Commercial	British Maritime Industries								
	Continental Ferryport	✓						✓	✓
	Local Fisheries Committee								
	Southern Marine Industries	✓					✓		✓
	Selsey Regeneration	✓	✓	✓			✓		✓
Landowners	Cakeham Manor Estate	✓		✓			✓		
	Church Farm Holiday Village	✓					✓		✓
	Country Landowners								
	Defence Land Services		✓	✓					
	Hayling Island Golf Club								
	Meon Shore Chalet Owners Association	✓					✓		
	National Farmers Union	✓		✓					✓
	National Grid Company	✓		✓					✓
	Pagham Beach (Holdings)	✓		✓	✓	✓	✓		✓
	Park World Holidays	✓		✓			✓		✓
	Solent Breezes Chalet Owners	✓		✓					
	West Wittering Estate	✓		✓			✓		
	White Horse caravan Co.			✓			✓		✓
Conservation Groups	Bosmere Hundred Society	✓			✓				
	Council for the Protection of Rural England			✓	✓	✓	✓		
	English Heritage								
	Fareham Society								
	Friends of the Earth (Portsea)								
	Friends of the Earth (Gosport and Fareham)	✓			✓				
	Friends of the Earth (Manhood Peninsula)	✓			✓				
	Friends of the Earth (Havant)								
	Gosport Environmental Forum	✓			✓		✓		
	Gosport Society	✓			✓				
	Hampshire and Wight Trust for Maritime Archaeology	✓			✓				
	Hampshire Wildlife Trust	✓			✓		✓		
	National Trust								
	Portchester Society	✓			✓				
	Portsmouth Harbour Conservation Group								
	Portsmouth Urban Wildlife	✓			✓				
	Portsmouth Society	✓			✓				
	Portsmouth Environmental Forum	✓			✓				
	RSPB	✓			✓		✓		
	Solent Protection Society	✓			✓				
	Stokes Bay Society	✓			✓				
	Sussex Wildlife Trust	✓			✓				
Recreation	Fareham Sea Angling Club								
	Hill Head Sailing Club	✓		✓			✓	✓	
	Marine Safety Agency	✓						✓	
	Portsmouth and Langstone Sailing Association	✓					✓	✓	
	Royal Yachting Association	✓					✓	✓	
	Southern Tourist Board	✓					✓	✓	✓



Solid geology

Figure 2

3 Coastal processes

3.1 Introduction

The past, present and future forms of the East Solent shoreline are the result of natural forces acting on the sea bed, beach and backshore, modified by man's activities and coastal vegetation.

The natural forces include:

- swell and locally generated waves
- tidal currents
- tidal and meteorologically induced water levels
- winds
- fresh water flows.

These forces act on the mobile surface material or solid geology causing erosion, accretion and flooding. Since Roman times these natural processes have been influenced by man's activities, including:

- construction of ports
- maintenance of navigation channels
- construction of coastal defences to protect shoreline property and structures
- removal of beach and sea bed material for construction
- reclamation of land.

The physical forces are also influenced by biological processes, including:

- development and breakdown of saltmarsh communities and the formation of wetland habitats
- stabilization of backshore windblown sand by dune communities
- nearshore transport of gravel and cobbles by 'kelp rafting'
- erosion control by established vegetation
- cementation of seabed material.

These forces and processes are described in this chapter. The geological and historic evolution of the coast are presented first, followed by the present day situation. Possible future coastal developments are then considered based on potential changes to sea levels and the wind/wave climate. This volume concentrates on the open coastline and Pagham Harbour, while the companion Volume III covers the situations in Chichester, Langstone and Portsmouth Harbours.

Much of the information presented is derived from the Pagham Harbour to River Hamble study undertaken for the Coastal Group by HR Wallingford (HR Wallingford, 1995a&b). This source is supplemented by referenced information from other publications and reports reviewed for the SMP.

3.2 Geological evolution

The underlying bedrock of the East Solent comprises chalk with overlying soft clay and sand Tertiary sediments and a mantle of Recent sediments. Figures 2 and 3 present the solid and surface geology for the area. The surface geology includes unconsolidated Recent drift deposits and exposures of underlying solid formations. Table 2 provides further details of the lithologies. This information has been derived from various maps produced by the British Geological Survey.

Table 2 Lithological descriptions of the East Solent solid and drift formations

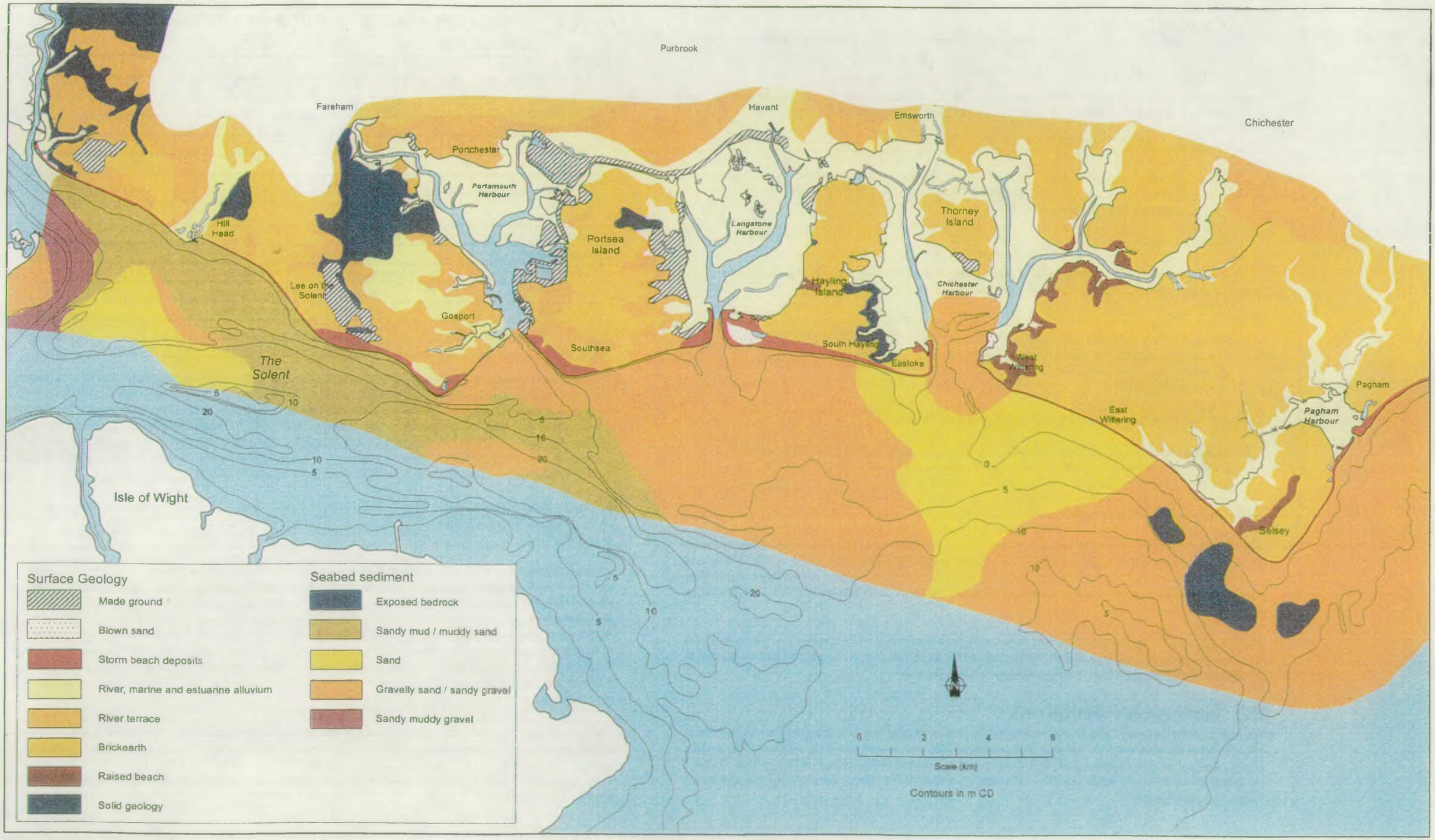
Recent	
Blown sand	modern deposits
Shingle and sand beaches	modern deposits
River, marine and estuarine alluvium	relict and modern deposits of fine material
River terrace deposits	mainly gravels
Brickearth	mainly loam and clay
Raised beach	coarse flint gravels above sand at about 5m OD, Ipswichian transgression (100,000 BP?)
Tertiary	
Brackleham Beds	clays and clayey sands
Bagshot Beds	sands and gravels, with seams of clay
London Clay	sandy clays, with occasional pebble beds
Reading Beds	clays, sand with occasional flint gravels
Mesozoic	
Upper Chalk	thickly bedded chalk with regularly spaced bands of flint nodules

The East Solent represents the drowned channel and flood plains of the ancient Solent River that flowed across south east Dorset and southern Hampshire and into a major "English Channel" river. The Solent River developed during the late Devensian glaciation when sea levels were as much as 120m below the present level. Rising sea levels during the Holocene transgression from 15,000 years BP to 5000 years BP caused the river valley to become drowned and infilled by fluvially deposited gravels. The river deposited vast quantities of sand and gravel throughout its flood plain. These deposits are the major source of beach material throughout the region, and remaining offshore deposits are the focus of the regional dredging industry.

The rate of global sea-level rise due to post-glacial meltwater slowed some 5000 years BP, but general subsidence of the land mass of south-east England has continued. The resultant relative sea level rise has been about 250mm per century.

As sea-levels rose, large quantities of sand and shingle were combed up and driven landwards. These are thought to have formed a series of massive shingle spits, forelands, barrier beaches and major offshore shoals located several kilometres seaward of the present shoreline and protecting marshy lowlands. Relict beach bases have been identified on the sea-bed in Bracklesham and Hayling Bays. Tidal channels through the barriers facilitated inundation of the Solent and the harbours, as suggested by various dated organic deposits that have been related to ancient sea-levels. Indeed, the connection of a tidal channel through the western Solent to isolate the Isle of Wight at between 8,000 to 6,000 years BP probably marks the beginning of the present complex tidal regime within this area. Thick sequences of fine sediments have infilled the estuaries and large harbours of the region since that time.

Over the past 2,000 to 3,000 years, it is thought that the barrier beaches within Bracklesham and Hayling Bays were driven progressively landward by continuing sea-level rise and wave activity, and perhaps also by relative sediment shortages. Fresh coarse sediments are only available through erosion of the low lying soft cliffs, so with declining rates of sea level rise, transgression would have occurred in response to continuing wave activity upon the depleting barriers.



Surface geology

Figure 3

During this same period Selsey Bill would have been developing as a headland due to the local protection offered by scarps of resistant Bembridge limestone, now several kilometres seawards. The headland would have formed a drift divide and, over time, the supply of sediment from offshore would have been diverted eastwards towards Pagham with diminishing supply to Bracklesham Bay. Continuing sea level rise would have reduced the protection afforded by the limestone scarps, allowing the rate of erosion at Selsey Bill to increase. This erosion would have fed the beaches both to the east and west.

In its natural state, the Selsey - Portsmouth coastal system probably operated as a linked series of beaches and offshore stores (ebb tidal deltas) that cycled existing sediments towards sinks around the harbour entrances. The upper beaches were, and still are, primarily shingle, with a lower beach of sand overlying the sub-stratum. Erosion and onshore shingle movement would have provided materials.

With widespread coastal protection over the past 100 years, erosion no longer supplies much additional sediment, and groynes interrupt many transport pathways. Furthermore dredging for navigation (Portsmouth and Chichester entrances) and for aggregate (especially Horse and Dean Sand for Portsmouth Harbour reclamations) have removed large quantities of sand and shingle from the system. Littoral sediments within this system are therefore both finite and depleted. The natural protection afforded by beaches will diminish unless countered by management actions.

In the absence of artificial protection, the geomorphological response would involve continued shoreline retreat. This would eventually tend to increase regional coastal stability through adoption of a flatter, more dissipative shore face profile, the release of eroded sediments and formation of a shoreline in equilibrium with the wave and tidal regime. However the complexity of this coast means that it is not easy to predict where transgression might occur first, the amount of transgression that might be needed to achieve stability and the possible consequences for neighbouring areas of permitting natural processes to operate in this manner.

This summary is compiled from the work of Allen and Gibbard (1993), Dyer (1975) and Bray et al (1991a,b&c).

3.3 Beach sediment distribution

The beaches of East Solent open coast are mainly shingle upper and sand lower as a result of their geological evolution. Construction of seawalls and groynes, and the placing of recharge, have influenced the natural beach form resulting in a narrowing of the upper shingle beach in some areas.

Detailed sediment sampling has not been undertaken or otherwise investigated for this SMP. Beach types have been assessed by observation only. Information from laboratory analysis is not required for transport modelling as the influence of sediment size is only important in wide grading bands (i.e. sand *vs* shingle). Apart from being unnecessary in the context of an SMP, beach sampling can provide misleading results as sediment gradings vary rapidly both temporally and spatially. If detailed information is required for specific design purposes, then local field studies could be undertaken. Harlow (1978, 1979a&b, 1980) presents sediment information for some areas.

3.4 Historical evolution

Changes to the East Solent coastline have been recorded since Roman times, but the most reliable information is available from Ordnance Survey map analysis using the 1867-75 County Series as a baseline and the NRA (Environment Agency) photogrammetric data for recent changes. The Pagham Harbour to River Hamble study (HR 1995a & b) presents the changes in some detail as do Harlow (1980) and Hooke and Riley (1987). These studies concentrate on the development of the High Water line, but also consider the Low Water line where reliable information is available. The impact of coastal defence works and dredging on the shoreline are discussed.

The following sections summarize the information and its relevance to the SMP. Areas are discussed in accordance with dominant drift directions. Figures 4 - 6 present the changes to the High Water line since 1870. The inset figures indicate the rates of change for specific locations over the same period. Changes to the low

water line are not mapped as this information is much less reliable. Notes are added to the map for areas of significant low water change.

Selsey Bill to Pagham Harbour

Comparison of historic maps of the Selsey area from Roman times through to the present shows that major changes to the shoreline have occurred. Rapid erosion of the "Raised Beach" deposits at the headland released vast quantities of shingle and sand to feed littoral drift eastwards to Pagham Harbour and the West Sussex coast and westwards towards Chichester Harbour. The main area of erosion prior to construction of the seawall and groynes in 1956 was along East Beach where the High Water line had retreated by about 150m over a period of about 60 years. As new beach material now arrives only sporadically from the nearshore banks to the south of the Bill then erosion continues although the High Water line is constrained by the seawall and groynes. Groyne maintenance and beach renourishment has been required in recent years to maintain an effective beach.

Downdrift from East Beach towards Pagham the shoreline has undergone periods of both erosion and accretion. Recently the shoreline has been either stable or accreting as it benefits from losses at East Beach, from onshore transport across the Inner Owers and from the construction of timber groynes. The shingle spit at Pagham Harbour has undergone many changes over time, but has been generally stable since the entrance channel was fixed by sheet piling in 1963. Recent evidence has shown some recession but this may only be temporary. The Pagham Harbour area is a major sink for shingle and sand, with material arriving from the Pagham Estates beach to the east as well as from Selsey to the south. The southern spit is relatively narrow and has been maintained in recent years by regular recycling operations.

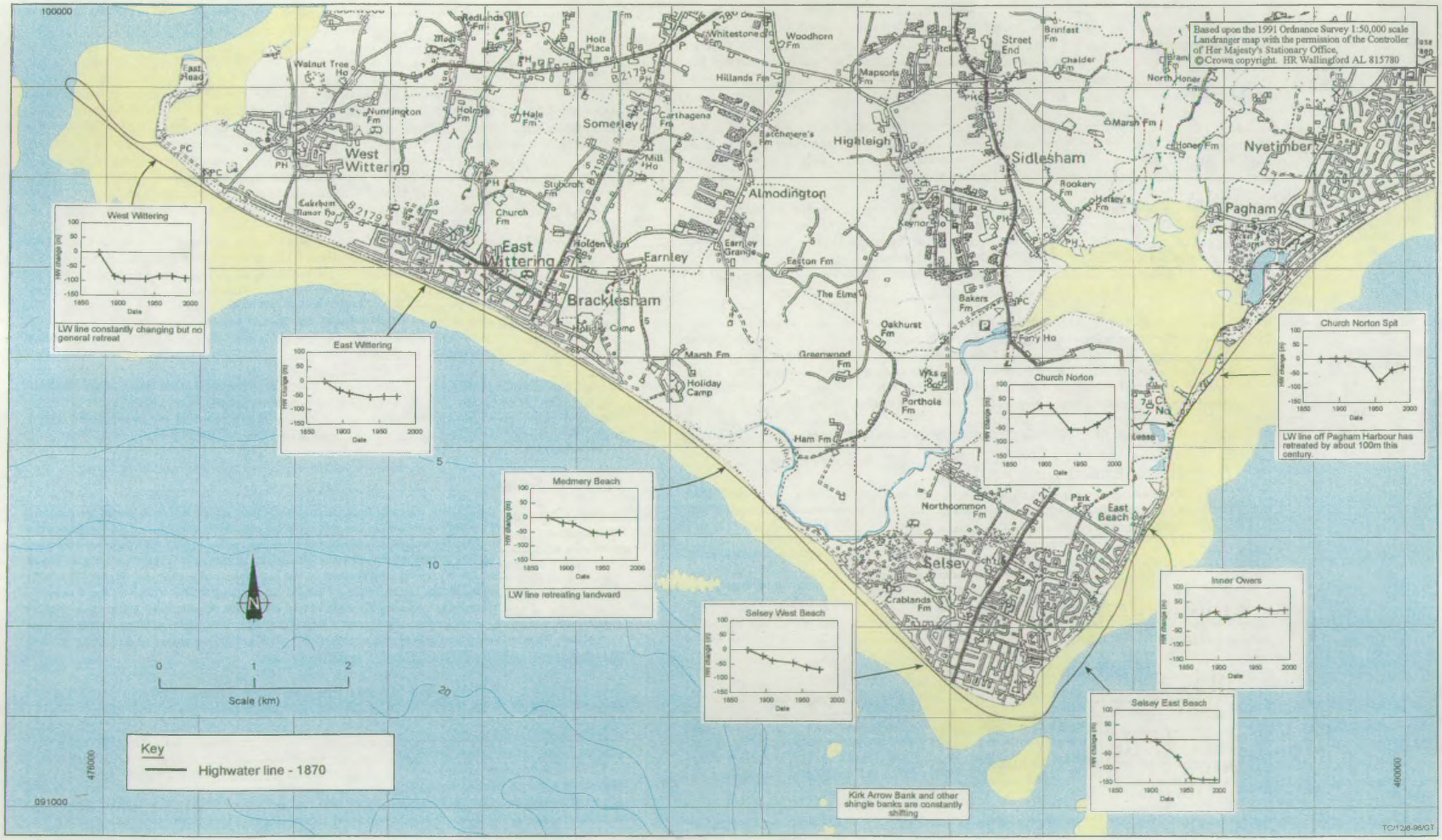
Pagham Harbour has undergone many changes over time. Prior to construction of the flood embankments and the raised causeway for the road, Selsey was an island separated from the mainland by mudflats. From 1876 to 1910 the harbour was entirely enclosed by the spit and the present intertidal land was reclaimed for grazing. Breaching of the spit in 1910 and the maintenance of the present channel since 1963 have caused this land to revert to saltmarsh.

Selsey Bill to East Head

Erosion at Selsey Bill and onshore transport from the nearshore banks off the Bill have provided substantial volumes of drift to this frontage, but this has not prevented the soft cliffs northwest of Bracklesham from undergoing rapid erosion. The cliffs suffered erosion rates of 1-2m/year and the shingle bank between Selsey and Bracklesham has been breached, most notably in 1910 when Selsey temporarily reverted to being an island. Groynes were built along the West Wittering frontage in the last century and extensive groyne fields were constructed in stages along the shingle bank at Medmery and the Witterings up to 1938. The west beach at Selsey from the Bill to Mill House was protected by a seawall in the 1950s, leaving only a few short sections unprotected. Further major works were constructed at East Wittering in 1964 and a recharge scheme has been in operation between Selsey and Bracklesham since 1974. Cliff erosion continues along a short frontage immediately west of Selsey where no protection works are in place.

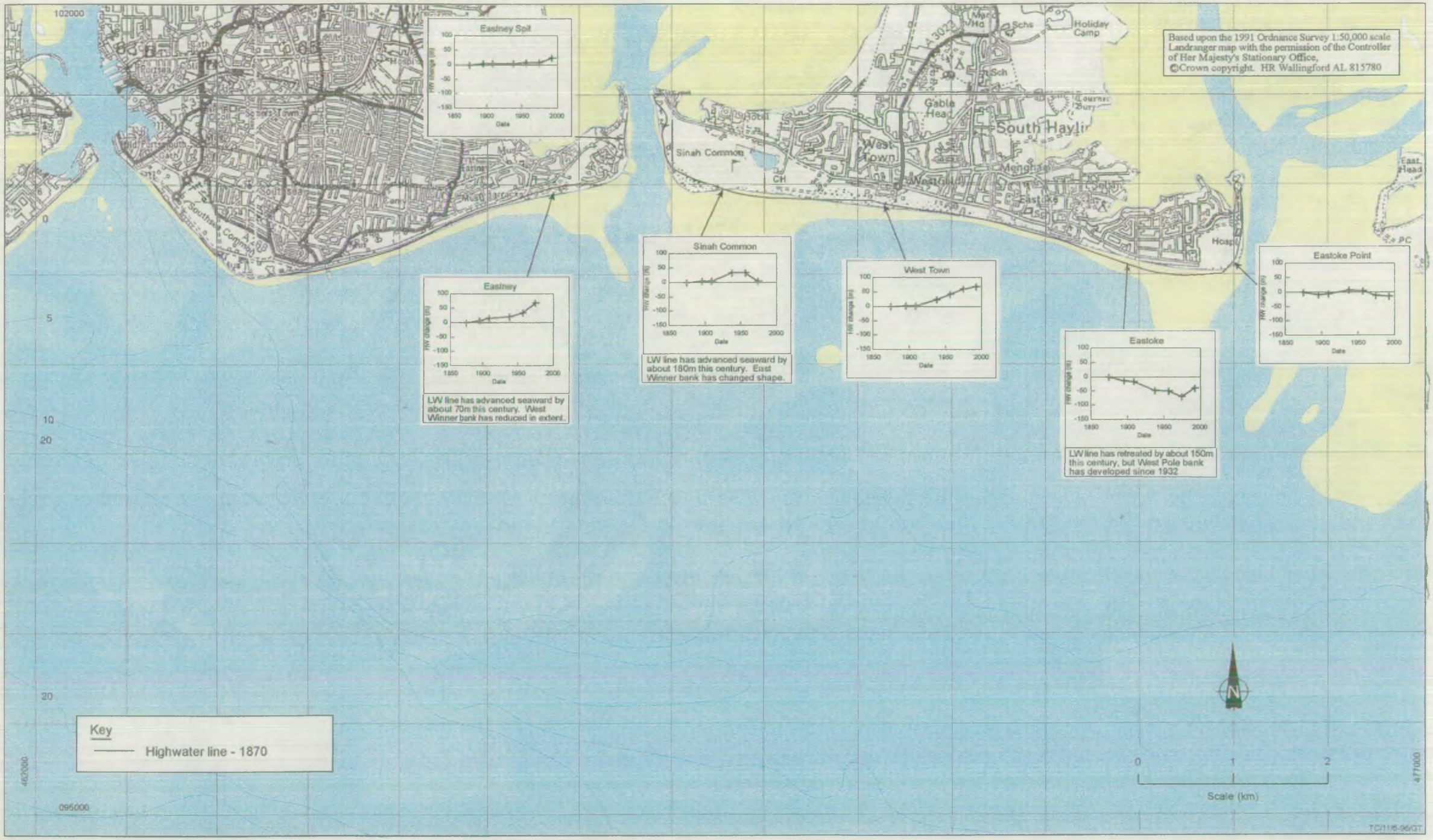
The lower foreshore from Selsey to West Wittering is undergoing a slow process of erosion, though there is little documented data on the rate of lowering of the sand over clay forming the lower part of the beach.

East Head has undergone a major change over the past 100 years. Early maps show a substantial shingle spit extending northwest across the Chichester Harbour entrance. In the late 19th century the spit apparently rotated by 90° towards its present northeastern orientation and altered in character from a shingle bank to sand dunes. This change occurred mainly before any significant coastal defences were in place and was therefore a result of natural changes to the coastal environment. The present sand spit is considered to be reasonably stable except at the neck, known as The Hinge. Since the turn of the century work has been carried out to prevent breaching, including construction of groynes and gabions. The dunes on the main spit have been actively managed since the 1970s.



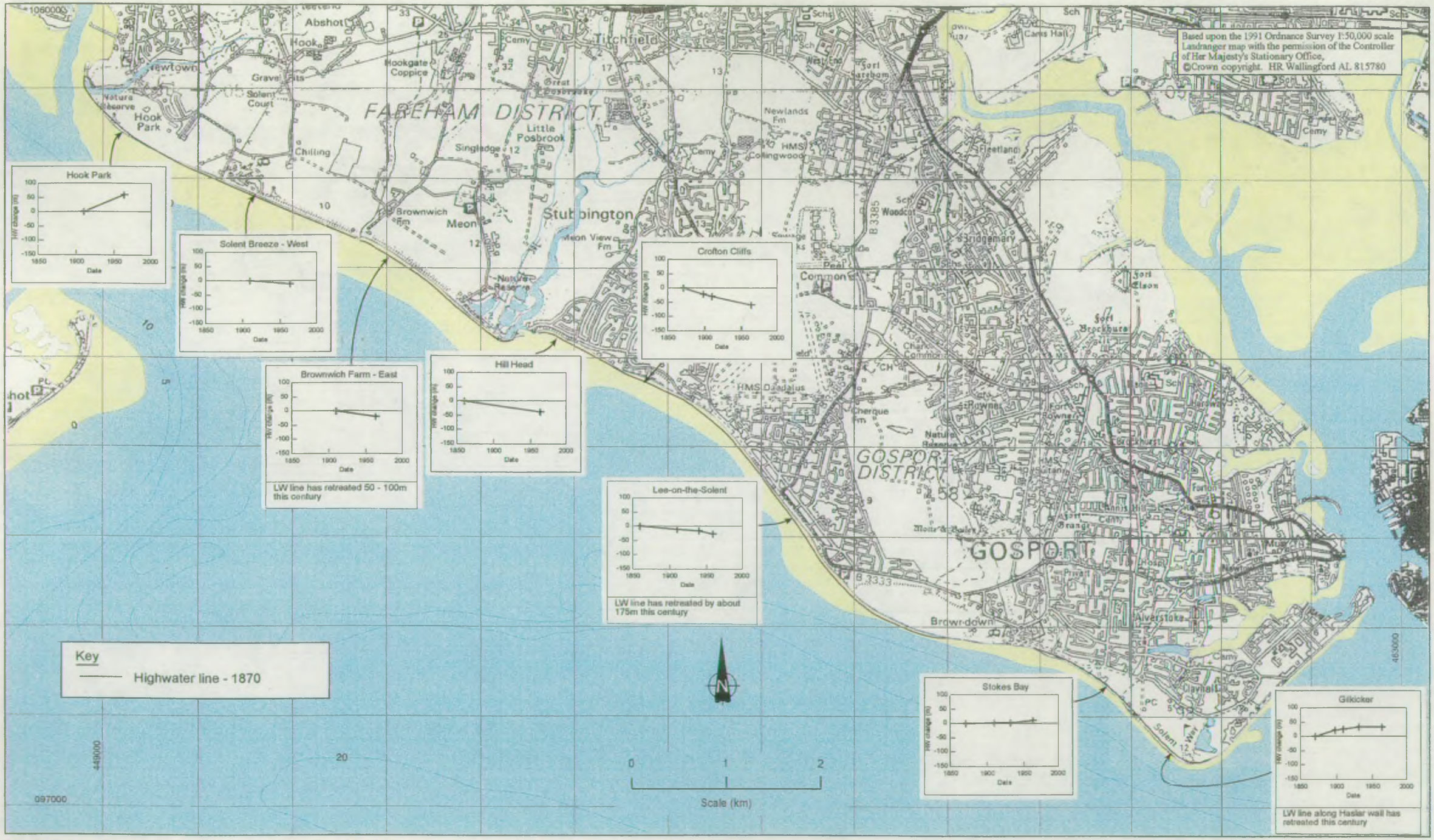
Historical evolution - Pagham Harbour to East Head

Figure 4



Historical evolution - Hayling and Portsea Islands

Figure 5



Historical evolution - Portsmouth Harbour entrance to River Hamble

Figure 6

Chichester Harbour entrance channel and bay were dredged in 1988 to re-establish the published safe navigation depth. 20,000m³ were removed and dumped as spoil.

Hayling Island

Hayling Island is low lying and has suffered rapid erosion and flooding. Residential and commercial development of the open coast began in the 1930s with the construction of beach huts and bungalows on the backshore of the wide shingle bank at East Hayling. By the late 1930s coastal defences, including a wall, revetment and groynes, had been built to protect the new properties. These defences were extended both west and east in stages until 1974 when they covered 2.6km of the frontage west from Eastoke Point. In 1985 a major shingle recharge was undertaken along East Hayling and further work involving rock revetments and groynes has been carried out recently at Eastoke Point to prevent a breach of the shingle bank.

East Hayling has been particularly difficult to defend as the nearshore and beach transport processes are subject to significant seasonal and annual change. Inshore wave transformation is influenced by strong tidal currents and shifting nearshore banks and channels; minor changes in offshore wave direction can cause beach drift directions to reverse with severe consequences for beach erosion and wave overtopping.

The central and western parts of the Hayling Island shoreline are largely undeveloped and have tended to accrete. This is particularly so at Gunner Point where the shoreline has moved seaward by some 200m this century, resulting in the development of multiple shingle ridges.

The East Winner bank was dredged for aggregate until 1994. Volumes of between 30,000m³ and 40,000m³ were removed annually between 1955 and 1994. Dredgers worked the bank before 1955 but records are not available.

Portsea Island

The open coastline of Portsea Island is largely formed by a substantial shingle bank, the eastern part of which has a history of stability or accretion. The major area of recent accretion is to the east between Fort Cumberland and the outfall at Eastney Point. To the west there is some long term foreshore steepening around Southsea Castle where a variety of defences have been built to stabilize the High Water line. Beyond these walls and groynes is a further area of shingle beach leading up to Clarence Pier which acts as a large groyne. From Clarence Pier to Old Portsmouth the High Water line is defined by sea walls and fortifications, some dating to the 15th Century. Little change of the foreshore is recorded for this frontage.

Offshore of Portsea Island are the Horse and Dean Sand which have been heavily dredged in the past to provide fill and aggregate for reclamation and construction works in Portsmouth Harbour. This area is a sink for sediment transport along the shoreline, and dredging has had little apparent impact on the shoreline.

Gilkicker Point to Portsmouth Harbour

The High Water line of this frontage is defined by the Haslar seawall, protecting MoD property. The wall has been in place for over 140 years. The low water line has moved shoreward over time requiring extensive footings along the seawall.

Solent Breezes to Gilkicker Point

The sandy cliffs of Bracklesham Beds topped by plateau gravels extending east and west of the Solent Breezes holiday camp are undergoing erosion. Apart from the frontage immediately along Solent Breezes the cliffs are unprotected. The erosion feeds a slow drift to the east with accumulations west of Titchfield Haven, and from the River Alver outfall to Gilkicker Point. Erosion has also occurred from Hill Head to Browndown with the highest rates at Crofton Cliffs southeast of Hill Head. Groynes, revetments and seawalls have been built at various times along this frontage to stabilize the High Water line. A beach recharge scheme with large rock

groynes will be completed at Lee-on-the-Solent during 1996. Major outfalls affect the beach at Crofton Cliffs causing updrift accumulations and downdrift starvation.

The low water line has also retreated along this frontage. The greatest shift has been off Lee-on-the-Solent where the low water line has moved shoreward by 175m this century.

Solent Breezes to River Hamble

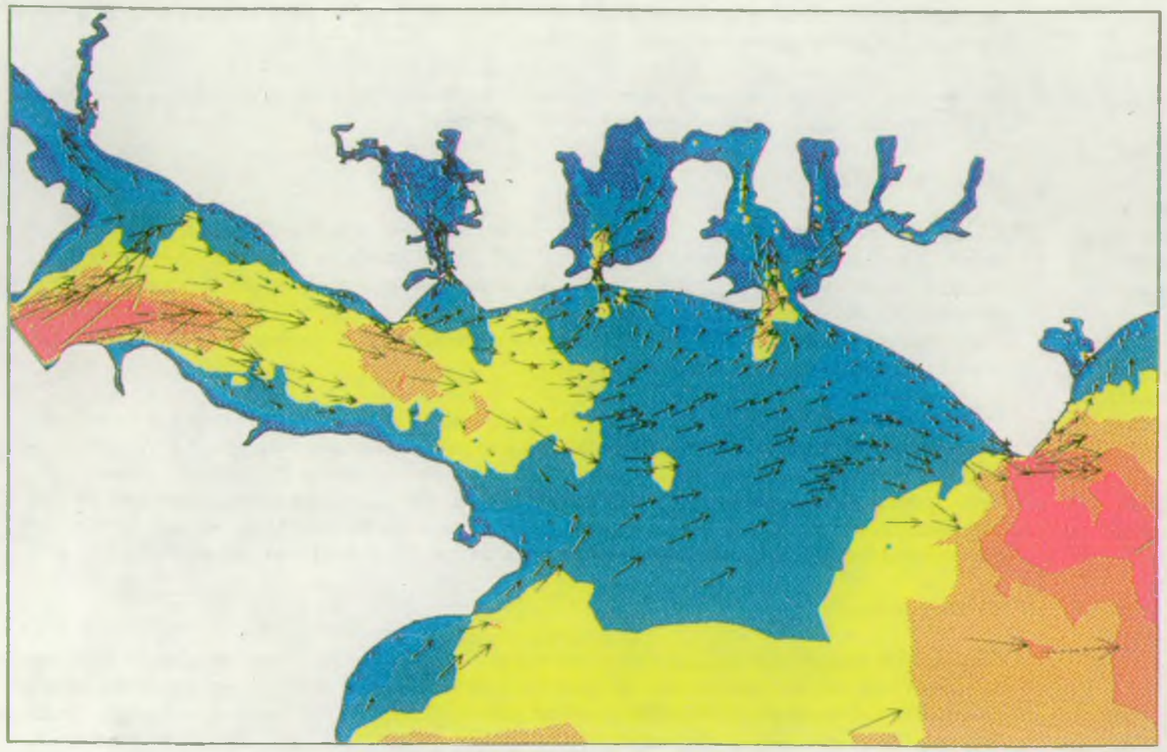
A littoral drift divide occurs around the Solent Breezes. As there is no significant onshore feed of fresh beach material then the area suffers a nett loss of material and erosion of the cliffs. Transport northwest of Solent Breezes is predominantly towards the River Hamble. Rapid accretion rates have given rise to a substantial shingle spit beyond the end of the low eroding cliffs. The spit, known as Hook Spit, extends for 1.5km and encloses a large area of saltmarsh which drains into Hook Lake near the mouth of the River Hamble. The lake is enclosed by a masonry wall with a sluice connection to the river.

The proximal end of Hook Spit is subject to breaching and concrete blocks have been dumped along the upper foreshore to breakup wave attack. The spit provides shelter to the low lying estuary margins up to Warsash. Low walls protect Hook Lake and the School of Navigation under normal conditions, but are subject to overtopping during storms and high water levels. The wall extends to Warsash Pier after which there is a short stretch of low cliff subject to slow erosion. At Warsash the shore road and car park area are subject to occasional flooding. The reclaimed land used for boat yards and light industry at Warsash provides a convenient endpoint to the SMP area.

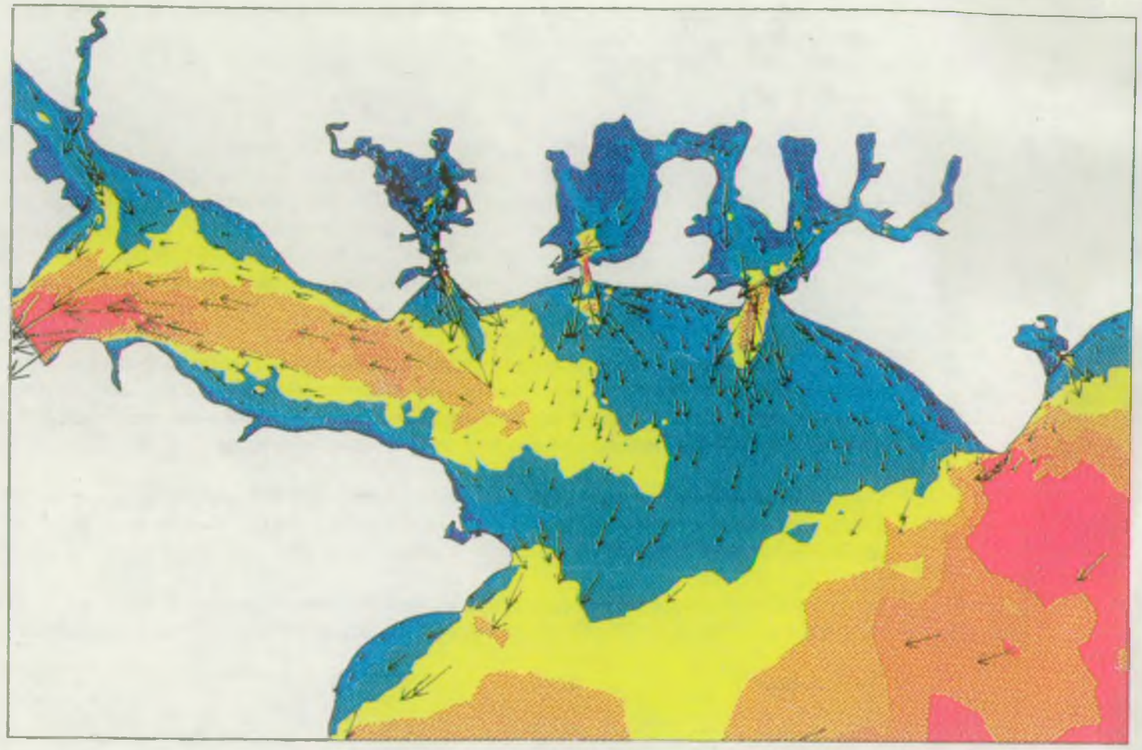
Evolution summary

The present shoreline of the East Solent is a result of very active post-glacial processes of erosion and accretion, increasingly controlled by coastal defences and beach management activities during this century. Rapid erosion of soft cliffs has occurred around Selsey Bill, from Bracklesham to East Head, and from Lee-on-the-Solent to the distal end of Hook Spit. Substantial erosion and roll back of the shingle banks has occurred along the shoreline from Selsey to Bracklesham, at East Head, along the eastern frontage of Hayling Island and along part of the Browndown frontage. Concurrent accretion has occurred at Pagham Harbour, Gunner Point on Hayling Island, Eastney on Portsea Island and from the River Alver outfall to Gilkicker Point at Gosport.

Groynes, seawalls and revetments constructed over the past century have stabilized the high water line along most of the frontage, but continued erosion of the lower foreshore has resulted in a steepening of the beaches. A consequent spiral of increasing erosion puts ever greater pressure on the defences and emphasizes the need for long term shoreline management.



Flood tide



Ebb tide

Speed (m/s)
3.00
1.50
1.25
1.00
0.75
0.50
0.25
0.00

Vectors (m/s)
1

Tide currents - Peak spring tide flow contours and vectors

Figure 7

3.5 Tidal regime

Tidal currents

Tidal currents for the East Solent were investigated in detail in HR Wallingford (1995a&b). The study used the TELEMAC 2D depth averaged tidal flow model with a variable density mesh to improve resolution in areas of complex bathymetry. The model was run to simulate spring and neap tide flows, plus storm surge conditions, for the existing sea levels and for a projected 260mm sea level rise over 20 years. The model was calibrated and verified against available Admiralty tidal stream data and field data collected for the study in 1994.

Figure 7 presents the ebb and flood current vectors and speed contours for a spring tide under existing sea level conditions. The contours are for peak flow at each grid point (i.e. not at a single time) while the vectors represent flow at each point at the moment of peak flow in the entrance to Chichester Harbour.

Figure 8 presents the tidal current residual speed contours and directional vectors for a Spring tide cycle. These residuals are important in driving sediment transport in areas outside the breaker zone. The model can also be used to predict: flows at any state of the tide; the interaction between waves and currents, and their combined effect on sediment transport; and to predict the impact of surges, future sea level rise and changes to the shoreline or nearshore bathymetry.

The model shows that:

- ebb currents (westward) are generally stronger than flood (eastward)
- the strongest currents are found off East Beach, Selsey Bill, Gilkicker Point, and within the harbour entrance channels
- residual currents are an important component of the transport regime off Selsey Bill where they oppose the dominant wave induced currents, and in the harbour entrances where they give rise to ebb tide deltas
- currents are unlikely to change significantly if sea level rises, and currents during storm surge conditions are not significantly stronger than existing spring tide currents.

Water levels

The tidal regime in the Solent is extremely complex with an extended high water and spatially variable tidal ranges along the coastline (Geodata, 1991). The previous study (HR Wallingford, 1995a & b) investigated extreme water levels and the effects of sea level rise in considerable detail. Table 3 summarizes the available water level information for the locations marked on Figure 9. It is apparent that high water levels and tidal ranges generally increase from west to east. The extreme water levels are important in determining flood risk areas.

Future relative sea level rise, due to the combination of global warming and the ongoing post-glacial movements of the earth's crust, has been predicted at between 5mm/year (Houghton et al, 1990) and 13mm/year (Bray et al, 1991 & 1992). The accepted level for MAFF funded schemes is 6mm/year for the Solent area. The SMP assumes this level, except for Portsea Island where MAFF have accepted a 10mm/year rise. Given that most coastal schemes will be designed for a 50 year life, then a relative sea level increase of 300mm should be used for design except for Portsea Island where 500mm is considered to be more appropriate.

Comparison of the HR Wallingford study with other tidal data sources (Graff and Blackman, 1977 and Graff, 1981, Coles and Tawn, 1990) indicate that there are some inconsistencies in definition of extreme levels. As definition and evaluation of both mean and extreme water levels is very important to shoreline management, then a field programme should be instigated to improve the regional distribution of long term tide monitoring stations with the aim of establishing future trends in sea level rise and reappraising predicted extreme levels. This work is particularly important for Portsmouth and Gosport as there is some doubt associated with the data used in estimating a 10mm/year rise and the extent of the area over which this value should be applied.

Table 3 Tide levels and predicted extreme water levels (mOD)

Point	LAT	MLWS	MHWS	HAT	Return Period (years)					Estimated 50 year rise (m)
					1	5	10	50	200	
A			2.48	2.85	2.99	3.31	3.38	3.53	3.69	0.3
1		-2.55	2.55	2.92	3.06	3.38	3.45	3.60	-	0.3
2		-2.3	2.48	2.89	3.03	3.35	3.42	3.57	-	0.3
3		-2.10	2.40	2.78	2.91	3.21	3.28	3.43	-	0.3
4		-1.98	2.28	2.69	2.82	3.11	3.18	3.32	-	0.3
5		-1.84	2.16	2.57	2.70	2.98	3.05	3.18	-	0.3
6		-1.84	2.16	2.57	2.70	2.98	3.05	3.18	-	0.3
10	-2.73	-1.93	1.97	2.37	2.46	2.72	2.78	2.90	-	0.5
11		-1.93	1.97	2.37	2.46	2.72	2.78	2.90	3.05	0.3
12		-1.88	1.92	2.28	2.40	2.65	2.71	2.83	2.97	0.3
13		-1.88	1.82	2.16	2.27	2.51	2.57	2.68	2.82	0.3
14		-1.94	1.76	2.10	2.21	2.44	2.50	2.61	2.74	0.3

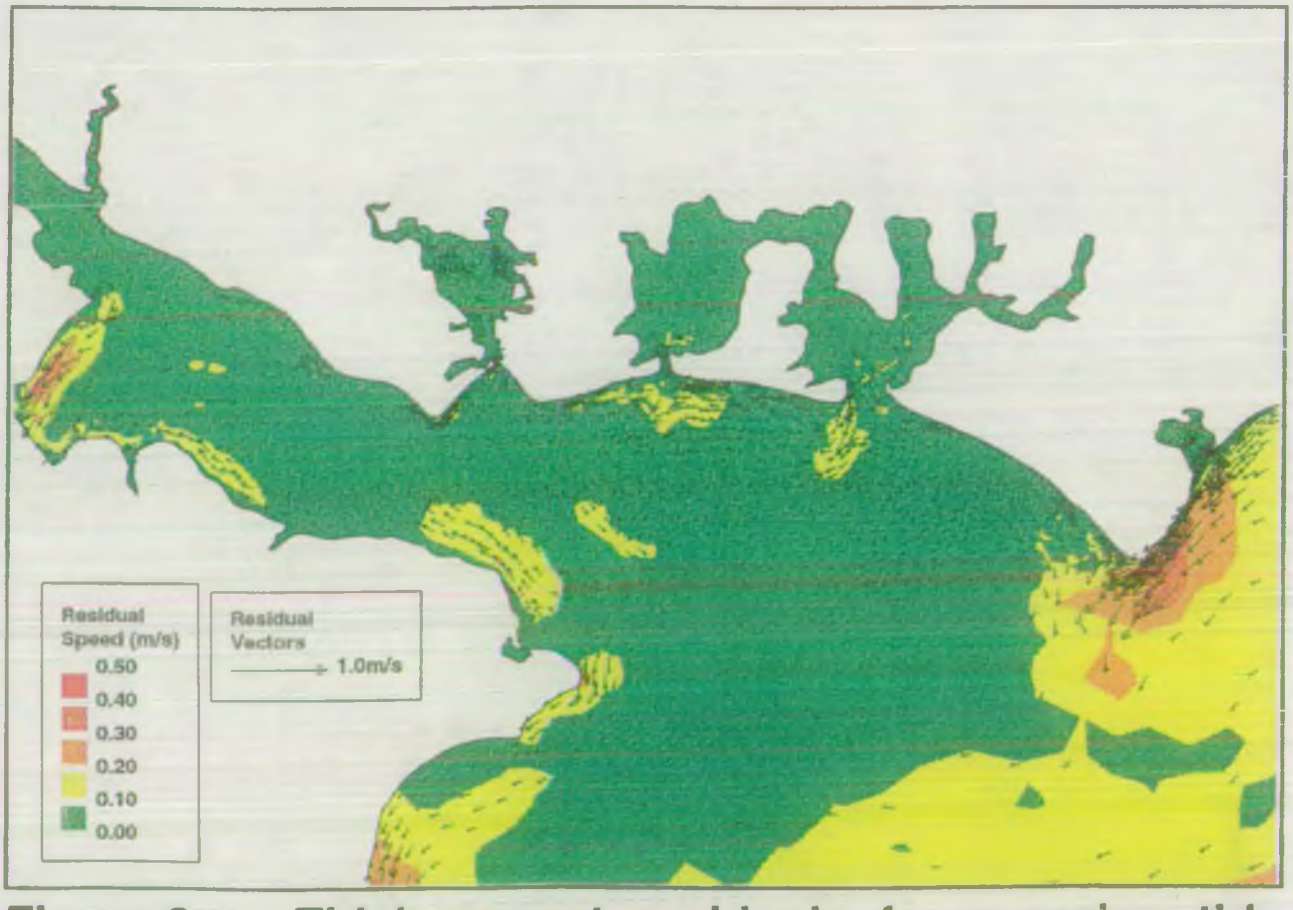
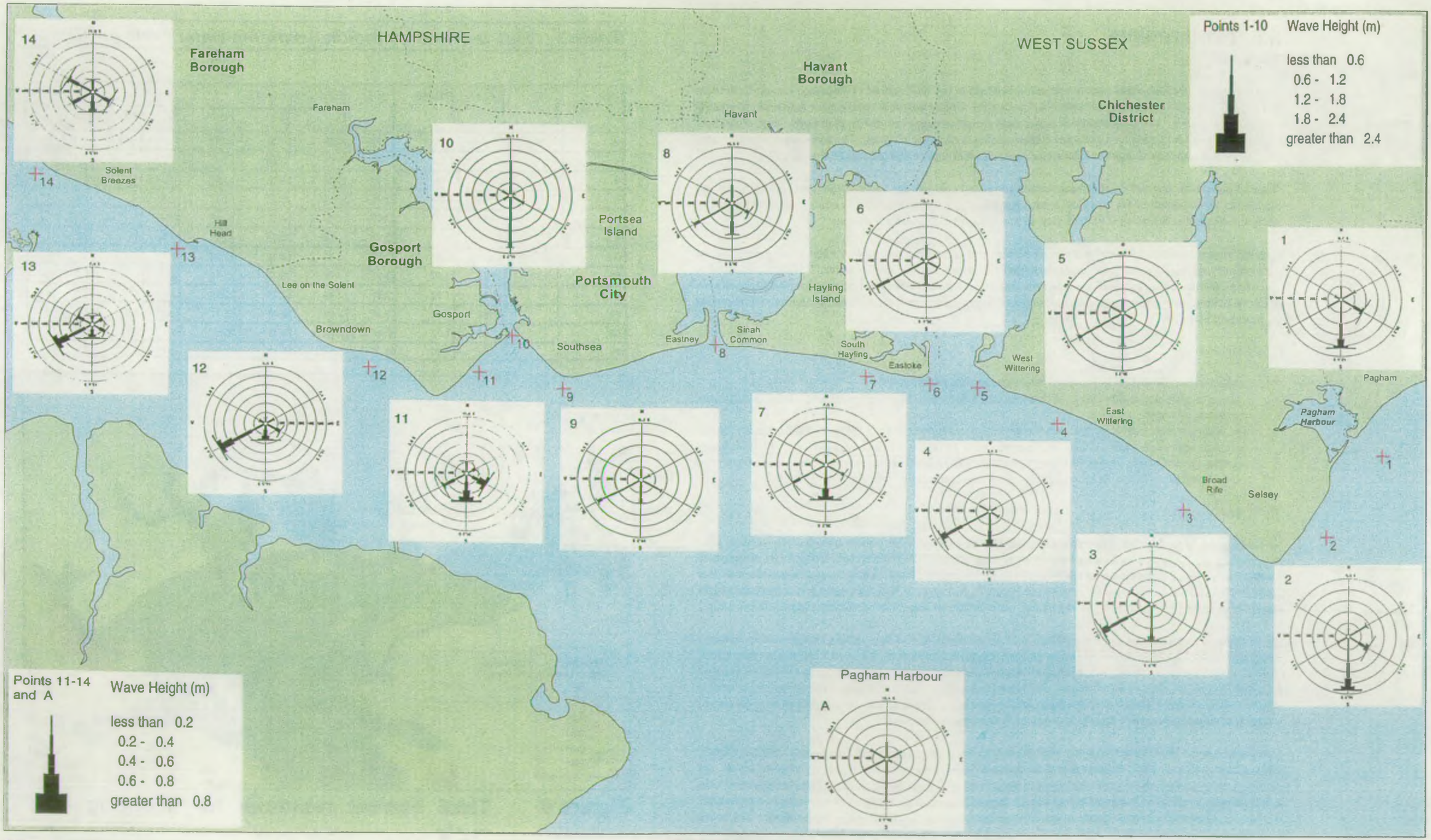


Figure 8 Tidal current residuals for a spring tide cycle



Wave climate

Figure 9

3.6 Wave climate

The processes of wave generation and transformation from offshore to inshore are particularly complex in the East Solent. Storm waves reaching the coast can be generated locally under winds from the southwest through to the east, or in the English Channel. Swell waves generated further afield will also penetrate the area, though heights will be modest. The Isle of Wight offers protection from the most severe waves in the Channel, but the level of this protection varies greatly along the frontage. Wave conditions at Selsey Bill and along East Beach are severe as these areas are exposed directly to waves from the south and east and to diffracted waves generated by southwesterly winds in the Channel. Further west the exposure to waves generated outside the Solent decreases. West of Southsea Castle up to Solent Breezes wave energy increases slightly and the dominant direction changes due to the increased southwesterly fetch up the West Solent. Waves in Pagham Harbour are generated locally and are only of significance at higher water levels.

Nearshore wave transformations are complex due to the variable bathymetry and the presence of strong tidal currents. At Selsey Bill the shoreline is offered protection by the nearshore limestone scarps and shingle banks. Further west the wide lower beaches and submerged banks also offer protection, while the strong ebb and flood currents around the harbour entrance channels have a variable impact on waves as they move inshore. These influences vary according to water level and the neap-spring cycle of tidal currents.

The wave climate for the area is considered in detail in HR Wallingford 1995 (a & b). The HINDWAVE and TELURAY models were used to predict inshore wave conditions at a number of nearshore points. These models take account of refraction, diffraction and shoaling due to the bathymetry, the presence of tidal currents and the tidal cycle of water levels. Work is also presented on swell waves, the effect of climate change and extreme wave conditions based on a Weibull distribution.

Table 4 Extreme wave heights (non-directional)

Point	Depth (m OD)	Significant wave heights (m) for given return periods				
		1 year	10 year	50 year	100 year	200 year
A	*	0.37	0.44	0.48		
1	-4.7	3.94	4.72 +	5.24 +		
2	-4.7	4.60 +	5.53 +	6.10 +		
3	-4.7	3.87	4.58 +	5.04 +		
4	-4.7	4.32	5.20 +	5.79 +		
5	-0.2	1.44	1.67	1.82		
6	-12.1	2.82	3.42	3.84		
8	-12.7	2.10	2.42	2.62		
9	-4.7	1.22	1.37	1.46		
10	-12.3	1.20	1.34	1.43		
11	-4.7	1.39	1.58	1.71	1.76	1.81
12	-4.7	1.24	1.41	1.52	1.57	1.61
13	-4.7	1.27	1.47	1.60	1.65	1.70
14	-4.7	0.97	1.14	1.26	1.31	1.36

* Treated as deep water. Waves too small to be breaking.

+ Unbroken wave heights. Actual wave heights will be depth limited to about 4.5m

Table 4 presents the predicted wave conditions at the points indicated by Figure 9. The figure presents directional wave roses for each of the points to indicate dominant directions.

Analysis of the local wave conditions over the past 20 years suggests that changes in the wave climate have already occurred, with far reaching implications for shoreline management of erosion, accretion and flood risks. Figure 10 presents variations over 20 years in three categories of wave height (waves exceeded 50%, 10% and 1% of the time) and in mean wave directions. The locations selected are representative of conditions throughout the area. The plots also show linear regression lines.

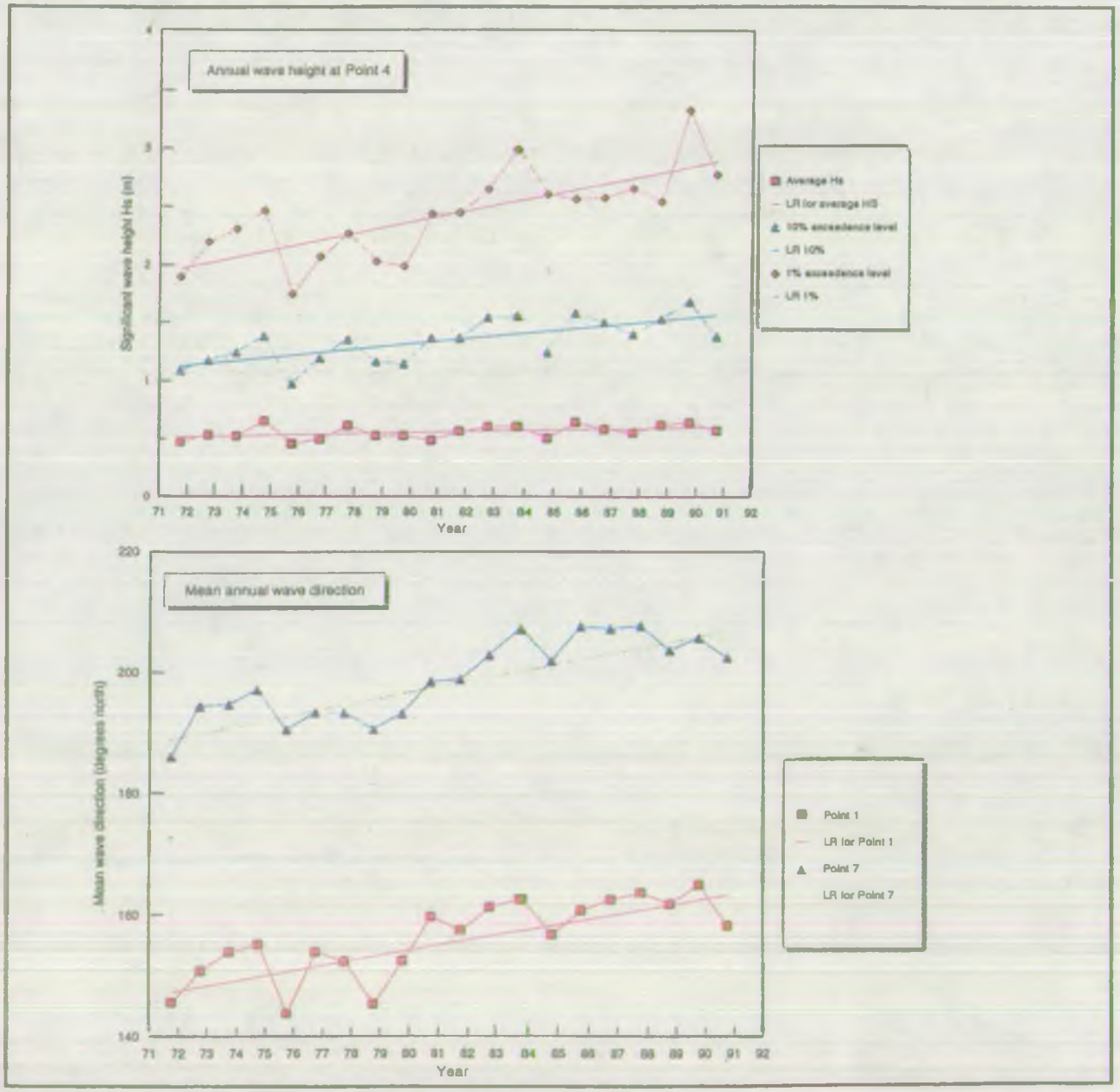
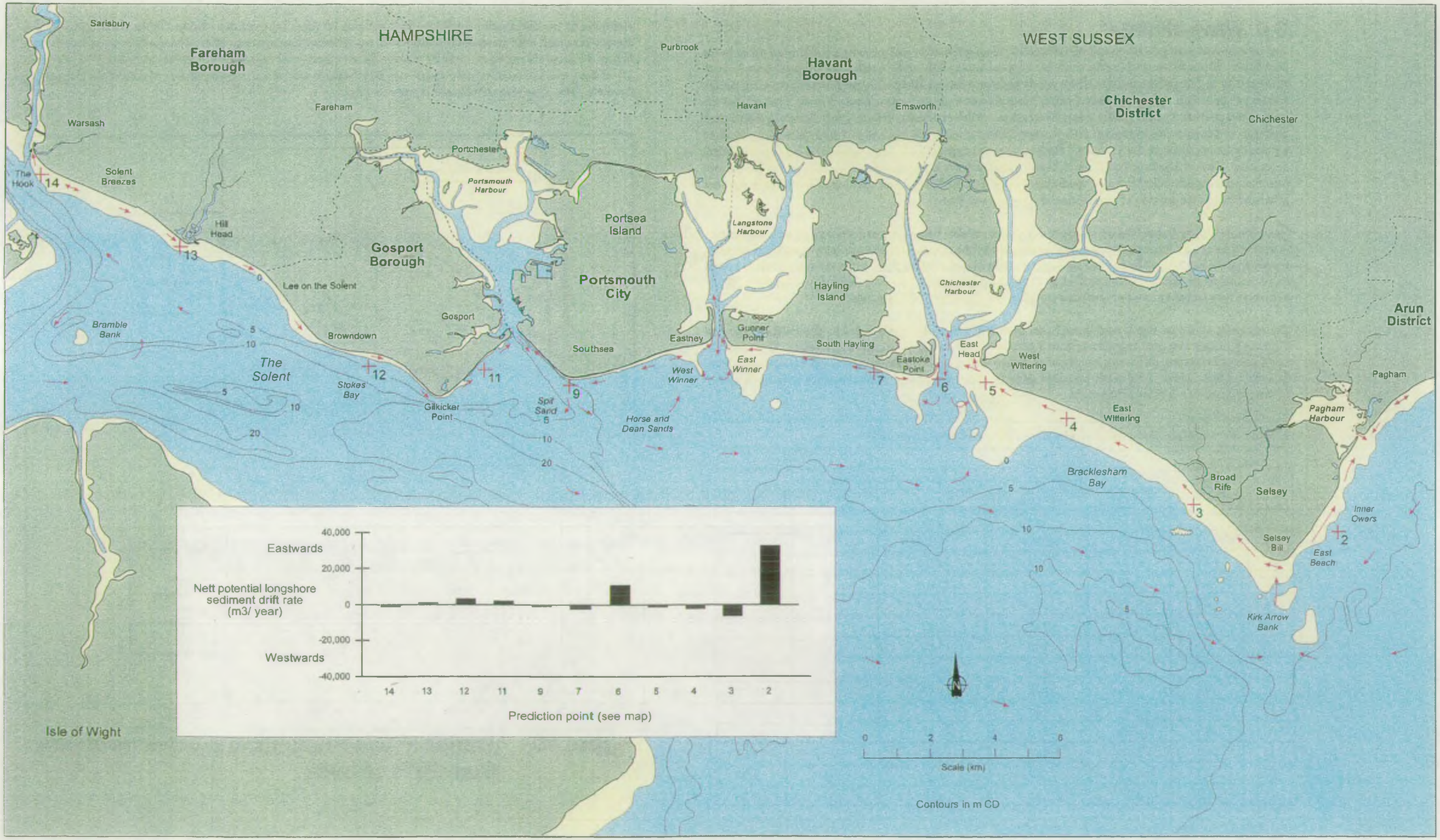


Figure 10 Trends in wave heights and wave directions from 1971 to 1991



Transport paths for sand and shingle (Inset: mean annual nett *potential* shingle drift rates)

Figure 11

Wave modelling of the East Solent also suggests that changes in offshore wave heights due to increased storminess and/or rising sea levels will cause a near linear change in inshore wave heights. However, a shift in wave direction due to a shift in the North Atlantic weather patterns, will cause a more complicated change inshore: a clockwise shift in offshore wave direction will cause a clockwise shift in nearshore waves from Selsey Bill to Pagham, but an anti-clockwise shift to nearshore waves further west due to the protection afforded by the Isle of Wight. The opposite will occur if there is an anti-clockwise shift offshore.

Changes in the nearshore wave climate, whether short or long term, will have significant implications for sediment transport and for the effectiveness of the existing coastal defences. Short term monitoring of the local wave climate at several nearshore and inshore locations would allow detailed verification of the existing wave transformation models. Long term monitoring of nearshore waves and of local winds would allow trends in the wave climate to be continually re-evaluated in the management plans.

3.7 Sediment transport

Sediment transport along the East Solent open coastline has been discussed in detail in the previous study (HR Wallingford 1995a & b). The study utilized advanced numerical models and related the results to geomorphological studies and field observations (Dyer, 1976; Wallace, 1984, 1990 & 1994; Sudo, 1991) and the South Coast Seabed Mobility Study (HR Wallingford, 1993).

It should be noted that transport predictions are subject to the limitations of theoretical understanding of processes, algorithm development and the availability of high quality field data, particularly regarding wave forces within the intertidal zone. Areas with complex wave and tidal regimes, such as the East Solent, are difficult to simulate and model predictions can be misleading. The following discussion and figures attempt to summarize the important aspects of the sediment transport regime that are relevant to the area planning requirements of the SMP. Detailed information required for specific scheme designs can be obtained from the earlier HR Wallingford study. Repetition of the results of that study in isolation from the background information on modelling approaches and input information is considered unnecessary and potentially misleading.

Figure 11 indicates the dominant drift directions and presents an inset showing the mean annual *potential* shingle drift rates calculated using derived nearshore wave conditions for the period from 1971 to 1991. Figure 12 indicates the annual variability in gross and nett drift rate at Eastoke and serves as a warning of the potential misunderstanding of the complexity of predicted drift rates. These figures are discussed further below.

Sediment sources

Natural sediment sources for the Plan area beaches were:

- relict nearshore deposits of post-glacial sand and gravel (Figure 3)
- eroded material from the low soft cliffs along the shoreline at Selsey Bill, East Wittering and from Lee-on-the-Solent to beyond Solent Breezes
- eroded material from exposed nearshore outcrops of bed rock
- material lost to ebb tide deltas at the entrance channels to the four harbours and subsequently returned under favourable conditions.

Present day sources are limited by the protection of formerly eroding cliffs and by the dredging of the ebb tide deltas. A major source is now the recharge material placed at East Beach, Bracklesham Bay and Eastoke. Further information on nearshore sediment movement can be found in the South Coast Seabed Mobility Study (HR Wallingford, 1993).

Littoral drift

Littoral drift along the open coast is dominated by breaking wave processes. Tidal currents have a strong influence around the headlands of Selsey Bill and Gilkicker Point, and around the harbour entrance channels, through direct transport and through their effect on shallow water wave transformation. Drift rates have been calculated or estimated by various studies. Some have considered total transport of sand and shingle while others have separated the two components. The recent HR Wallingford study calculated potential drift rates at a number of points along the frontage (potential rates assume that there is no restriction on the supply of material); most of the points considered shingle transport only. These rates and directions are indicated in Figure 11. Other studies have used beach volume changes to estimate actual drift.

Potential drift rates vary with wave energy and wave direction. The mean wave direction, weighted for swell and wind sea energy from each direction sector, was used in HR Wallingford (1995 a & b) to determine long term shingle drift rates as well as changes in annual drift rates over the past twenty years. The highest potential rates were calculated for East Beach, Selsey at around 30,000m³/year. High rates of about 15,000m³/year were also found around the entrance to Chichester Harbour and along West Beach, Selsey. The Selsey area is affected by high wave energy as it benefits least from the protection offered by the Isle of Wight. Further west wave energy reduces due to increasing protection from waves generated in the English Channel. Mean wave directions also change as waves from the eastern approaches to the Solent become dominated by waves generated locally in the Western Solent. Potential nett transport rates along Bracklesham Bay and west of Chichester Harbour are low at less than 5000m³/year. Actual rates are even lower due to the influence of groynes and the lack of available material.

Gross rates in either direction may be much higher than the predicted nett rates, making beach management difficult; single storm events can have a marked effect on the annual rates, causing beaches to be very volatile. Beach monitoring is thus particularly important in this area as transport models are indicative only and cannot provide absolute drift rates in an area of variable sediments, variable wave climate and strong tidal currents. Figure 12 presents gross and nett rates at Eastoke over a 20 year period and indicates the level of annual variability that can occur in a complex area such as the East Solent.

Beach transport is predominantly north-eastwards from Selsey Bill towards Pagham and north-westwards from Selsey Bill towards Portsmouth. The beach at Selsey is fed by intermittent onshore transport from nearshore banks formed of relict deposits and renewed by tidal current dominated nearshore transport. The majority of this material is believed to feed East Beach rather than West Beach. Reports by Wallace (1988 and 1994) and Southampton University (SUDO 1991) provide details of transport processes around Selsey Bill inferred from geomorphological studies and field research.

The high northwards potential drift rate along East Beach reduces along the Pagham Harbour Spit due to the impact of the nearshore Inner Owers Bank and the ebb tide delta off the harbour mouth. Studies by Southampton University (SUDO, 1991) have shown that the Pagham Harbour ebb delta is sufficiently prominent to dampen waves and to refract them round so that there is a local drift reversal from Pagham Beach Estate towards the harbour entrance. This counter-drift means that, from the viewpoint of coastal management, the Pagham Beach Estate forms a sensible eastern boundary to the SMP area, albeit not a closed boundary.

From the Bill towards Portsmouth Harbour the shelter against south-westerly waves gradually increases and drift becomes increasingly dominated by southerly and south-easterly waves. These waves, in combination with strong currents in the Chichester Harbour Channel, promote a transfer of material from the Selsey peninsula to Hayling Island.

Hayling Island receives considerably less material than it did in the past when Chichester Bar was a more effective bypassing mechanism. In recent years the bar has diminished in size (Webber, 1979) and the entrance has deepened, making it more difficult for material, particularly shingle to be transferred to the Island from Selsey peninsula. Onshore movement can still be observed to be taking place via the West Pole but the v

are believed to be diminishing. The Island does not have any significant input of supply from the seaward nor is there any fresh source of material produced by coastal erosion. The coastal sediment budget, as on the Selsey peninsula, is therefore negative making recharge an important management requirement.

At the western end of Hayling the increased shelter against easterly wave action reduces the bypassing capacity of Langstone Harbour channel, hence the long term accretion at Gunner Point. On the west side of the inlet, drift along the Portsmouth frontage is very low and this promotes conditions for long term beach accretion at Eastney, encouraged by the sheltering effect of Horse and Dean Sand.

Little drift passes the Southsea Castle headland and littoral drift along the western end of the Portsmouth frontage at Southsea is low. The coastal defences which have been in place for many years at the mouth of Portsmouth Harbour have fixed the high water line resulting in a very narrow foreshore due to the long term tendency for beach erosion. This, coupled with low energy wave conditions, means that littoral drift and the supply of material to the entrance is now very small indeed. Some sand and shingle is swept onto the banks on either side of the approach channel to Portsmouth Harbour.

Sand transport paths along the lower beaches are less clearly understood than the shingle transport of the upper beaches. Beaches to the east of the Bill are characterised by a steep shingle foreshore with a tidal channel close inshore. There is little evidence of sand deposits except at the Bill itself and an admixture of sand at the Pagham Harbour entrance. By contrast there is a wide sand foreshore at low tide immediately west of the Bill. The presence of sand at the Bill suggests a possible throughflow of fine sediment from the east linked to a back eddy on the eastern flank of the Bill (Wallace, 1994). Due to a lack of contemporary sediment supply, sand beach levels at the Bill have been falling in recent years, resulting in the frequent exposure of Bracklesham Clays. Further west at West Wittering/East Head beach profile analysis indicates that sand levels are stable or accreting.

The coastline from the River Hamble to Portsmouth is dominated by southwesterly waves, causing southeasterly drift except for the frontage north of Solent Breezes, where the northwesterly drift has given rise to Hook Spit. Erosion of the soft cliffs and nearshore seabed around the drift divide at Solent Breezes provides shingle and sand to the sediment budget. Cliff erosion rates reduce to the southeast and shingle accretion occurs updrift of Hill Head harbour. Erosion begins again at Hill Head, but shoreline protection in the form of groynes and seawalls hold the high water line as far as the south end of Lee-on-the-Solent. Onshore migrating shingle bars are believed to feed the beach south of Hill Head. Drift continues southwards to feed the shingle forelands at Browndown and along Stokes Bay. Shingle tends to accumulate around the River Alver outfall, causing maintenance problems. Some drift passes Gilkicker Point and enters the ebb tide dominated processes of the Portsmouth Harbour entrance channel, though the volume is considered to be low.

Nearshore and offshore transport

Bedform surveys (Dyer, 1972), diver observations (Wallace, 1984, 1990, 1994), analysis of dredging operations (Fishbourne, 1977) and numerical modelling (HR Wallingford 1993 and 1995a&b) have been considered in determining transport pathways below low water and out to the deep channels of the Solent. The dominant processes in this area are tidal currents. Nett transport rates in the deep channels are low and generally run south-eastwards out of the Solent. To the south and east of Selsey Bill the nett transport is southwestwards for suspended load, including kelp rafted shingle which has been observed to form an important part of the total drift in this area. From the Portsmouth Harbour entrance channel to Selsey Bill there is believed to be a nett movement southeastwards in the broad nearshore zone, driven by the dominant ebb tidal flows; this general pattern is complicated by the channels and ebb tide deltas of the harbours, and by onshore transport driven by wave action.

From the Portsmouth Harbour entrance channel to the River Hamble the nearshore and channel transport paths are even more complex. There is an anticlockwise circulation around Brambles Bank, giving a nett northwesterly movement from Lee-on-the-Solent to the River Hamble and an easterly movement in the deeper channel to the south. Within Stokes Bay there is little nett movement. East of Gilkicker Point sand and shingle is carried towards Portsmouth entrance, but is flushed back by the strong ebb flows feeding the sediment sinks at Spit Sands and Horse and Dean Sand.

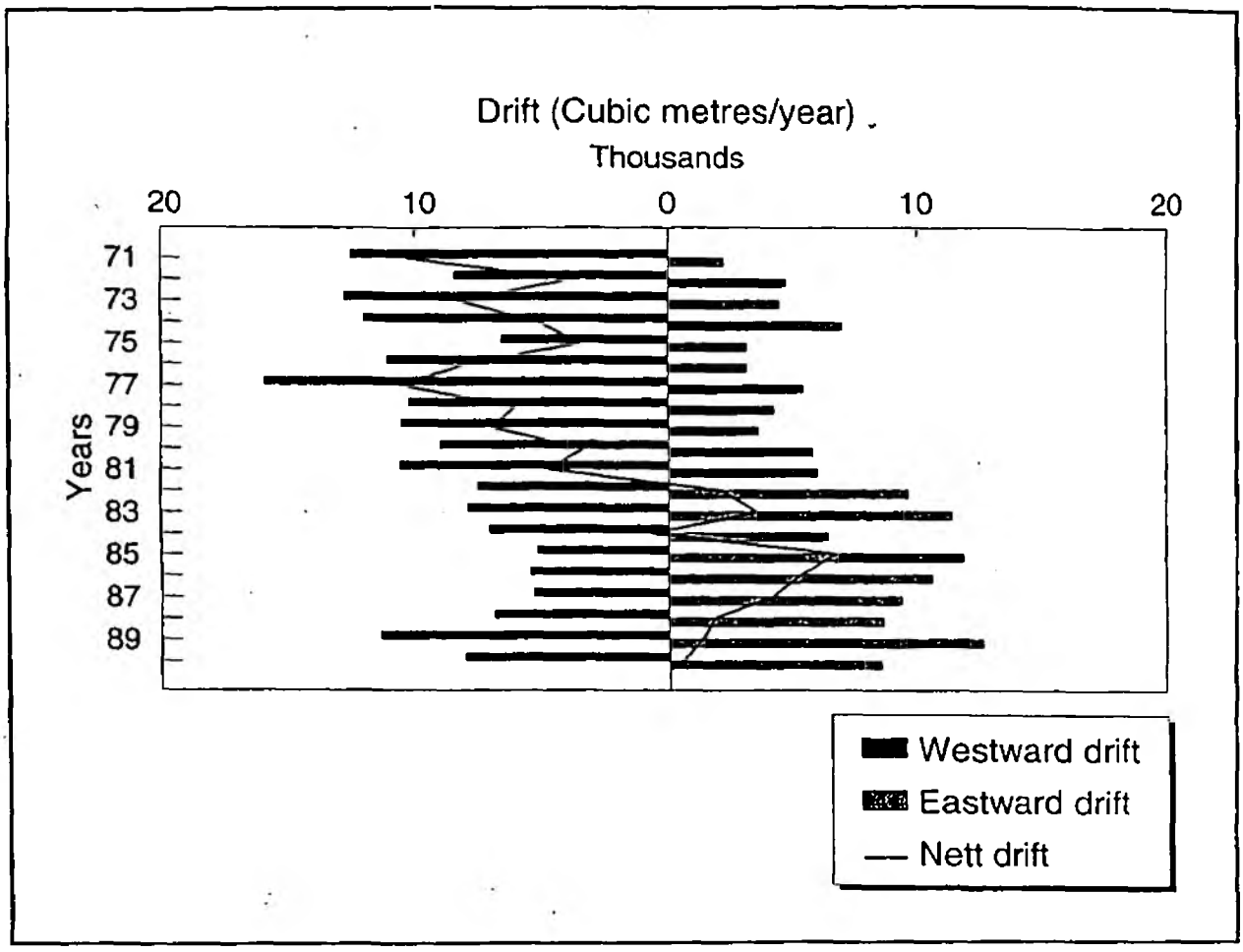


Figure 12 Nett and gross annual drift rates near Eastoke, 1971 - 1991

Future drift

Future patterns of sediment transport can not be predicted with any certainty as they will depend on management operations and changes in the wave climate, tidal regime and water levels. Best estimates can be made based on recent trends in wave climates, which in general are becoming more energetic and are shifting clockwise (HR Wallingford, 1995a & b).

These wave climate changes suggest that the high north easterly drift to the east of Selsey will increase, while the much lower north westerly drift west of Selsey will decrease still further and may even reverse direction. The low nett drift westward from Eastoke may also decrease, causing further complexity in this area of annual variations (Figure 12).

Low southeasterly drift from Solent Breezes towards Gilkicker Point may increase resulting in accelerating erosion of the unprotected cliffs northwest of Hill Head and further deposition around Stokes Bay. Drift north from Solent Breezes to Hook Spit may decrease, improving the stability of the cliffs, but causing starvation of the Spit.

It must be noted that the wave climate trends may not continue, and will, in any case, not be sufficiently constant to allow great confidence to be placed on predictions of the future.

3.8 Joint probability conditions and existing defence standards

The previous HR Wallingford report (1995a&b) assessed the effectiveness of the existing defences during storms. This was done using numerical models of beach response and wave overtopping.

The greatest risk to the shoreline occurs when high waves coincide with high water levels. The probabilities of the joint occurrences of extreme events are expressed in terms of their likely return period in years, and coastal defences are usually designed to resist storms up to a pre-determined return period. As a general guide defences for urban areas are normally designed to prevent significant risk to property or life under conditions with a 1 in 200 year probability of occurrence, while rural areas with predominantly low grade agricultural land might only be protected against 1 in 50 year events, beyond which some property damage would be accepted.

As a first step in assessing defence standards, the areas of risk must be defined. This is not a straightforward matter as risk combines the complex matter of the failure mechanisms for a given type of defence and the consequence of different types of failure. For example, undermining of a short section of seawall may only cause localized damage to a section of promenade, while a major breach of a shingle ridge may cause extensive flooding of hundreds of hectares of farmland or damage to major holiday facilities.

Joint probability

The joint probability of wave and water level extremes requires an informed assessment of the degree of correlation between the two variables, based on long term records and an understanding of the forcing conditions. The joint probability values set out for the SMP are for guidance only as they are based on the worst case conditions for specific overtopping or beach erosion tests. More rigorous definition is required for detailed design of coastal structures or management operations, particularly in areas of high risk.

Most of the shoreline is fronted by shallow water relative to the extreme wave conditions. This means that wave heights will be limited by water depth as they approach the shoreline, therefore making extreme water levels the more dominant condition of the two. Table 5 sets out the extreme conditions for return periods of 5, 50 and 200 years for the points shown in Figure 9. These conditions are all based on the -4.7m OD contour unless marked otherwise. They also assume present day water levels.. Actual conditions at the toe of the beach or seawall will depend on wave transformation inshore from the prediction contour.

Table 5 Worst case joint probabilities conditions

Point	Return period (years)	SWL (m ODN)	Storm waves	
			H_s (m)	T_m (s)
1	5	3.19	2.50	5.40
1	50	3.53	2.85	5.76
1	200	3.60	3.18	6.09
2	5	3.16	2.90	5.35
2	50	3.50	3.32	5.72
2	200	3.57	3.70	6.04
3	5	3.03	2.53	5.24
3	50	3.36	2.87	5.58
3	200	3.43	3.18	5.88
4	5	2.93	2.69	5.87
4	50	3.25	3.09	6.29
4	200	3.32	3.46	6.66
5[1]	5	2.81	0.95	3.49
5	50	3.11	1.08	3.72
5	200	3.18	1.20	3.92
6[2]	5	2.81	1.74	2.82
6	50	3.11	2.00	3.02
6	200	3.18	2.25	3.21
8[3]	5	2.69	1.47	3.97
8	50	2.98	1.63	4.18
8	200	3.04	1.78	4.36
9	5	2.61	0.91	3.12
9	50	2.88	0.99	3.26
9	200	2.94	1.06	3.37
10[4]	5	2.57	0.88	2.50
10	50	2.83	0.97	2.63
10	200	2.90	1.04	2.72
11	5	2.72	0.99	3.25
11	50	2.90	1.11	3.44
11	200	3.05	1.11	3.44
12	5	2.65	0.96	3.20
12	50	2.83	1.08	3.40
12	200	2.97	1.08	3.40
13	5	2.27	1.13	3.47
13	50	2.27	1.44	3.92
13	200	2.27	1.54	4.05
14	5	2.31	0.68	2.69
14	50	2.61	0.68	2.69
14	200	2.74	0.68	2.69

[1] Point 5 - Depth = -0.2m OD
[2] Point 6 - Depth = -12.1m OD
[3] Point 8 - Depth = -12.7m OD
[4] Point 10 - Depth = -12.3m OD

Areas at risk

The areas considered to be at risk from erosion, overtopping or flooding have been determined from published data (including HR Wallingford 1995a&b, the Environment Agency flood maps, MAFF Coast Protection Survey (MAFF, 1994) and NRA (Environment Agency) Sea Defence Survey (NRA, 1991)), site observations and discussions with the responsible engineers. For the purpose of the SMP a conservative approach has been adopted which should be refined for later strategy plans.

Figures 13, 14 and 15 present the potential flood areas, the frontages at risk from erosion and the potential shoreline assuming a "do-nothing" management approach over 50 years. The flood areas are taken as the extent of land below the maximum 1:200 year water level, but the probability of flooding to the extent shown would be much more remote for most areas. Flooding to the extent shown would require major breaches of the defences allowing inundation over the peak of the storm event. In addition it must be noted that there is no adequate land survey data to support the flood contours shown, except on Hayling and Portsea Islands. Areas of particular concern include the very extensive low lying farmland around Pagham Harbour and across to Bracklesham Bay, the residential areas of Eastoke and the environmentally important area around Gilkicker Lagoon.

The erosion risks indicated on the figures are based on a combination of existing erosion and the potential for erosion if the present day defences are not maintained. The shoreline is broken into four categories from high actual or potential erosion down to no significant erosion. In some area, such as Browndown Ranges or Gunner Point, erosion trends have been variable over long time periods; however in these cases the consequences of short term erosion are minimal so they are classified according to recent trends. Areas of particular erosion concern include the National Grid frontage north of Solent Breezes, Eastoke Beach, the shingle ridge and adjacent unprotected cliffs between Bracklesham and Selsey, the headland at Selsey Bill and East Beach at Selsey. The potential shoreline changes are presented only for areas subject to erosion and not flooding. They are based on a "do nothing" management approach and assume the historical erosion rate, modified for the expected life of the existing defences (MAFF and NRA surveys modified after site observations) and their continued influence after failure. In some areas, such as the Old Portsmouth frontage, continued erosion may not cause failure of the defences but may render them unsafe for their secondary functions of providing public access to the seafront and protection of historic sites.

Seawall overtopping risks are not included in the figures but were calculated for the HR Wallingford study (1995a&b). Overtopping can cause extensive flooding, although volumes of water will be less than result from a breach. Low overtopping rates may not cause flooding, but can cause local damage to structures or may be hazardous to pedestrians or motorists if roads or promenades follow the shoreline.

The seawalls around Selsey are predicted to suffer the greatest overtopping, depending on the level of beach along the frontage. At East Beach peak rates under a 1:5 years event are sufficient to cause damage to shoreline structures and to put the public at risk along the immediate shoreline. Under the 1:200 years event the overtopping rates will cause severe damage and flooding of the low lying ground behind the walls.

At West Beach, Selsey, the rates are lower and there is no low lying land to flood, but property and structures close to the wall will be damaged. Overtopping along East Wittering and at Sandy Point will cause similar localized damage. At Eastoke the predicted overtopping will cause local damage, and will result in flooding of low lying residential areas if the beach levels are not maintained. Frontages along Portsea Island are subject to some overtopping, and low lying areas of Old Portsmouth are liable to some flooding.

The Haslar Seawall suffers minor overtopping along much of its length. At the southwest end of the wall the crest elevation drops to only 3.8m OD and severe overtopping is predicted in the event of beach drawdown. Under the 1:200 years event, damage to shore front structures and extensive flooding of the Gilkicker Lagoon area is likely.

A short length of seawall along the Stokes Bay shoreline protects the coast road along the backshore. Overtopping of this wall under a 1:5 year event is sufficient to make use of the road dangerous. Under more severe events the overtopping could cause localized flooding.

Overtopping rates at Hill Head harbour predict some localized risk of damage. The previous HR study did not examine the possibility of overtopping for the low cliff fronting the National Grid tunnel, but recent minor flooding highlights the future problems likely in this area.

3.9 Future changes

An understanding of possible future situations is important to the development of sustainable management. As present trends cannot necessarily be taken as a guide to the future then it is important to consider a range of likely changes.

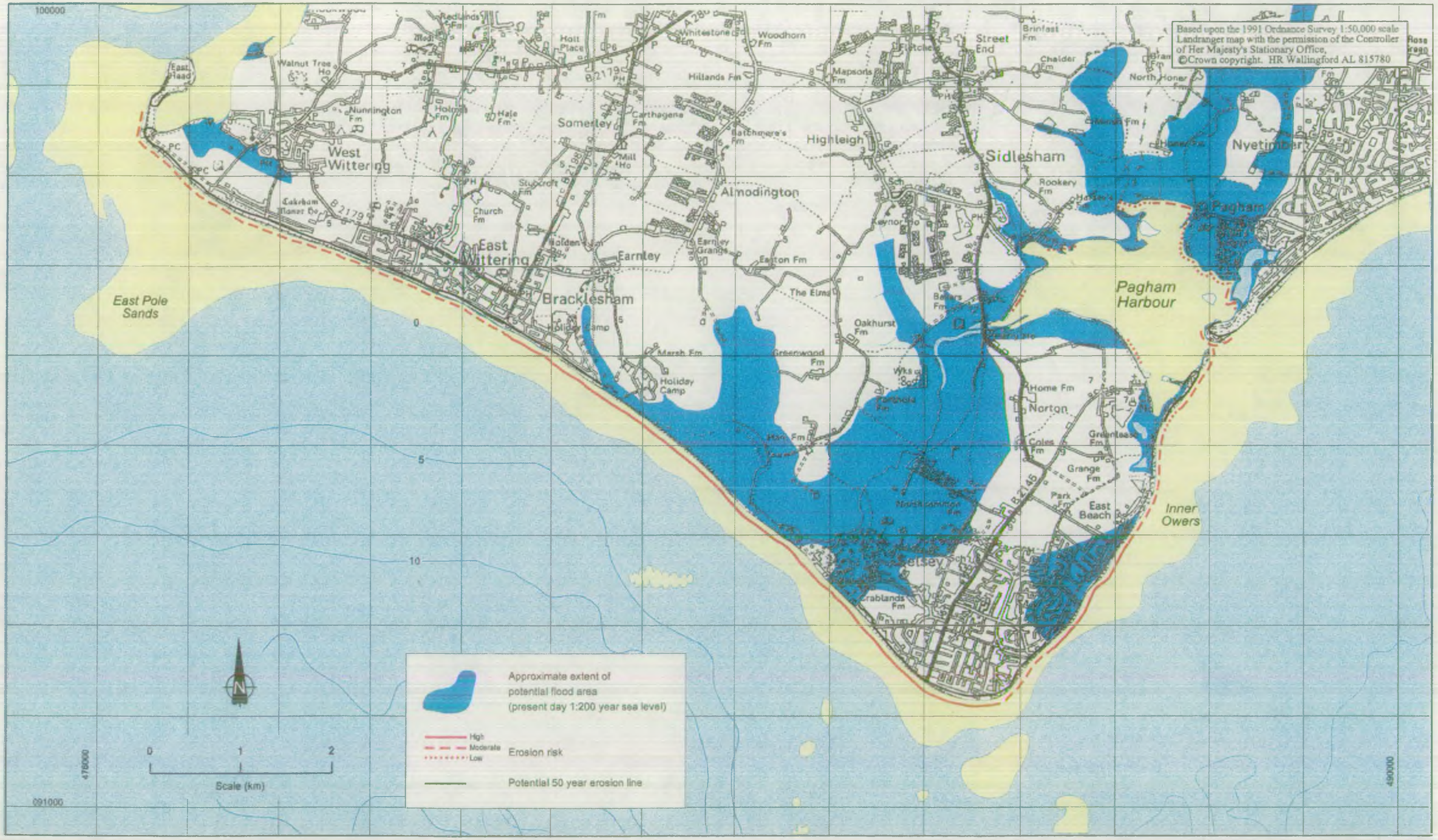
Recent research studies (Houghton et al, 1990; Bray et al, 1992; Jelliman et al, 1991; Brampton, 1993) have considered possible changes to water levels and waves. It is generally accepted that present rates of sea level rise are likely to increase. Predicted future rates vary from 5mm/year to 13mm/year over 50 years. Similarly it is also accepted that the wave climate is changing. Although long term predictions are not consistent, it is likely that storm frequency and offshore wave heights will increase and that wave directions may shift.

Given these potential developments, and an ever decreasing natural supply of sediment, then a number of shoreline changes are likely:

1. Increased wave energy and water levels will tend to increase erosion of beaches. Where the beach forms the main existing defence then the potential for major breaches and flooding increases with time. Where the beach is in front of a seawall then erosion will lead to greater overtopping and greater risk of structural damage.

2. Increased water levels will tend to increase tidal flows through the harbour channels, leading to more prominent ebb deltas and greater nearshore wave refraction. Greater refraction at Pagham and Chichester Harbour entrances will enhance the drift separations at Pagham Estate and Eastoke, leading to increased local erosion.

3. Changes in wave directions, even by small amounts will lead to changes in the sediment budget. Decreasing potential drift due to more shore normal waves will lead to reduced erosion; conversely, increasing potential drift will lead to increased erosion. As many areas of the frontage have very low nett drift rates due to their orientation with the dominant wave direction, then a shift in offshore wave direction may cause a reversal in drift. Although different amounts and directions of shift will have different effects, it is possible to say that any changes, whether long or short term, will lead to important changes in the sediment budget.

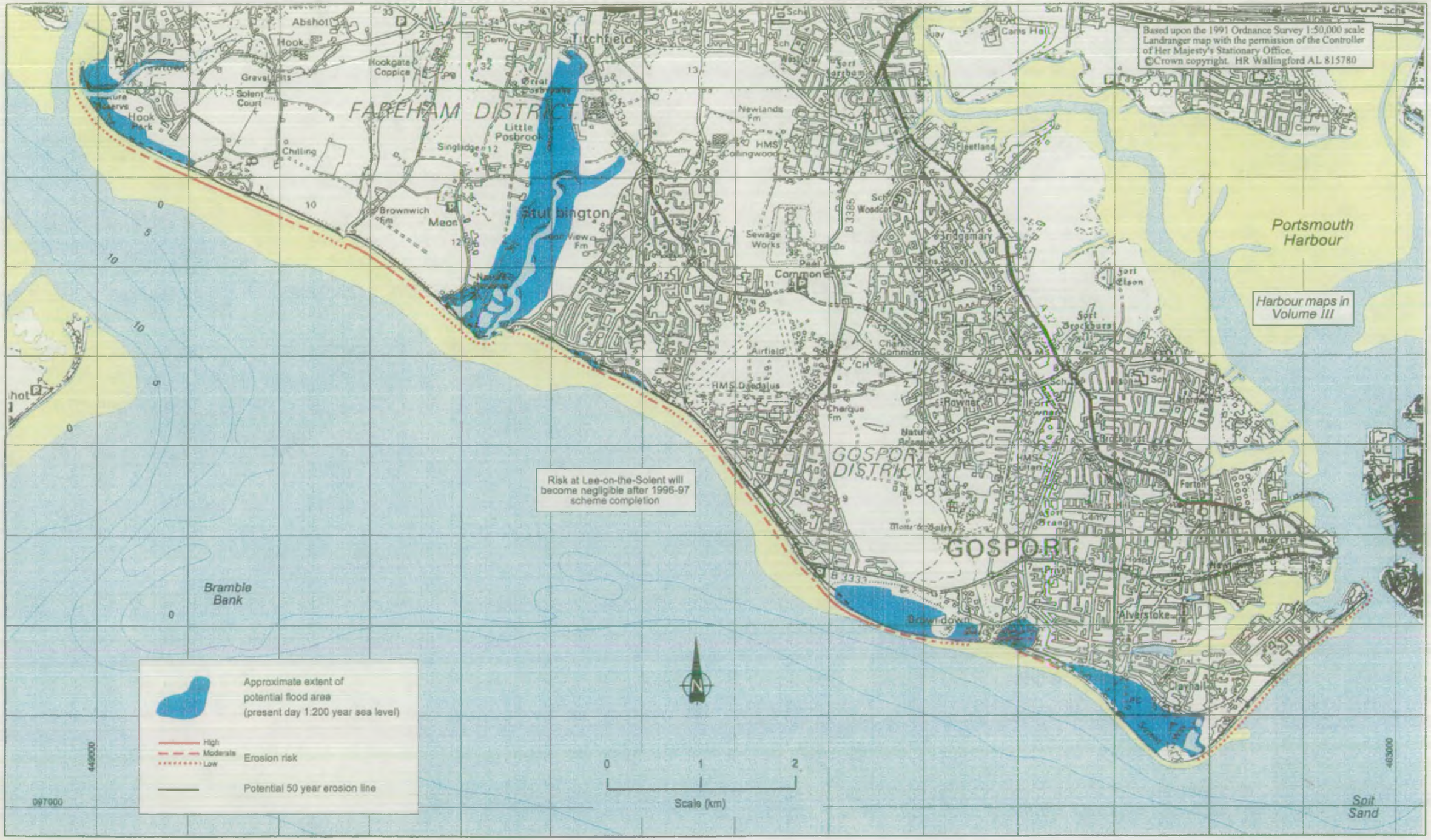


Flood and erosion risk - Pagham Harbour to East Head

Figure 13

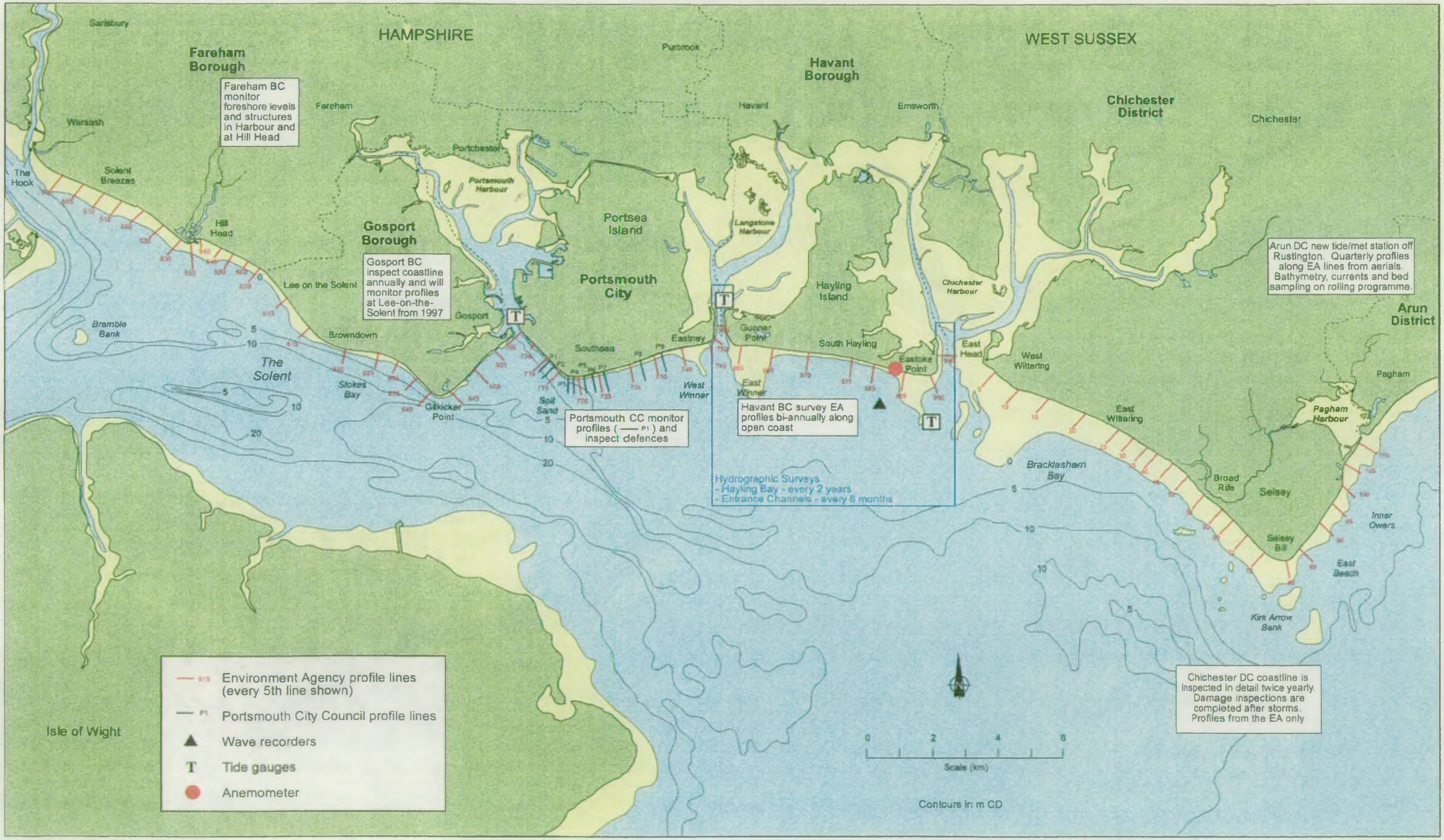
Flood and erosion risk - Hayling and Portsea Islands

Figure 14



Flood and erosion risk - Portsmouth Harbour entrance to River Hamble

Figure 15



Field monitoring sites

Figure 16

3.10 Existing monitoring programmes

A number of monitoring programmes are ongoing in the area and much of this information has been used in HR Wallingford (1995a&b):

- The Environment Agency undertake annual aerial surveys of the whole area within their south coast programme. Photogrammetry is used to produce profile plots, although the quality of the work has been questioned due to insufficient ground control in some areas.

- Tide levels are monitored at the Portsmouth Naval Dockyard and at the Langstone Harbourmaster's landing stage, by Havant Borough Council off Eastoke (since 1995) and by Arun DC at a new installation (1996) in the east of the area off Rustington.

- Wave measurements have been undertaken at a number of sites including the Owers Light Vessel (1968-69) and off Hayling Island (Whitcombe, 1995) but these programmes are not ongoing. Havant Borough Council have installed a pressure sensor to monitor waves off Hayling Island (1996).

- Wind data have been collected at a number of sites suitable for use in wave modelling, including Lee-on-the-Solent and Thorney Island. Havant BC established a permanent Met Station at Eastoke in 1994. Arun DC are collecting meteorological data at their new (1996) permanent installation to the east off Rustington.

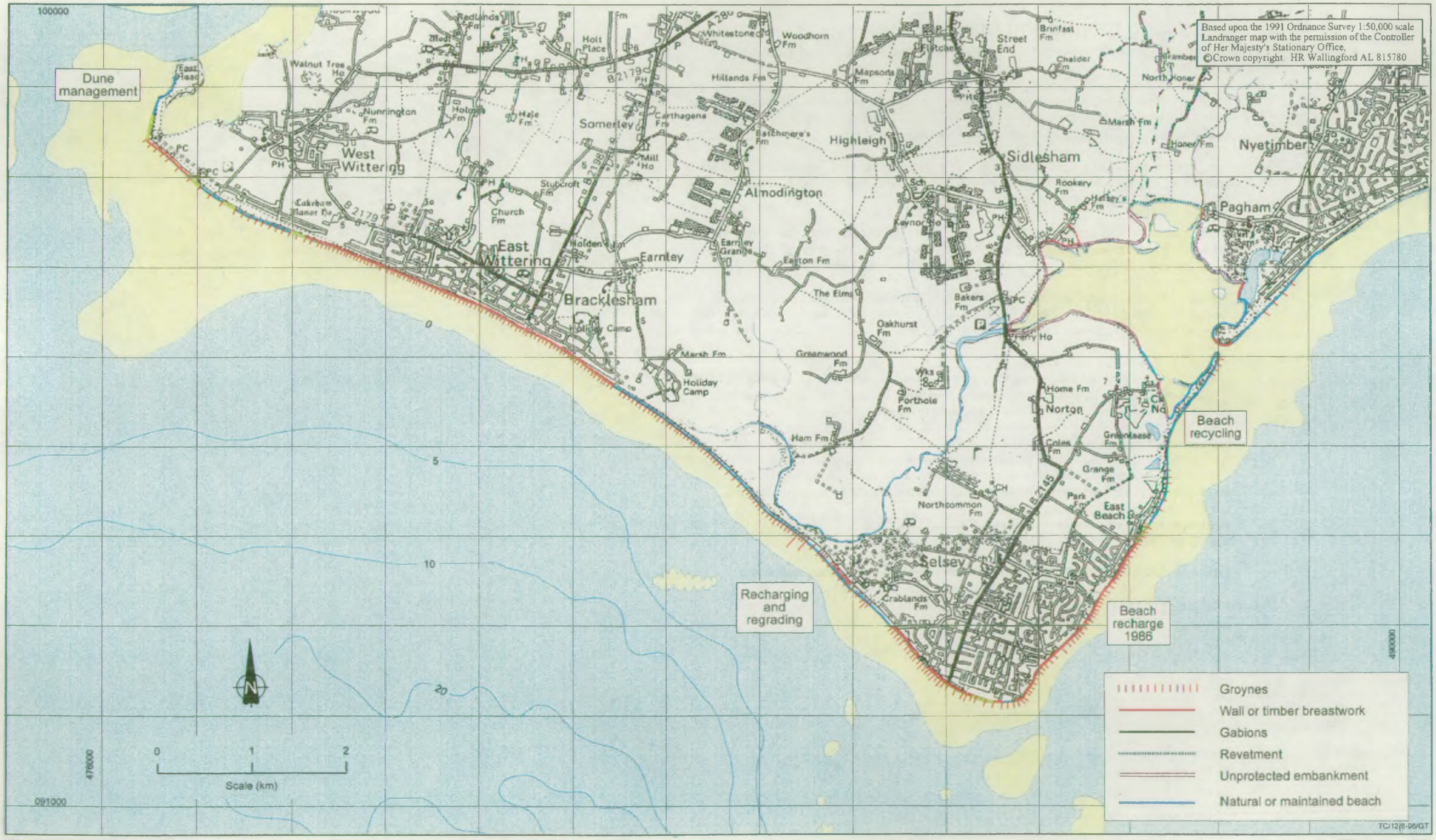
- Profile surveys have been undertaken along many parts of the shoreline for specific purposes and as part of coordinated, long term programmes. Portsmouth City, Havant Borough, Fareham Borough and Arun District Councils undertake regular surveys of their open beaches.

- Tidal currents have been measured at a number of sites by the Admiralty, HR Wallingford, Havant Borough Council and others. Coverage is good at the entrances to Chichester and Langstone and further south to the east of the Isle of Wight. No current meters have been deployed around Selsey. Float tracking has been undertaken around Selsey specifically for the TELEMAC model calibration.

- Bathymetric surveys are undertaken by Havant Borough Council and Arun District Council for beach management purposes, and by the harbour authorities for navigation purposes.

- Defence inspections are carried out at regular intervals by each of the Operating Authorities.

Figure 16 indicates the extent of the existing monitoring programmes.



Existing shoreline defences - Pagham Harbour to East Head **Figure 17**

4 Existing shoreline management

4.1 Introduction

A review of past shoreline management practice and the condition of existing structures provides important information for future management. Past schemes may have provided good service and may still have a considerable useful life. Alternatively they may have been unsatisfactory, either locally or due to their effect on adjacent frontages, or they may be nearing the end of their useful life and a new approach may be appropriate.

The following section outlines the existing defences and management practices. Information has been derived from site visits, consultations with the responsible authorities and a review of the MAFF Coast Protection Survey (MAFF, 1994), the NRA (Environment Agency) Sea Defence Survey (NRA, 1991) and various documents held by the Local Authorities. The site visits and consultations were particularly useful in providing an updated review of the present state of the shoreline and their likely residual life.

Appendix 2 presents information on each defence element, including location, length, maintaining authority, structure type, condition and residual life. This information is based on the MAFF and NRA surveys, updated during the SMP process. Figures 17, 18 and 19 summarize the extent of different defence types. For classification purposes within this SMP it should be noted that walls and timber breastworks are vertical, while revetments include all sloping structures whether concrete, timber or rock, except gabions. Complex structures including both vertical and sloped elements have been classified according to their dominant element. Unprotected embankments are earth banks raised above the hinterland level with no armouring on their seaward face. Regraded slopes are formerly eroding natural or reclaimed frontages that have been artificially graded and/or vegetated to improve the landscape or reduce possible safety hazards. Unprotected frontages have been left to respond naturally to coastal processes.

4.2 Review

Selsey Bill to Pagham Harbour

The foreshore north east from Selsey Bill comprises a steeply shelving shingle beach controlled by closely spaced timber groynes and backed by a concrete wall. At the north eastern end of the built up area of Selsey the concrete wall changes to a short length of timber breastwork and then gives way to a broad shingle backshore; the beach is controlled by widely spaced timber groynes and is fronted by the lower shingle foreshore of the Inner Owers. Further north accretion of shingle has created a wide foreland that extends into the Pagham Harbour Spit. The Spit itself is narrow and liable to breaching.

Selsey East Beach underwent very rapid erosion prior to construction of the present seawall and groyne system. The processes causing the erosion are still active, and although the groynes reduce the rate of transport there is still an ongoing problem of beach loss. Beach nourishment has been undertaken to make up for continuing losses and the groyne system has required extension and repair; ongoing maintenance is required to retain the existing situation. Most of the seawall remains in good condition, though some sections near the Lifeboat Station pier are in need of upgrading. Without a substantial beach the seawall would suffer overtopping and possible breaching, both leading to damage to property on the low lying backshore. A large area of public open space and residential development would be liable to flooding in the event of a breach or serious overtopping during an extreme storm.

Losses from East Beach feed the shoreline further north. Groynes are in generally good condition, except on the Spit to the south of the entrance to Pagham where they are too low to have much impact. Regular recycling of shingle (15,000 m^3/year) and regrading of the beach face is undertaken along the Spit to maintain an adequate defence against breaching. The Inner Owers bank provides fresh material to the beach and dissipates wave energy. Shingle reaching the end of the Spit enters the harbour channel and is transported seaward for later return to the shore, predominantly to the Pagham Estate beach north east of the entrance.

On the north side of the harbour entrance the wide shingle backshore has been partly developed and there is a strip of housing at Pagham Beach Estate. There is a local drift divide along the beach with a southerly drift of shingle towards the Harbour entrance and an eastward drift outside the influence of the Harbour; this divide has caused concern about beach erosion. Recently a number of rock groynes have been constructed across the lower foreshore recently to counteract this drift and related erosion but to date they have not had time to have any significant impact on shoreline development. Although the shingle beach along this frontage is very wide and the threat to properties arising from coastal recession is not serious at present, there is a need for continuing monitoring to determine the future trends.

Pagham Harbour is very sheltered by the spits at the entrance and only the shorelines of the lagoon embankment, the caravan site to the west Pagham village and along the northern flood embankment (Pagham Wall) are subject to any significant wave action. Elsewhere the flood banks are fairly rudimentary and fronted by upper saltmarsh. Some reclaimed land along the course of the dismantled railway on the east side of the harbour is prone to erosion, though the worst area around an existing sluice has been protected by riprap. Land levels around Ferry House and between Sidlesham and Pagham are very low. In the event of the spits at the entrance becoming breached much of the shoreline would be at risk of erosion and failure of flood banks could take place. Figure 13 shows the extent of the very large potential flood area.

A particular management concern relating to Pagham Harbour is the need to improve storm water drainage from Chichester. The Environment Agency's favoured option is to route the storm water through Pagham Rife to the harbour via a sluiceway in the north shoreline. This approach will require a commitment to the long term maintenance of the existing revetment, in an area where managed retreat might be considered as an option.

Selsey Bill to East Head

The shoreline immediately west of Selsey Bill is protected only by the beach and erosion is ongoing due to exposure to waves and strong tidal currents. This area receives natural feed from the nearshore Kirk Arrow Bank and is offered some wave protection by submerged scarps of limestone further south. Further west from the Bill there are a variety of seawalls protecting higher ground. These include near derelict concrete walls, gabions, stepped walls, some with rock aprons, vertical walls and sloped concrete revetments. Despite being heavily groyned the beach reduces towards the west, becoming only a narrow strip exposed at low tide and providing little protection to the wall. Posford Duvivier (1992) reviewed the defences in this area.

West of Selsey a short section of shoreline is unprotected and erosion of the low cliffs of unconsolidated sands and gravel (Brickearth and Raised Beach deposits) is ongoing. Groynes resume further west where they are intended to stabilize a long shingle ridge fronting low lying land liable to extensive flooding. The ridge is retreating and was recharged with 225,000m^3 of shingle in 1975-80. It is now maintained by occasional smaller recharges, and a continual recycling and regrading operation. The groynes are generally in disrepair despite an ongoing maintenance programme, and they provide little interruption to drift.

Overtopping and breaching of the ridge have occurred on a number of occasions, with consequent flooding of the caravan park built on the low lying land behind. Future risks will increase as the underlying clay stratum is exposed on the lower foreshore and is undergoing slow erosion, resulting in increased wave attack to the ridge.

The Broad Rife outfall, near the centre of the shingle ridge, provides a substantial barrier to drift. The shingle ridge around the outfall has been artificially held in place and now acts as a focus for wave energy. Renourishment and regrading operations are most active along the ridge adjacent to the outfall due to the high risk of overtopping and breaching in this area.

Existing shoreline defences - Hayling and Portsea Islands **Figure 18**

At Bracklesham the backshore ground rises above flood level, and the shoreline is defined by concrete walls interspersed with sections of timber breastwork. Future risks will increase as the beach is of variable width and responds unpredictably to variations in the annual wave climate and intermittent feed from the east. Groynes and seawalls are generally in fair condition, apart from sections of private wall at the western end of East Wittering where houses are close to the wall crest and are liable to overtopping damage. Maintenance work is required to retain the present standards of protection including extensions to the footings.

Beyond East Wittering the shoreline is mainly protected by a groyned shingle beach, with sections of timber breastwork revetment. Several groyne compartments are severely depleted of shingle resulting in recent gabion work to prevent erosion of the low cliffs and dunes. Toward the Hinge there is a near continuous timber breastwork. Beach levels are maintained by intermittent recharges. The lower beach fluctuates due to shifting sand bars dominated by tidal currents. Long groynes provide partial barriers to transport, but suffer from scour channels and holes around their seaward ends.

Gabions have been placed at the Hinge to prevent a breach separating East Head, but erosion may continue further along the neck. Shingle levels are low, but sand accretion has occurred along East Head, encouraged by active dune management by the National Trust who manage the area.

Hayling Island

Defences along the Eastoke frontage comprise a concrete seawall fronted by a recharged shingle beach and timber groynes. At Eastoke Point the wall gives way to a shingle ridge, protected by a rock revetment placed as Temporary Emergency Works in 1992 to prevent flooding due to rapid erosion. Rock has also been placed to support or replace existing timber groynes in an attempt to stabilize the beach and protect Sandy Point nature reserve. Existing plans to extend the rock revetment and groynes will be implemented in two phases between 1998 and 2002. Further northwards along the Chichester Harbour entrance channel a shingle beach fronts sections of timber or concrete walls. Groynes, gabions and seawalls of varying condition and effectiveness protect the spit running north to Sandy Point.

The recharge, placed in 1985, has had a mixed impact on the shoreline. Much of the initial volume has been redistributed east and west. The rock groynes at Eastoke Point were placed in 1990 to control losses into the Chichester Harbour entrance channel and a recycle programme has been initiated to bring material from accreting areas on the central Hayling frontage back to eroding areas, particularly after severe storms. The Eastoke frontage continues to be unstable despite these works, and a comprehensive scheme is needed to stabilize this area. The Chichester Approach Channel has been identified as a possible source of future recharge material. Maintenance dredging in 1988 removed 20,000m^3, and a further dredging operation is needed to reestablish the published safe navigation depth of -1.5m CD (the material is high quality coarse sand and shingle and ideal for purposes of beach nourishment).

The central Hayling frontage is an area of accretion, although parts of the timber breastwork west of the Eastoke seawall that were formerly covered by the recharge are now exposed and are undergoing repair. Similarly, the breastwork west of the "Inn on the Beach" is exposed and has required repair, though the frontage has generally benefitted from the recharge at Eastoke.

Gunner Point is an area of historic accretion although there has been some recent erosion. The area is a possible source of recycle material for Eastoke, though environmental constraints may prohibit its use.

The shoreline of the Langstone Harbour entrance channel is protected by short sections of seawall, block groynes and gabions. The seawalls and groynes are in poor condition. Further north the jetties and wharves at Langstone Ferry are in reasonable condition. Slow moving waves of shingle move up the channel from Gunner Point; troughs between the waves are areas of erosion.

Portsea Island

Eastney Point is presently an area of shingle accretion. A seawall runs along the backshore but is no longer within the active beach zone except along the south side of Fort Cumberland. Shingle is transported north along the Langstone Harbour entrance channel, but the beach deteriorates towards the ferry landing. Gabions and groynes have been used to protect Eastney Spit, but are in generally poor condition.

The main Eastney frontage is also an area of substantial shingle accretion although overtopping and localized flooding has occurred west of Fort Cumberland during storms. The backshore seawall comes into the active beach zone about 500m east of South Parade Pier, where the beach narrows and overtopping occurs more often. Available data suggests that beach levels have been stable, and that drift rates are low.

West of the Pier the beach continues to narrow up to the promontory formed by Southsea Castle, around which there is no upper beach. The wall around the promontory is in reasonable condition. Recurved crests and blockwork aprons have been added to reduce overtopping and toe scour.

From Southsea Castle to Clarence Pier there is a substantial shingle beach fronting the promenade. The beach suffers storm draw down and has been recharged recently with about 1000m^3 per year. Clarence Pier acts as a permeable groyne, causing accretion to the east and cut back to the west.

From the Pier to Portsmouth Harbour entrance the beach is generally only present below mid-tide, and the shoreline is protected by a variety of walls and revetments, some of which were intended as military, rather than coastal defences. The fortifications are of historical importance and date back to as early as 1415. All of the walls have undergone some repair work and most sections are in need of further work to retain their standard of service. Wave overtopping occurs at several points during extreme storms, leading to some flooding of the Old Portsmouth area. Flooding also occurs due to ground water levels during surge conditions being higher than ground levels.

Accumulations of shingle inside the harbour entrance and at several points along the section of walls provide some protection to the walls against wave action, but equally serve to abrade them when storm waves hurl the shingle against the stone faces. Defences in this area are discussed in detail in Portsmouth (1991).

Aggregate dredging of up to 250,000m^3 per year occurs to the southeast. Although this area is considered to be a sediment sink it may be prudent to review the impact of removing so much material from such a complex sediment transport regime.

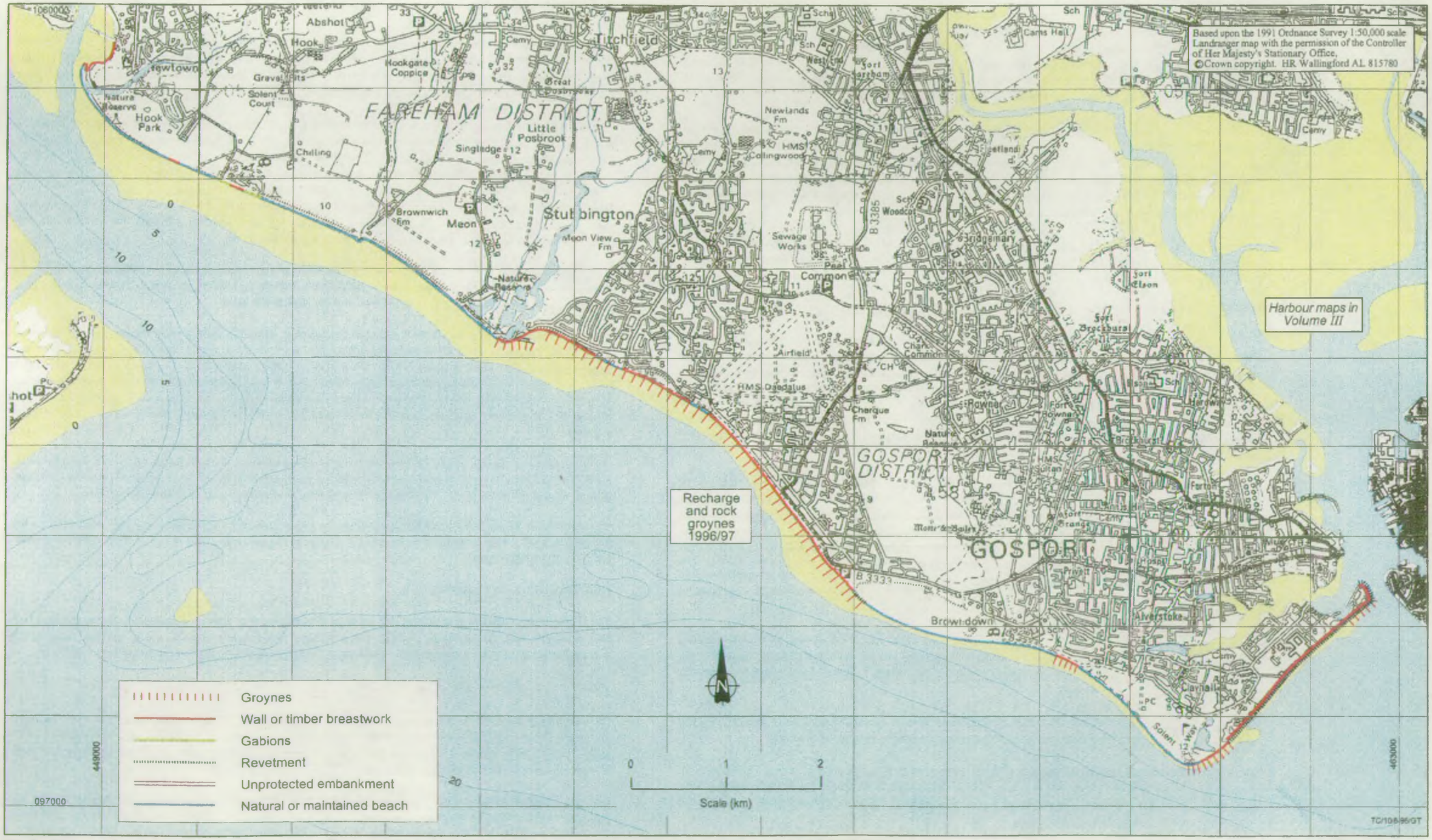
Gilkicker Point to Portsmouth Harbour

The Haslar seawall extends over most of this frontage. The sloping wall is built of masonry and concrete and has had extensive footings added to prevent undermining. The beach along the toe is narrow, with small accumulations around the short groynes. Ongoing maintenance is required to retain the present condition.

Gilkicker Point to Lee-on-the-Solent

From Gilkicker Point east to the Haslar seawall the steep shingle beach is groyned to retain the limited supply of shingle passing eastwards around the Point. The backshore is protected by a short section of seawall built along a narrow bank To landward is a low lying area of high environmental value. Overtopping of this frontage occurs, but has not caused significant damage.

Between Gilkicker Point and the short stretch of seawall several kilometres to the west where the coastal road impinges on the backshore, the wide plateau of low lying land is fronted by a substantial shingle beach. The area has no formal coastal defences, and the growth of vegetation on the backshore indicates that the area is unlikely



Existing shoreline defences - Portsmouth Harbour entrance to River Hamble **Figure 19**

to be affected by overtopping under present day climatic conditions. A promenade extends westwards from the Gosport and Fareham Inshore Rescue Station, but does not form part of the coastal defences.

In the centre of Stokes Bay the coast road meets the shoreline and is protected by a concrete seawall. This area has been protected since the latter part of the nineteenth century and due to the indented nature of the coastline here, continues to be a point which is sensitive to intermittent erosion and wave attack. Several timber groynes are found in front of the seawall, but these are generally well covered with shingle and do not seriously interrupt the eastwards littoral drift. Further recession of the beach line at this point will increase the severity of wave attack and overtopping. The risk of flooding of the hinterland is not serious, with housing being well landwards of the coast road and situated on slightly higher ground.

The outfall of the River Alver via a sluice has created a significant barrier to the eastward littoral drift. A small delta of shingle banks extends over the lower foreshore. The reduction of drift may be contributing to the erosion of the coast road seawall to the east, and the accreting shingle is causing a problem for land drainage through the sluice.

The firing ranges of Browndown occupy the frontage from the River Alver to Lee-on-the-Solent. The area is historically one of substantial shingle accretion indicated by a series of shore parallel shingle ridges. However, the construction of sea defences at Lee-on-the-Solent in the late 1950's initiated a phase of erosion to the east. The western extremity of Browndown Ranges has been groyned since the mid 1960's and more recently the shingle crest has been reinforced by the addition of concrete rubble to reduce local erosion. Both the backshore protection and the timber groyne field require considerable maintenance to fulfil their protective role. The 1996/97 recharge and groyne works at Lee-on-the-Solent will affect the future of this frontage.

Lee-on-the-Solent to Hill Head Harbour

This length of coastline comprises low cliffs with occasional low lying areas. The higher ground is heavily developed and the shoreline is defended by seawalls, timber breastwork and groynes. Several large outfalls and a slipway interrupt drift, causing beach widths to vary.

Prior to coast protection works, the cliffs which extend over virtually the whole of the Lee-on-the-Solent frontage, were eroding and producing a substantial supply of material to the beach zone. This, together with material from further west provided a plentiful supply to the downdrift frontage. The cliffs have subsequently been regraded and by 1959 the whole of the frontage was protected by a promenade/seawall. The frontage has been extensively groyned, but the volume of shingle on the upper beach has been decreasing. The lower beach and nearshore zone have also suffered erosion, resulting in a narrowing of the intertidal area and a reduction in natural wave energy dissipation.

These conditions have caused Gosport Borough Council to undertake extensive maintenance work along the shoreline. As of 1997, the Council have implemented a shingle beach recharge and groyne scheme that will reduce their maintenance commitment. Downdrift monitoring will be required to determine the impact on the Browndown foreshore.

North from Lee-on-the-Solent the shingle beach is generally healthy, partly due to the drift barrier formed by the HMS Daedalus slipway. The groynes and seawalls are in a good condition.

Several large outfalls control the drift to the south of Hill Head, causing areas of updrift accretion and downdrift but back. The area is believed to benefit from feed from a nearshore shingle bar, but this may be an intermittent process.

The Hill Head frontage suffers from a deterioration in beach levels despite being groyned, and the backshore defences are fragmentary. Low lying properties are at risk from flooding if the beach erodes further. At the north

end of Hill Head the shoreline is backed by a seawall protecting cliffs that previously suffered rapid erosion. The beach continues to be narrow, and is fed intermittently by shingle bypassing the entrance to Hill Head harbour.

Hill Head harbour to the River Hamble

Low lying land within Titchfield Haven is protected by a seawall and a wide shingle beach forming a spit along the south western side of Hill Head Harbour. Immediately east of the harbour an area of reclaimed foreshore is protected by a sheet steel piled wall which is occasionally subject to wave overtopping. In general, however, the level of protection is high, with seawall protection at the rear of the shingle beach. The beach levels are relatively stable, having a supply of shingle from the west. West of the harbour, the beach provides a high level of backshore protection to the beach houses, with shingle being supplied by the erosion of the cliffs further to the west.

The coastline to the west undergoes a rapid change in character. Cliffs of sandy clays are topped by a thick bank of gravel deposits which extend westwards to Solent Breezes. The coastline here is unprotected and erosion of these cliffs provides a significant amount of beach building material. The accumulation of sand and shingle is sufficiently large to provide a considerable level of protection to the cliffs along part of this frontage. Littoral drift appears to be low since the rate of accretion immediately west of Hill Head Harbour is only moderate.

Further north towards Solent Breezes the frontage is directly exposed to the longest wave generation fetch within the Solent. As a result the cliffs are undergoing more rapid erosion here than elsewhere, though drift rates are still low. The Solent Breezes holiday camp, several private houses and the National Grid tunnel to Fawley Power Station are the only developments along this frontage. Due to erosion of the adjacent cliffs, the gabion defences constructed for the holiday camp have formed a promontory. It is situated on a sediment drift divide, with material eroded from the cliffs to the southeast feeding the shoreline towards Hill Head and Stokes Bay while the erosion to the northwest feeds Hook Spit at the mouth of the River Hamble. Cliff erosion north of Solent Breezes has placed the National Grid tunnel under severe threat of flooding.

Hook Spit extends into the mouth of the River Hamble and encloses a large and environmentally important area of marsh. The marshes drain into Hook Lake. The shingle spit is unprotected and is vulnerable to breaching if the drift from the southeast is reduced or the beach is draw down by storm waves.

Hook Spit forms the natural end of the East Solent area, but its presence has an impact on the shoreline of the River Hamble estuary up to Warsash. This area receives little coarse sediment and has only a narrow beach. The shoreline up to Warsash pier is defined by timber and masonry walls subject to some overtopping despite the lack of waves of any size. Under extreme water level conditions these walls could suffer severe overtopping with consequent flooding of public and private land.

Beyond Warsash pier there is a stretch of low cliffs suffering very minor erosion. This natural shoreline gives way to the low revetments and walls around the Warsash frontage. The shoreline road and car park are subject to regular flooding, but damage is minimal.

East Head GCRS

Chichester Harbour SSSI (Also SPA and Ramsar Site)

West Wittering Beach SNCI

Solent Maritime proposed SAC Landward boundary is high water line, including Langstone and Chichester Harbours

Bracklesham Bay SSSI, GCRS (seaward boundary is the mean low water line)

Bracklesham Balls mSNCI

Pagham Harbour SSSI, GCRS (Also SPA and RAMSAR) LNR (WSCC)

Bognor Reef SSSI, GCRS

Inner Mulberry Harbour Unit mSNCI

Pagham Harbour GCRS (seaward boundary is the mean low water line)

Earnley GCRS

Crablands Farm Meadow SNCI

Selsey GCRS

East Selsey Beach SSSI, GCRS

West Wittering
East Wittering
Somerley
Almodington
Earnley
Bracklesham
Highleigh
Sidlesham
Nyetimber
Pagham
Norton
Selsey

- Sites of Special Scientific Interest
- Special Protection Area and Ramsar Site
- Local / National Nature Reserve
- Countryside Heritage Sites
- Geological Conservation Review Site
- Sites of Nature Conservation Interest
- WSCC West Sussex County Council

N

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Scale (km)

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TC/17/5-96/3T

Designated conservation areas - Pagham Harbour to East Head **Figure 20**

5 The natural environment

5.1 Introduction

The East Solent shoreline has a very high environmental value as demonstrated by the extensive areas designated for protection (Figures 20, 21 and 22). Although much of the environmental interest centres on the bird life and coastal habitats within the harbours, the open coast also has considerable importance including a number of sites of geological interest.

Shoreline management must take account of this environmental value and the significance of any proposed management operations on the environment must be understood. The area of potential impact is not restricted to any particular coastal zone - coastal operations may have a very limited impact, or may affect the environment at a considerable distance from the shoreline (e.g. changes to land drainage).

The present day environment is the result of many factors and processes, some relict and some on-going. Evolution of the environment occurs over a variety of time scales and the existing situation must be seen as transient rather than fixed. Appreciation of the transient nature of the environment is important to the SMP for two reasons:

- change to the shoreline may be beneficial as well as detrimental, and should not necessarily be resisted
- assessment of environmental impact must be based on existing trends for change as well as on present day conditions.

The following sections discuss environmental issues within different parts of the Plan area. Much of the information presented is derived from the Pagham Harbour to River Hamble study (HR Wallingford 1995a & b). That work is supplemented by further literature reviews, site visits and consultation with interested groups.

Within the East Solent there are many areas of high biological and geological value. This natural richness is reflected in the range of designations awarded to the sites. Table 6 lists and defines the designations and states whether they are of local, national, European or international importance. Further information, including exact boundaries, on each of the sites of national or international importance can be obtained from the citations prepared by English Nature.

5.2 Designated nature conservation areas

Pagham Harbour

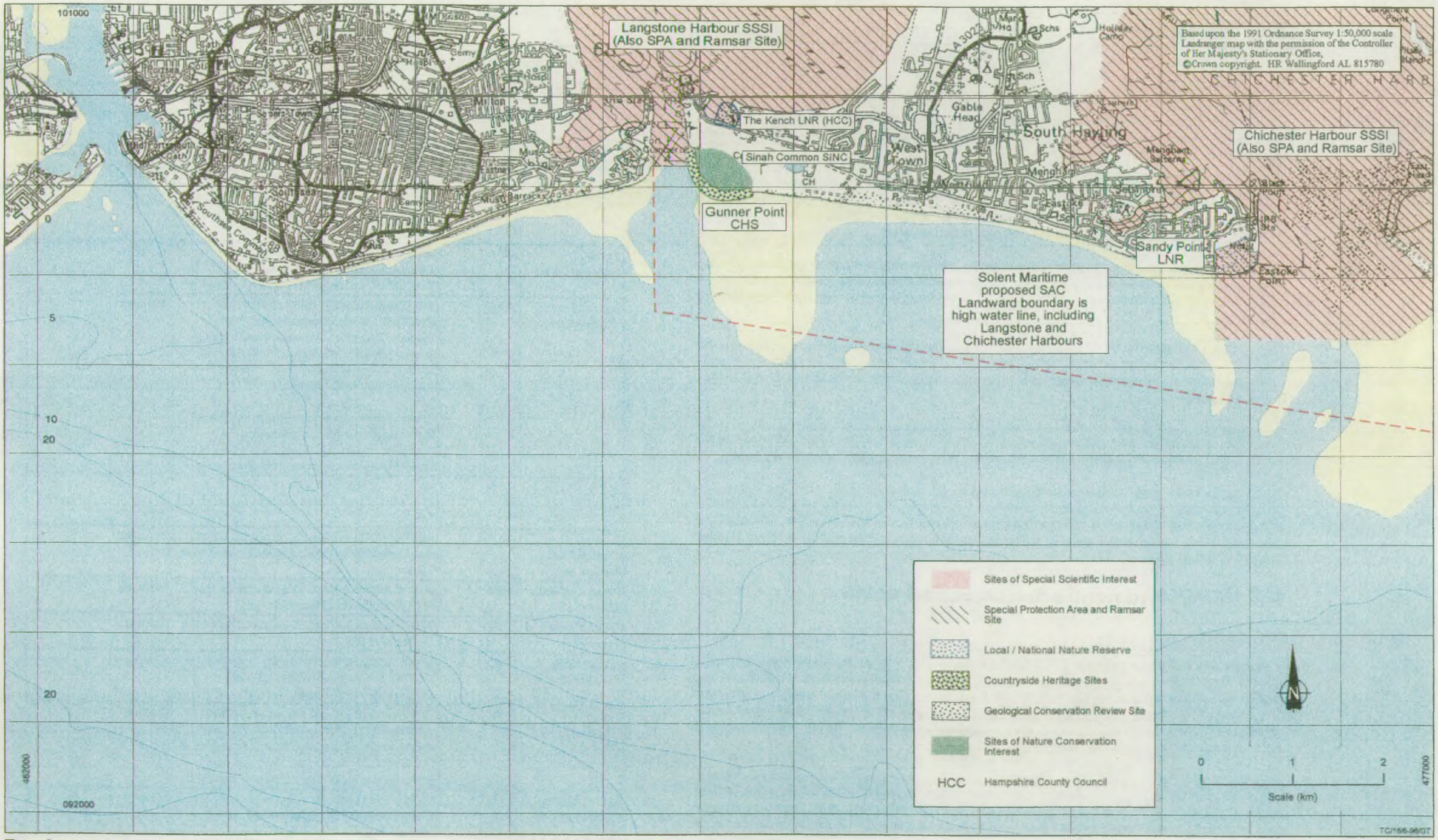
Pagham Harbour is designated as an SSSI, CGRS, SPA and Ramsar site. West Sussex County Council (WSCC) manages the harbour and some outlying areas as an LNR. The area comprises extensive saltmarsh and tidal mudflats with a variety of surrounding habitats including shingle banks, open water, reed swamp and permanent wet grassland. The Harbour is of national importance for wintering wildfowl and wading birds and also for breeding birds both within the Harbour and on the surrounding grazing pasture. The site supports nationally important communities of plants and invertebrates,

In geological terms Pagham Harbour is a key site for coastal geomorphology both for the possession of classic shingle spit landforms and for the links that have been demonstrated between the coastal nearshore and offshore forms and sediments. The site is also of outstanding palaeobotanical interest due to the presence at its north eastern end of an area which yields abundant plant fossils from the London Clay. Indeed, two genera and some thirty species have only been found here.

Running north east from Pagham Harbour, the Bognor Reef SSSI is a long stretch of foreshore of great geological interest. The site includes an extensive area of rare vegetated shingle foreland and a small area of old sand dune with an interesting flora. Offshore of Pagham Harbour is the Mulberry Harbour marine SNCI, of interest for historic reasons and for its artificial reef communities.

Table 6 Definition of site designations

Designation	Acronym	Definition	Level of Importance
Ramsar Site	none	Wetland site recognised for its international importance for nature conservation especially as Waterfowl Habitat. Designated under The Ramsar Convention on Wetlands of International Importance".	International
Special Protection Area	SPA	Internationally important area for birds. Designated under 'Council directive 79/409/EEC on the conservation of wild birds'.	European
Special Area of Conservation	SAC	Site designated under 'Council Directive 92/43/EEC', more commonly called the 'Habitats Directive'. The sites are selected to conserve natural habitats and wild flora and fauna of European importance. The aim is to sustain European biodiversity. Potential sites are currently being considered. The final list must be agreed by the Government with the EC. by June 1998 and by June 2004 all these sites must be designated.	European
Site of Special Scientific Interest	SSSI	An area of recognised scientific value in terms of its flora, fauna, geology or physiographical features.	National
Geological Conservation Review Site	GCRS	An SSSI site of geological interest which has been identified by the Geological Conservation Review.	National
National Nature Reserve	NNR	Area of natural interest designated under the 1981 Wildlife and Countryside Act.	National
Local Nature Reserve	LNR	Area of natural interest. Designated under the Countryside Act.	County.
Countryside Heritage Site	CHS	County designation (Hampshire only) with no attached statutory protection. Includes archaeological and natural interests.	County
Site of Importance for Nature Conservation	SINC	CHS's are currently undergoing a change of name to SINC. The name change is being conducted on a District to District basis. As yet, most of the sites in the SMP study area retain their original name. Equivalent to SNCI.	County
Site of Nature Conservation Interest	SNCI	County designation, usually designated because of wildlife value. No attached statutory protection. Equivalent to SINC.	County



Designated conservation areas - Hayling and Portsea Islands **Figure 21**

Selsey East Beach to East Head

Selsey East Beach SSSI (designated for its geological interest and hence also a GCRS) has exposed sequences of freshwater and estuarine sediments of Ipswichian Interglacial Age that are a unique source of vertebrate fossils.

Bracklesham Bay is of significant biological interest. Its designation as an SSSI also reflects high geological importance and for this reason it is also a GCRS. The exposed clays on the beach were deposited in shallow seas 45 million years ago and contain fossilised shells and plants. Younger rocks of about 1.5 million years BP are exposed at the southern end of the Bracklesham Bay SSSI and are a unique source of vertebrate fossils.

Crablands Farm Meadow SNCI is a low lying area of wet grassland and scattered scrub located just inland of the eastern extremity of Bracklesham Bay SSSI. It is of general botanical interest and an important site for breeding, wintering and migrant birds.

West Wittering Beach SNCI is located just to the east of Chichester Harbour mouth. It comprises a small area of vegetated sand and shingle which supports a number of uncommon and notable species. Immediately to the east of this site the Bracklesham Bay SSSI extends along the length of the shore as far as Selsey. This site consists of a long stretch of coast with a variety of habitats including a small area of salt marsh, shingle bank, rifes (wide flowing ditches) and associated reed beds and some rough unimproved pastures subject to seasonal flooding. In terms of size and wildlife interest the pastures are the most important habitat as they represent a relict habitat type now scarce within the county due to the impact of agricultural activity.

East Head, Eastoke Point and the entrance to Chichester Harbour all fall within the Chichester Harbour SSSI, SPA and Ramsar site. East Head is a National Trust holding with a sand dune and shingle system of geomorphological interest and is designated as a GCRS.

Offshore of Bracklesham is the Bracklesham Balls marine SNCI of interest for the unusual spherical and hemispherical boulders found there.

Hayling Island

Sandy Point LNR on Hayling Island is considered to be the best example of vegetated sand and shingle in Hampshire and also contains brackish water habitats. It is managed by Hampshire County Council (HCC) and is to be designated as a LNR.

Gunner Point CHS is located at the west end of Hayling Island. It is the most extensive sand-dune system in Hampshire comprising both dune grasslands and un-vegetated sand and shingle. In addition, it possesses substantial geomorphological interest exhibiting a number of unusual coastal landform features. Immediately adjacent to Gunner Point are the scrubland dunes of Sinah Common LNR, managed by the Hampshire and Isle of Wight Wildlife Trust. Gunner Point and Sinah Common contain sufficient interest to qualify as an SSSI. The Kench LNR is within the small embayment on the Hayling Island shore and is managed by HCC.

Langstone Harbour entrance channel is part of the Langstone Harbour SSSI, SPA and Ramsar site

Portsea Island

There are no designated conservation sites along the south coast of Portsea Island, although there is an area of invertebrate interest along the Fort Cumberland shingle beach frontage.

Portsmouth Harbour to River Hamble

Gilkicker Point is an extensive area of natural coastal landform and vegetation, and includes Gilkicker Fort. The site includes open shingle communities, closed grassland of several types and brackish pools. It is rich in plants and invertebrates and is designated as a CHS. The area qualifies for consideration as an SSSI.

Gilkicker Lagoon is an SSSI which lies within the Gilkicker Point CHS. It is a saline lagoon, a rare habitat in Britain, supporting a specialised flora and fauna including five nationally rare invertebrates and one nationally rare charophyte. Indeed one of the invertebrates, the starlet sea anemone is the only British marine invertebrate to be included in the relevant International Union for the Conservation of Nature and Natural Resources, Red Data Book (IUCN, 1993) which documents rare and endangered species.

Browndown SSSI is an extensive shingle foreland comprising of a sequence of shingle ridges which support three principal plant communities. The first of these, a scrub community of gorse, oak, bramble and rose is widespread, but the ling/heather/dwarf gorse/lichen community is probably not found elsewhere in lowland Britain. Several rare plants are found within the site which also possesses a rich invertebrate fauna including a range of species specialised to this habitat and, therefore, rare in southern England.

The foreshore is of local significance biologically in supporting extensive populations of eelgrass and American hard-shelled clam in the sandy and muddy/gravelly substrate respectively.

The stretch of coastal frontage running from Lee-on-the Solent to the lower estuary of the River Hamble is part of the Lee-on-the-Solent to Itchen Estuary SSSI. This SSSI extends from the beach head to the mean low water mark, with the exception of Hook Links, Hook Lake, Bunny Meadows and Hamble Common, which extend further inland. Collectively the area contains a wide range of habitats including intertidal marshes, vegetated shingle, saltmarsh, reedbeds, fen meadows and marshy grassland. These support a varied range of flora and fauna, some of which is now highly restricted in distribution in England. The area as a whole also contains vital pre-migratory feeding grounds for some species of wetland birds and it is of considerable ornithological importance. The cliffs north of Hill Head provide important exposures of terrace gravel of the former Solent river system, contributing significantly to the understanding of the geomorphological processes in the area. In palaentological terms, the first British bird fossils of the Mid-Eocene age were found at the Lee-on-The-Solent site. The site is also especially rich in fossil fish remains, including sharks, rays, chimaeroids and teleosts.

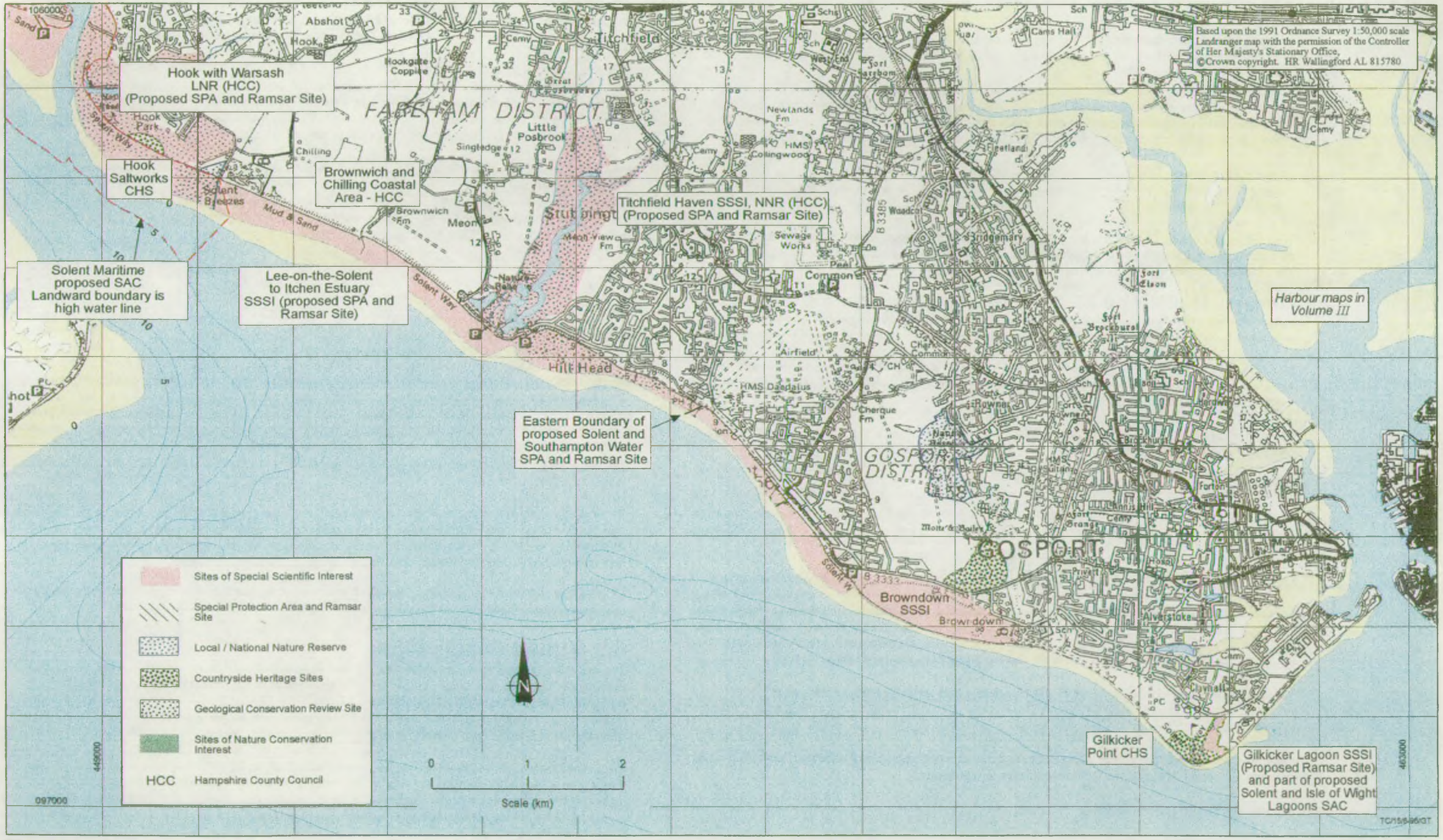
Titchfield Haven SSSI is a freshwater wetland which flanks the lower reaches of the River Meon. The wetland contains a variety of habitat types including, the river, reed beds, unimproved meadows, patches of fen, drainage ditches and pools. It is an important area for surface feeding ducks and also supports a breeding community of wetland birds such as Reed and Sedge Warblers. Titchfield Haven is also designated as an NNR.

HCC manage much of the shoreline from the River Meon to the River Hamble. Their control over this frontage ensures that no unsuitable development will occur.

5.3 Future designations

The abundance of sites subject to various environmental designations provides ample testimony to the region's conservation significance and value to wildlife. The significance of the area in conservation terms has been recognised in proposals to designate various parts as a Ramsar site, SPA, and SAC. These are shown on Figures 20, 21 and 22. In addition, there are a number of sites of importance that are under review for SSSI status; as these are still at an early stage of the designation process they have not been indicated on the maps.

The proposed Solent and Southampton Water Ramsar site extends along the West Solent coast up to Lee-on-the-Solent, plus an area at Gilkicker Point. This area qualifies under several criteria of the Ramsar Convention in terms of the range of habitat types, the significance of the flora and invertebrate fauna assemblage and its ability to regularly support internationally important numbers of waterfowl both in terms of numbers of specific species and total numbers of individuals.



Designated conservation areas - Portsmouth Harbour entrance to River Hamble **Figure 22**

The proposed SPA also extends along the West Solent coast up to Lee-on-the-Solent. The site qualifies by supporting nationally important breeding populations of several tern species internationally important numbers of Brent Geese and Blacktailed Godwit and by regularly supporting over 20,000 waterfowl in winter.

Two areas, Solent and Isle of Wight Lagoons and Solent Maritime, are currently being considered for designation as SAC because they contain habitat types and/or species which are rare or threatened within a European context. Within the SMP area the proposed Solent Maritime SAC is separated into a western component along the Fareham coast from Solent Breezes to the River Hamble, and an eastern component from Langstone Harbour to Chichester Harbour. Gilkicker Lagoon is included in the proposed Solent and Isle of Wight Lagoons SAC.

5.4 Responsibilities and restrictions due to conservation designations

Official conservation designations assigned to the harbours have implications for SMP. SSSIs, SPAs and SACs have statutory protection. An overview of the legislation relating to these sites and the relevant restrictions are given below.

SSSI, NNR and LNR

Designation as an SSSI is accompanied by a standard list of 'potentially damaging operations', which usually include operations such as the 'erection of sea defences' and the 'undertaking of engineering works'. Owners or occupiers must not carry out potentially damaging operations (or permit them to be carried out) on an SSSI without giving written notice of the proposed operation to English Nature. Works may only legally proceed if written consent is obtained, or the operations comply with a management agreement previously drawn up with the nature conservation agency, or four months have elapsed since written notice was given. Otherwise, a criminal offence is committed if a 'potentially damaging operation' is carried without reasonable excuse. The Wildlife and Countryside Act states that there is a reasonable excuse if the operation is an emergency one (provided that the nature conservation agency is notified as soon as practicable) or is one for which planning permission has been granted.

If English Nature seriously objects to the proposals and the objections cannot be resolved by negotiation within the four month period, English Nature may apply to the Secretary of State for the Environment for a Nature Conservation Order. Nature conservation orders are comparatively rare, and their main effect is to extend the period of delay to a maximum of 12 months, so that the nature conservation agency has more time to negotiate a management agreement or to consider compulsory purchase.

Planning authorities must consult English Nature about applications both within an SSSI or operations outside the SSSI which may have a significant impact.

European Sites (SPA/SAC)

Legislation to implement EC Habitats Directive 1992 has been introduced in the United Kingdom by the Conservation (Natural Habitats, &c) Regulations 1994, SI 1994/2716. This regulation covers both SPAs and SACs, which are collectively termed 'European Sites'. Planning authorities have to follow a set procedure when considering proposals for development on European Sites. Developments include coast protection works and new flood protection works. This procedure is summarised in the flow chart in PPG9.

The regulation stipulates that any proposed scheme likely to have a significant effect on a European Site should be appropriately assessed to determine its impact on the conservation objectives. The competent authority may agree to the plan if the integrity of the site is not jeopardized. If the assessment indicates negative impacts but the competent authorities decide that scheme should go ahead due to overriding public interest, compensatory measures must be taken to ensure that the overall value of Natura 2000 (the European habitat network of SPAs and SACs) is protected. The European Commission should be informed of the compensatory measures adopted.

Where the site concerned hosts a priority natural habitat and/or priority species listed in the Annexes to the Directive, the only considerations which may be raised are those relating to human health or public safety, or to beneficial consequences of primary importance for the environment.

Permitted development rights under the Town and Country Planning (General Permitted Development) Order 1995, such as the Environment Agency for flood protection works, may not be exercised if they are likely to have a significant effect on a European Site unless they have been approved by the local Planning Authority. The Planning Authority has the power to grant permission for the works but it must consult English Nature for its opinion and consider their view when making the final decision.

At present SACs are in the nomination stage. Part of the open coastline, along the south of Hayling Island and within the Solent form part of a nominated site called Solent Maritime. The Government advises in Planning Policy Guidance PPG9, *Nature Conservation*, that proposed SAC's should be protected as a matter of policy in the same way as designated sites.

Environmental assessment to support planning application

Under EC directive 85/337/EEC coastal and flood defence works must be subject to an environmental assessment if they are likely to have a significant effect on the environment. If the works require planning permission or are within a European Site (SAC or SPA) the Local Planning Authority decides whether an environmental assessment is necessary.

5.5 Implications for shoreline management

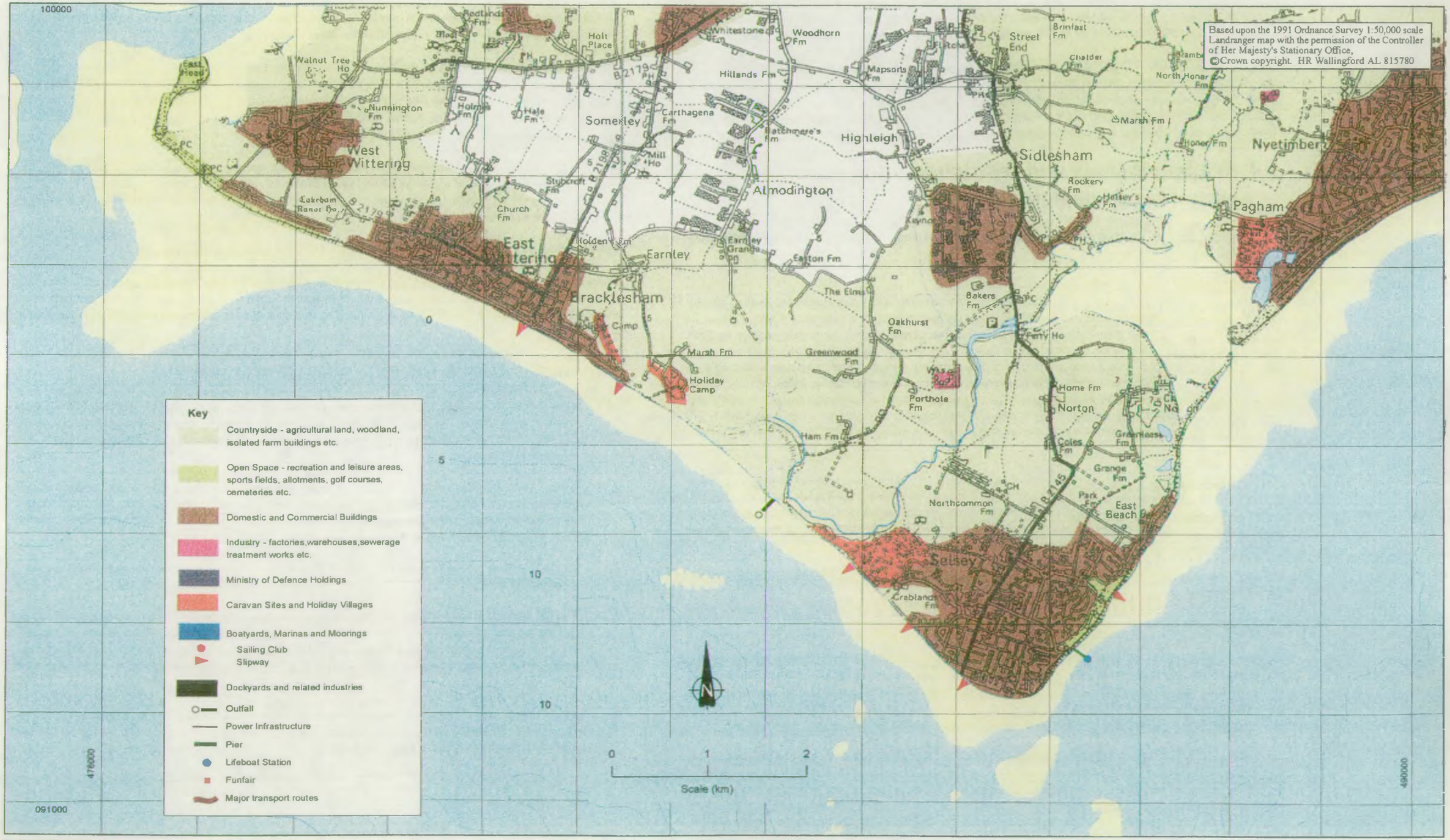
1. Significant lengths of the open coastline are of national and international nature conservation value. New coastal defence structures and improvements to existing defences may only be acceptable if there is an overriding public interest that can be shown to justify the potential impact on habitats or geological features. European designated sites also require that compensatory measures are taken for any significant habitat loss or damage.

2. Where new defences or improvements to existing defences are required it is important that full consideration is given to nature and geological conservation in the concept, planning, design, implementation and maintenance stages. There should be a general policy not to disrupt natural coastal processes except where life or important man-made or natural assets are at risk.

3. Coastal defence strategies should be compatible with the relevant management plans for designated conservation areas.

4. The EC Habitats Directive 1992 requires that European sites (SPAs and SACs) are managed to ensure that the habitats and species for which they were designated are safeguarded. There is therefore a need for a strategic approach to shoreline management which makes advance provision for habitats and communities to migrate as the shoreline evolves (e.g. conducting managed retreat to replace saltmarsh which has been eroded).

5. English Nature should be consulted at the outset of any proposal for shoreline management operations to determine whether the operation are likely to cause environmental damage and to determine whether alternative approaches may be more acceptable.



Land use - Pagham Harbour to East Head

Figure 23

Table 8 (continued)

General Description	Fareham BC	Gosport BC	Portsmouth City C	Havant BC	Chichester DC	Arun DC
Disposal of Ministry of Defence land	Policy for re-use of HMS Daedalus not yet confirmed	Development of sites surplus to requirements will need to comply with relevant plan policies and proposals (Policy MOD2)			The reuse of buildings and land for civilian use on Thorney Island will only be permitted for uses that are compatible with conservation interests. This would preclude the use of the airfield for aviation and noisy sports (Proposal C8)	
Public utilities			The following sites are allocated for Southern Water Services Ltd: • Fort Cumberland - underground treatment works • former MEME depot adjacent to Eastney Pumping Station for underground storm water storage (Proposal C34)	Land allocated at Kingscroft Farm as an extension to Portsmouth Water plc's site (Proposal PUS1; also Consult. Draft Chapt US)		
Nature conservation*	Development will not be permitted which destroys or harms: • SPAs • Ramsar sites • SSSIs • Nature Reserves • SINC (Proposal EN9)	Development will only be permitted which will not have an adverse effect on, or be detrimental to: • SPAs • Ramsar sites • SSSIs • National or Local Nature Reserves • Areas of significant nature conservation value (Policies NC1 and NC2)	Development which adversely affects nature conservation interest of: • Nature Reserves • SSSIs • iand of ecological importance will only be permitted in exceptional circumstances (Proposal E3)	Development will only be permitted where it would not destroy or adversely affect sites of importance to nature conservation, including: • SSSIs, SPAs and Ramsar sites • CHS • Other specified sites of importance • woodland areas of importance (Policies C19-C27; also Consult. Draft Chapt CO)	Permission for development will be refused if it would damage, destroy or adversely affect: • Ramsar sites • SPAs (declared or potential) • Candidate SAC • SSSI • Nature Reserves • other feature important to nature or geological conservation Where particularly sensitive ecological sites are threatened active steps will be taken to protect them (Proposals RE7 and RE8)	Development not normally permitted which would have an adverse effect either directly or indirectly on designated/statutory sites of nature conservation importance, including SSSIs, Ramsar Sites, SPA and other areas e.g. SNCIs (Policy RE5)

* PPG 9 and the Habitats Regulations published in 1994 have implications for development control in nature conservation sites that are near to designation. These implications are not included in plans adopted prior to 1994.

Table 8 (continued)

General Description	Fareham BC	Gosport BC	Portsmouth City C	Havant BC	Chichester DC	Arun DC
Public Open Space	Existing and new areas of public open space (Proposals L2, L3)	Existing and allocated areas for public open space, recreation and leisure facilities (Policies RL2, RL2, RL6-RL9)	New and existing public and other open spaces (Proposals OS1, OS2, OS5, OS6)	Development will not normally be permitted which adversely affects existing public open space etc. (Proposal RL1; also Consult. Draft Chapter RLC)	Existing recreational open space will be protected from unrelated development (Proposal R3; see also R1, R2, R4-R8)	The Council will protect open spaces from development (Policy ROS 1). Land is allocated for open space and recreation/leisure uses (Policy ROS 5)
Caravans	No additional camping and caravanning development will be allowed where it would be visible from the River Hamble or the Solent Way (Proposal L11)	Residential caravans or mobile homes will not be permitted except at the Bay House site (Policy H13)		Permission will not normally be granted for the expansion of static holiday caravan sites or for the creation of new sites except at Eastoke. Touring caravan site development not normally permitted (Proposals TO7-14; also Consult. Draft Proposal T0.7)	Planning permissions subject to occupancy restrictions. In flood risk areas occupancy restricted to specified time periods (Proposal T6) The change of use from touring holiday caravan sites to static caravan sites will not be permitted (Proposal T9)	Planning permission will not be given to new and unrelated incursions into the countryside, although proposals for expansion of existing sites will be considered (Policy TSM 6). Static holiday caravan sites will not be permitted in the Strategic Gaps (Policy TSM 7)
Coastal Paths	Footpaths and bridleways will be improved. Proposed footpaths include the Porchester Coastal Footpath, around Cams to the Delme Roundabout (Proposal L5, see also C8)	The Council will prepare a programme of footpath provision, including coastal footpaths (Statement RL9)		Permission will not normally be granted for development which is inconsistent with the objective of a complete coastal footpath around Hayling Island (Proposal RL6) A combined footpath link and cycle track proposed between Harts Farm Way, Havant and Portsea Island (Proposal RL8; also Consult. Draft Proposal T9)	Sea and coast defence works must make provision for the coastal path, either on the seawall or within the 5m access strips (Proposal C12)	The Council supports the protection of the public rights of way network (Policy ROS 10). Proposals for development o the coast will need to establish or improve public access on foot or cycle (Policy CT 4)
Land reclamation		Development including land reclamation and/or dredging will not normally be permitted except at: • N. of Mumby Road • Ferry Gardens (Policy CH5)	In Portsmouth Harbour reclamation and/or dredging is proposed at: • Rotten Row Lake • Tipner Lake • Albert Johnson Quay and Flathouse Quay • Adjoining Gunwharf and Harbour Station (Policy E12) In Langstone Harbour, reclamation that is inconsistent with wildlife designations will not be permitted (Policy EL14)	Development which entails significant reclamation of the Harbour or other than essential maintenance dredging of the main channels and adjoining slipways will not normally be permitted (Proposal RL20 & 23; also Consult. Draft Proposal CO6)	Proposals involving land reclamation or dredging (except essential maintenance dredging) will be refused where they would affect conservation interests (Proposal C4)	

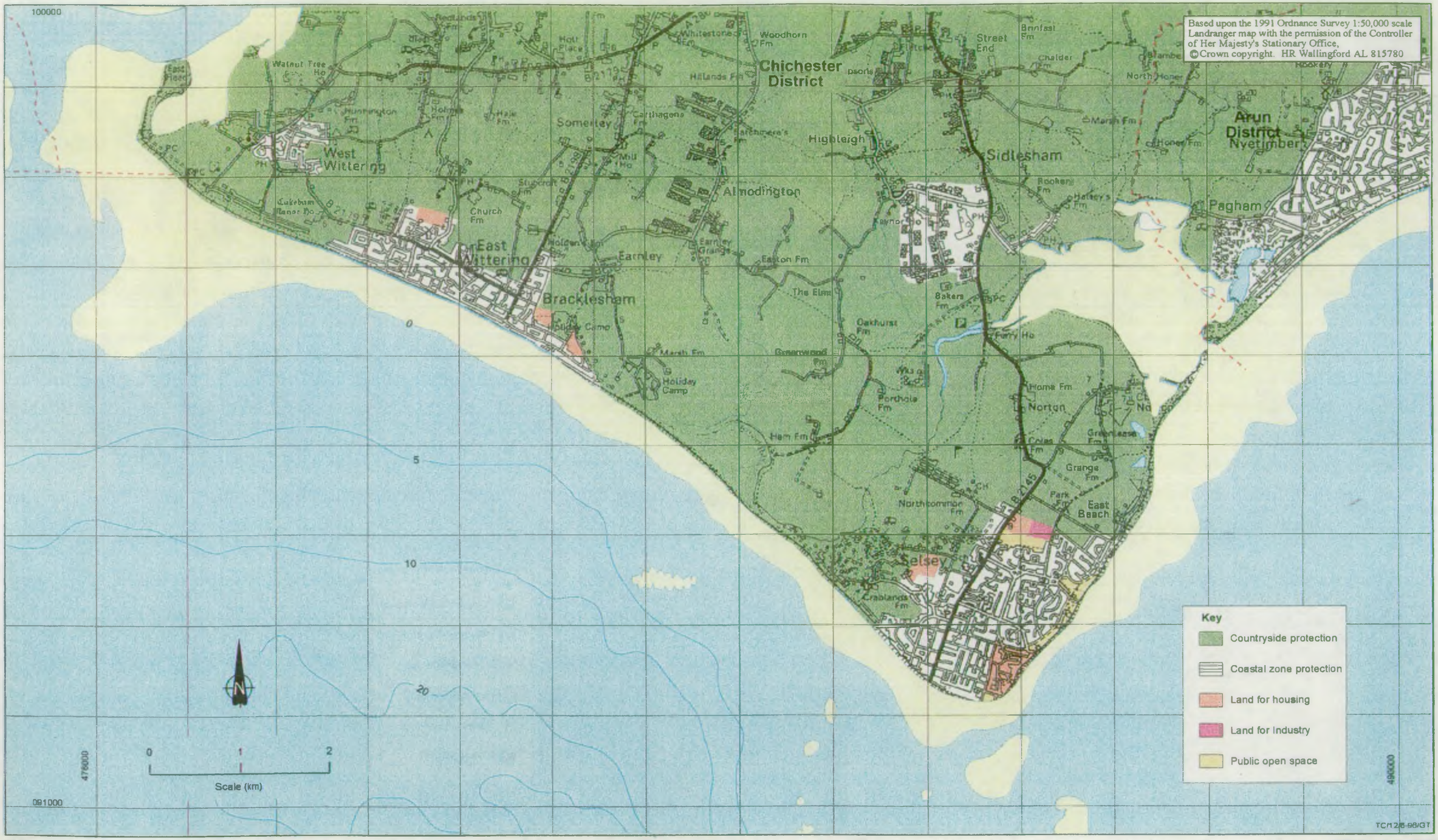
Table 8 A summary of relevant planning policies for the East Solent (see relevant local plans for details)

General Description	Fareham BC	Gosport BC	Portsmouth City C	Havant BC	Chichester DC	Arun DC
Countryside Protection	Development restricted to that which would not harm the landscape and is essential to the rural economy (Proposal C1) Development not normally permitted in Local Gaps between Fareham & Portchester and Strategic Gaps east of Stubbington (Proposals C2 and C3)	Development restricted in the Stubbington - Gosport Strategic Gap (Policy CY1)		Development permitted only if essential to needs of the rural economy (including agriculture, horticulture and forestry) and in other specified exceptions (Proposals C1-12: also Consult. Draft Chapt. C) Development restricted in Strategic Gaps and in other "Countryside" areas (Proposals C13-17: also Consult. Draft Chapt. C)	Development will not normally be permitted within the rural area, except for specific uses (Proposals RE1 - RE28) Development restricted in the Strategic Gaps between Chichester and Emsworth, West Wittering and East Wittering, Bracklesham and Selsey, Selsey and Pagham (Proposal RE6)	The countryside will be safeguarded for its own sake. Development only allowed if it is essential for agriculture, forestry, mineral extraction, waste disposal, informal recreation or appropriate diversification (Policy RE1). Development not permitted in the Pagham-Selsey Strategic Gap (Policy GEN 5)
Coastal Zone	Development will not normally be permitted in the coastal zone (Proposal C7)	Development not normally permitted in the coastal zone policy area (Policy CH9)	Development will not be permitted unless it would not significantly affect recreation, landscape or nature conservation (Proposal E9)	Development prejudicial to landscape and ecology of coastal zones not normally permitted (Proposals C19-24; also Consult Draft Chapt. C0) Development of south and south-west Hayling not normally permissible except for appropriate recreational use not harmful to the landscape character (Proposals RL19-21)	Development which detracts from the open aspect or rural character of the Harbour will not normally be permitted (Proposal C1)	Permission will not normally be granted for new tourism development along the coast (Policy CT 5)
Control of Boatyards, Marinas and Moorings	Development will not normally be permitted for an extension of boatyard use beyond the defined curtilages. New boatyards and marinas not permitted (Proposal C9)	Development proposals will be normally permitted for additional moorings etc. within established marina and mooring areas (Policy CH7)	Additional moorings normally only permitted in established locations provided there are no impacts on navigation, nature conservation, landscape, fishing, etc. (Proposals LC11, LC12)	Limited new moorings permitted in established locations or designated new areas (Proposal RL 22). A site at Broadmarsh is proposed for improved access and sailing facilities (Proposal RL 23, Consult Draft Proposal CO7) In Chichester Harbour development which would reduce the size of mooring free areas or increase the total number of deep water berths will not normally be permitted (Proposal RL 24)	Development which would result in an increase to the total number of moorings, marina berths or launch on demand facilities in the Harbour will not normally be permitted (Proposal C5; see also C6 and C7)	
Land for Housing	Land allocated for new housing (Proposals H1, H2, H9, L4)	Land allocated for new housing and major residential development (Policies H1-H3, H13)	Land allocated for residential development (Proposal H1)	Land allocated for new residential development (one in the coastal zone; Proposals H01, H02; also Consult. Draft Chapter H)	Land allowed for new residential development (Proposals H1-H13)	Land allocated for housing (Policies HSG 2-5)
Land for Industry	Land allocated for new business and industrial areas (B1, B5, B7)	Existing industrial areas (Policy EMP 4) and land allocated for business development (Policies EMP2, EMP3)	Land allocated for comprehensive development (Proposals GS2, GS3)	Land allocated for industry (Proposal ECD1 & 2; also Consult. Draft Chapter IN)	Land allocated for business, industry and warehousing (Proposal B1)	Land allocated for industry and employment (Policy EMP 1)

Planning policies and land allocations - Portsmouth Harbour entrance to River Hamble

Figure 30

Planning policies and land allocations - Hayling and Portsea Islands **Figure 29**



Planning policies and land allocations - Pagham Harbour to East Head **Figure 28**

6.4 Implications for shoreline management

1. The close proximity of built up areas to the foreshore (e.g. Selsey, East Wittering, Eastoke, Old Portsmouth) has led to frequent property damage due to the harsh marine environment. Effective coastal defences are necessary to ensure the secure future of these areas. However, the presence of private development adjacent to the foreshore has led to significant access problems for the operating authorities and hindered effective maintenance and repair works.

2. The importance of tourism and informal recreation to the local economy dictates that it is essential that easy public access to the foreshore is maintained, although not necessarily by car.

3. There are lengths of the undeveloped coastline where it may be economically unacceptable to provide publicly funded coastal defences.

4. There will be a need to protect existing public utilities on the coast, most notably the National Grid transmission cable site at Solent Breezes and the Eastney sewerage treatment works.

5. On the undeveloped coast it is likely that stretches of recreational footpaths will continue to be lost due to marine erosion (e.g. on the south west Fareham coast). As it is desirable that these footpaths should remain on the coast, provision will need to be made to ensure that land is available for their relocation, when necessary.

6. Historic structures along the shoreline need to be maintained without altering their appearance or character.

6.5 Future trends

Introduction

The planning system (as defined by the Town and Country Planning Act 1990) aims to regulate the future development and use of land (including mineral extraction and waste disposal) in the public interest. Planning powers are exercised by local planning authorities whose most important functions are:

- the preparation of statutory development plans
- the control of development, through the determination of planning applications and enforcement actions.

The planning system can be described as "plan led" in that all planning decisions must be made in accordance with the development plan, unless material considerations indicate otherwise. There is, in effect, a presumption in favour of development proposals that conform with the development plan which, thus, provides a strict framework for the future development of an area.

Development plans are prepared against a backdrop of national guidance in the form of Planning Policy Guidance notes (PPGs), Minerals Planning Guidance notes (MPGs); and regional planning guidance. The government therefore provides the policy framework within which the different types of development plan are prepared by planning authorities.

All statutory plans are subject to public consultation and public inquiry prior to being adopted.

The area covered by the East Solent SMP is administered by the following authorities:

- Fareham Borough Council
- Gosport Borough Council
- Portsmouth City Council

- Havant Borough Council
- Chichester District Council
- Arun District Council.
- Hampshire County Council
- West Sussex County Council.

The administrative area of these authorities, and hence the limit of their control, ends at mean low water mark, except within the harbours (which are included in the council areas). The Crown Estates own the land below mean high water along most of the open coast and must be consulted with regard to any management operations.

County Councils are responsible for the preparation of structure plans (in which they set out key strategic policies as a framework for local planning by the district councils), and minerals and waste plans. District councils prepare local plans (in which district councils set out detailed policies to guide development in their areas).

Prior to adoption, plans go through a series of revisions and consultation periods. Within this section the emerging plans have been afforded the most weight as these provide the future planning policy framework for the area.

The status of each of the plans (as of June 1996) is outlined below.

Plan	**Status**
Fareham Borough Local Plan	Consultation Draft
Gosport Borough Local Plan	Adopted
Portsmouth City Local Plan	Adopted
Havant Borough District Wide Local Plan	Consultation Draft
Chichester District Local Plan	Deposit Draft
Arun District Local Plan	Consultation Draft (replaces existing Adopted Plan)
Hampshire County Structure Plan	Deposit Draft
West Sussex County Structure Plan	Deposit Draft (Inspector's Report received)
Hampshire Minerals and Waste Local Plan	Deposit Draft
West Sussex Minerals Local Plan	Consultation Draft

Unitary local government is being introduced in some areas of England under the Local Government Act 1992. Of the councils within the East Solent SMP area only Portsmouth City Council is affected. Portsmouth City Council will become a unitary authority and thus inherit some of the County Council's functions.

Table 8 and the following sections provide a summary of the constraints to and opportunities for development within the open coast of the SMP area. They have been compiled selectively from the existing development plans and should not be read as a substitute for the relevant plans. Figures 28-30 set out the policy areas as they relate to the open coast.

Historic sites and landscape conservation areas

Figure 27

The nature of remains in the area span the following groups:

Upstanding Remains	built structures ranging from building to field boundaries
Earthworks	soil covered remains of any sort which can be seen as surface undulations at ground level
Buried features	soil covered remains which have no visible trace at ground level but may be visible by aerial photography
Artefact scatters	scatter of potsherds, flint tools, metal objects, coins, animal bones, worked stone, mortar, charcoal
Maritime sites	sites beyond low water mark including wreck sites or former occupation sites which have been inundated (the Roman quarry at Mixon Reef off Selsey, for example).

The key protective designation is scheduling as an Ancient Monument under the *Ancient Monument and Archaeological Areas Act 1979*. This relates to any building structure or other work above or below ground which appears to be of national importance because of its historic, architectural, traditional, artistic or archaeological interest. Once a monument is scheduled any development which may affect it requires the consent of the Secretaries of State. In this context, 'affects' means work, which would have the effect of demolishing, destroying, damaging, removing, repairing, altering, adding to, flooding or covering up the monument. Further site protection is provided through the planning system, with policy for landward archaeology set out in Planning Policy Guidance Note 16: *Archaeology and Planning*. This document outlines the importance of archaeological remains and the fact that they are a finite non-renewable resource.

Maritime sites are protected through measures in the *Protection of Wrecks Act (1973)*; *Ancient Monuments and Archaeological Areas Act (1979)*; the *Merchant Shipping Act (1984)*; and the *Protection of Military Remains Act (1986)*. There are, however, many areas which are of interest but not designated and the potential for important maritime archaeological sites is generally high around the natural harbours.

Conservation areas

Conservation areas are designated by the local authority under the Planning (Listed Buildings and Conservation Areas) Act 1990 to provide protection for historical features or buildings. In general, the protection is provided by stricter development control procedures, taking enforcement action, undertaking urgent works to preserve unoccupied buildings and providing for purchase notices. In other areas special attention needs to be paid to the desirability of preserving or enhancing the character and appearance of the area. Conservation areas relevant to the open coast are listed in Table 7

Table 7 Historic environment designations relevant to the open coast

Designation	
Conservation Areas	Pier Street Lee-on-the-Solent, Gosport Haslar Peninsular, Gosport Old Portsmouth, Portsmouth Sea Front, Southsea Eastney Barracks, Southsea High Street, Selsey
Scheduled Ancient Monuments	Motte and Bailey, Gosport Gilkicker Fort, Gosport Fort Monkton, Gosport No.5 Battery, Gosport Fort Blockhouse, Gosport No.2 Battery, Gosport Haslar Gun Boat Yard, Gosport Eastney Sewage Pumping Station, Portsmouth Fort Cumberland, Portsmouth WWII beach defences, Portsmouth Southsea Castle, Portsmouth Point Battery, Portsmouth Spitbank Fort, Portsmouth Horse Sand Fort, Portsmouth Eastney Forts, Portsmouth Long Curtain, Portsmouth Cakeham Manor, Chichester Ringworks at St Wilfreds Church, Chichester Becketts Barn, Arun

6.2 Nearshore activities

Fisheries - Fishing in inshore waters is controlled and managed by the Southern Sea Fisheries Committee (covering Hampshire, Dorset and the Isle of Wight) and the Sussex Sea Fisheries Committee, the jurisdiction of which includes coastal waters out to 3 nautical miles from coastal baselines. These committees enforce byelaws relating to fishing activity and the conservation of fish and shellfish stocks within their districts. At present there are no maps defining nearshore fisheries for the East Solent.

Much of the inshore fishing fleet is based within the harbours, although East Beach, Selsey owes much of its character to boats moored off the shore. The fleet tends to be involved in a range of activities at different times of the year: netting for bass and potting for crabs and lobsters in the summer, dredging for oysters and clams in the winter. The main species caught are cod, sole, bass, cuttlefish, plaice, bream, crabs and lobsters.

Dredging - Dredging within the East Solent includes aggregate extraction within areas licensed by the Crown Estates or within freehold sites, and navigation dredging within the entrance channels to the harbours. The only relevant aggregate extraction sites are shown in Figure 24.

The Review procedure for the Crown Estate site suggests that extraction from their licensed site has no influence on the East Solent shoreline but it may be prudent to review the situation in the light of more recent studies of sediment transport. Future licence applications will automatically consider these studies including the South Coast Seabed Mobility Study (HR Wallingford, 1993).

Navigation dredging in the Harbour entrance channels does have an impact on the shoreline as the channels and ebb tide deltas are part of the nearshore sediment pathway. The entrances to Portsmouth and Langstone are not dredged. Chichester Harbour Conservancy undertook a 20,000m³ maintenance dredge within their entrance channel in 1988 and further work is required in 1996 as the published safe navigation depth is no longer valid. The recycling of the spoil for use as recharge material should be encouraged.

Dredging for aggregate has also occurred at other sites which are controlled by freehold owners. The only nearshore site that has been dredged in recent years is the East Winner Bank off Hayling Island, but operations ceased in 1994. If the operators wish to resume dredging at this, or any other nearshore site, then impact assessments should be undertaken.

Minerals extraction

Oil and Gas Licences have been granted for the land and sea areas of the East Solent. A policy has been formulated for possible future developments (SCOPAC, 1986) to ensure that impacts on the environment, fisheries, the landscape and shipping are controlled. The major influences on shoreline management would be pipeline landfalls or the construction of offshore production islands. If such schemes are proposed in the future then they will need to be carefully assessed to ensure that their impacts are fully appreciated.

Recreation

The East Solent is a very popular water sports area. Dinghy sailors, sail boarders and canoeists make use of the various sailing club slipways and beach access areas along the open coast and within the harbour entrances. Yacht moorings are generally within the harbours and yachtsmen require free access through the entrance channels. Other nearshore recreational activities include diving on the various wrecks. Shoreline Management operations should not, if possible, detract from these activities.

6.3 Landscape conservation and historic sites

In addition to the designated areas of nature conservation discussed in Chapter 5, the East Solent area has a number of historic conservation areas, Scheduled Ancient Monuments and a large Area of Outstanding Natural Beauty. These are all indicated in Figure 27. The Scheduled Ancient Monuments relevant to the open coast are listed in Table 7.

Landscape conservation

The open coastline around East Head and Sandy Point lies within the Chichester Harbour Area of Outstanding Natural Beauty (AONB), designated in 1964 under the National Parks and Access to the Countryside Act 1949. The AONB is valued for the close proximity of low lying land and tidal waters. The Chichester Harbour Conservancy functions as the Joint Advisory Committee for matters affecting the "amenity area" of the AONB and has a consultative role within the land use planning system (Section 6). The local authorities have specific obligations to protect and enhance the landscape through their planning and other responsibilities. The AONB boundaries are shown in Figure 27.

Heritage and archaeology

The history of human occupation on the stretch of coast from Pagham Harbour to the River Hamble is long and varied. The archaeological and historical interest includes places of worship, defence installations, burial grounds, farms, fields and sites of manufacture. The significance of the area as a trading port is reflected in the large number of shipwreck sites and landward infrastructure associated with shipping. This heritage is in need of conservation and protection.

Figure 27 presents the distribution of record land and marine archaeological sites. This has been compiled from the Hampshire County Council's Sites and Monument Record (SMR), the West Sussex County Council's SMR, and data on maritime sites provided by Isle of Wight Council's Archaeological Unit.

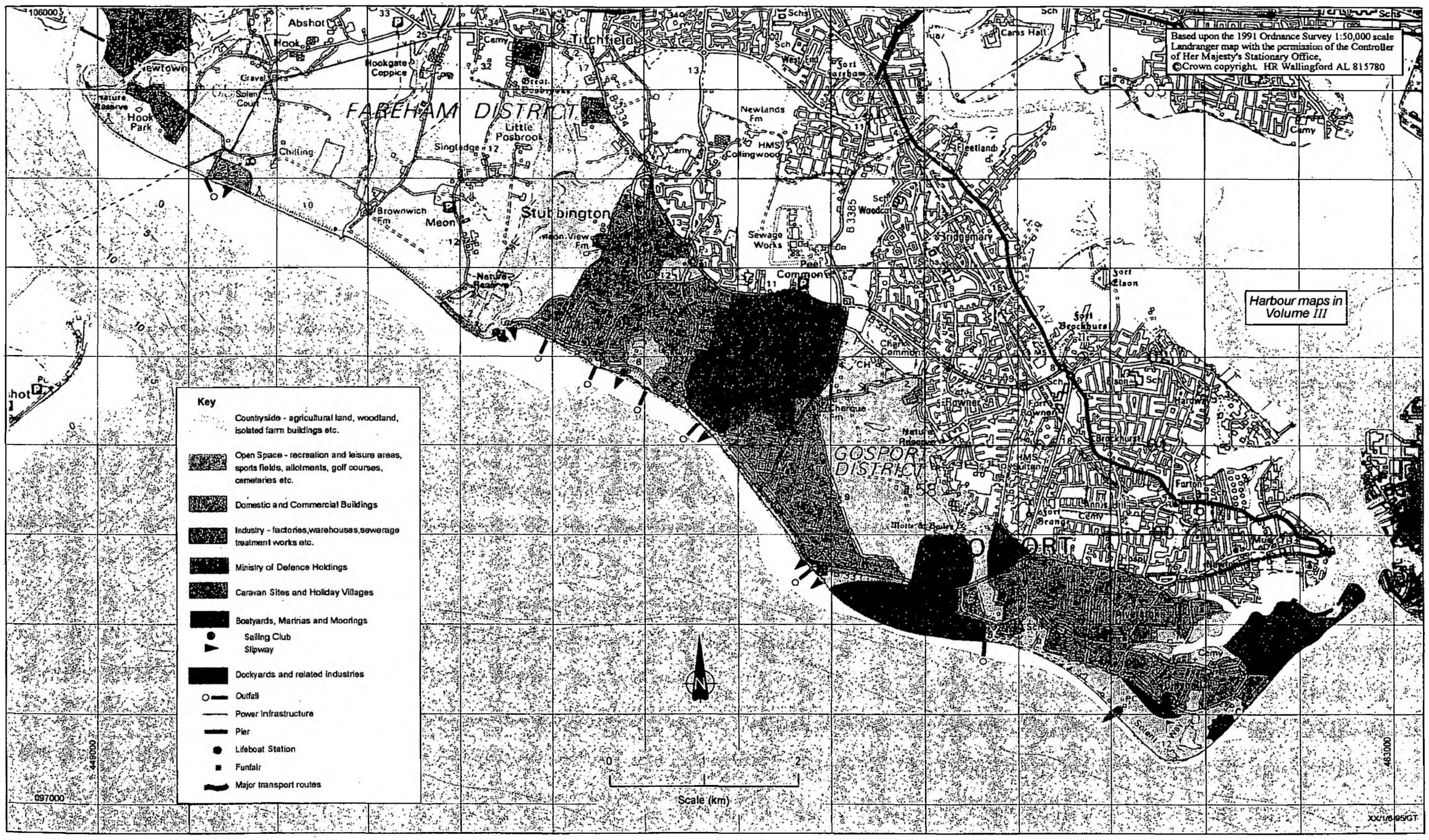
The SMRs predominantly contain information on landward sites but some information on maritime sites is included on the West Sussex SMR. The SMRs contain information on in-situ remains and details of find sites. Therefore, not all the sites mapped represent existing remains, some are simply find sites. Much of the information on maritime sites is anecdotal, particularly that relating to wrecks, and therefore the exact locations are not known. Further work on identifying, mapping and classifying sites is needed to ensure the survival of this heritage.

The varied history of the East Solent area is reflected in the nature of the archaeological finds and sites:

Prehistoric	(i.e. before the Roman invasion of AD43) ranging from the remains of palaeolithic people dating from around half a million years ago, to the farmsteads, villages and hillforts of the late Iron Age.
Roman	(i.e. AD43 to AD410) including remains of farms, settlements and military installations.
Medieval	(i.e. 5th to 16th centuries) the period during which most modern towns originated.
Post-Medieval	(i.e. late 16th to early 18th centuries) remains of industrial scale manufacture, country houses etc.
Industrial	(i.e. mid-18th century onwards) remains of the industrialisation of the UK, not only of the buildings and processes but also the infrastructure of industry - including, of particular relevance to the area in question, artifacts from World War II.

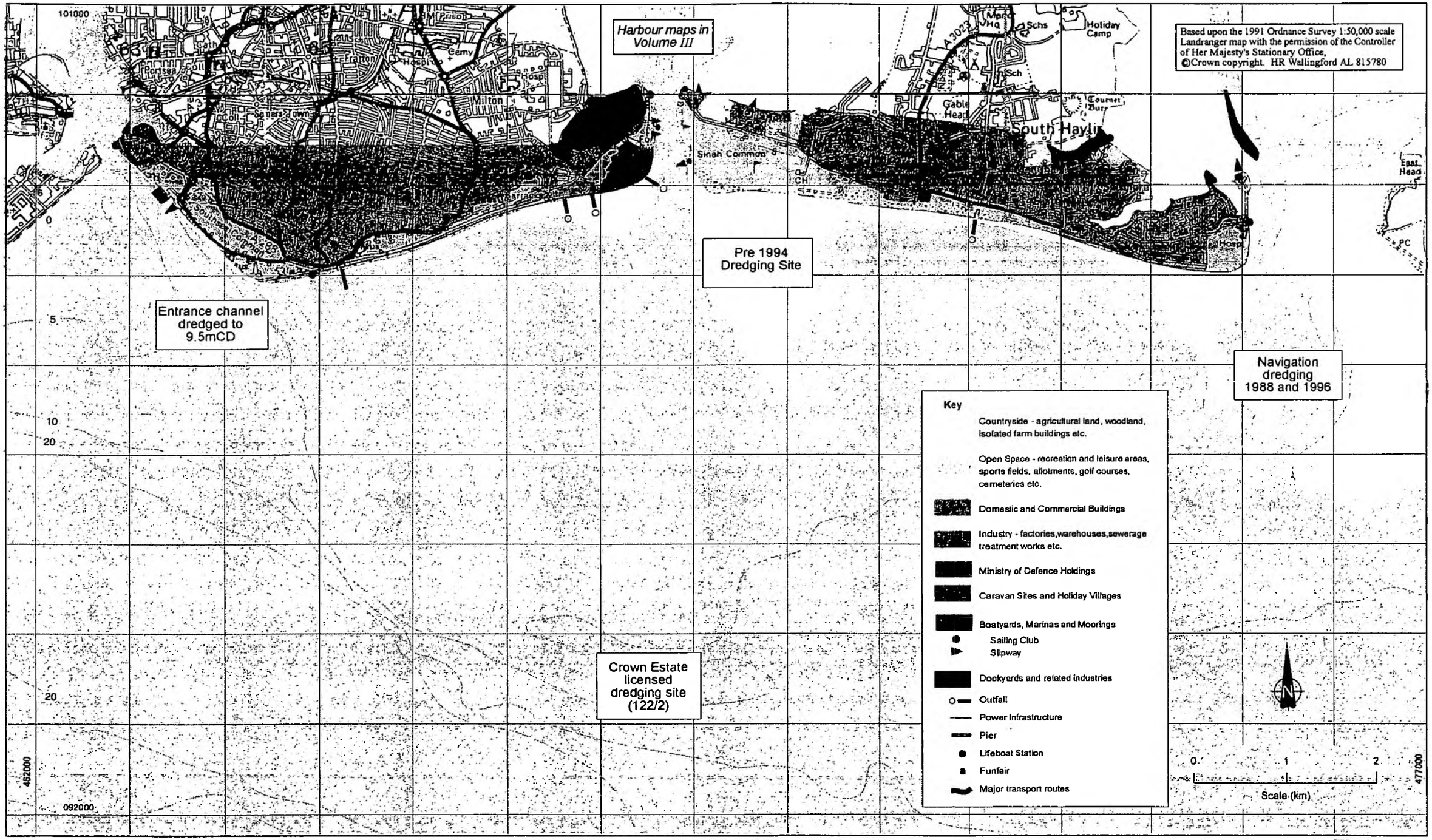
Areas of high grade agricultural land

Figure 26



Land use - Portsmouth Harbour entrance to River Hamble

Figure 25



Land use - Hayling and Portsea Islands

Figure 24

6 Land use and the human environment

6.1 Land use and recreation

The current land use within 1km approximately of the coastline has been recorded in Figures 23, 24 and 25. Agricultural land has been further subdivided into high grade (Grades 1 and 2) and other in Figure 26. The land use survey was based on aerial photograph interpretation (NRA 1995 Beach Monitoring Survey), field observations and information contained within various local authority development plans. The following main categories were recognised, simplified from the Land Utilisation Survey Field Mapping Manual (Coleman and Shaw 1980):

- Countryside: arable and pasture land, horticulture, greenhouses, woodland, isolated buildings
- Open space: public open space, sports and recreation areas, golf courses, cemeteries, allotments
- Domestic and commercial buildings: residential, commercial, institutions
- Industry: factories, warehouses, sewerage treatment works
- Ministry of Defence holdings
- Dockyards and related industry
- Caravan sites and holiday villages
- Marinas and mooring areas
- Major transport infrastructure
- Power lines

Also noted are shoreline developments including outfalls, piers, funfairs, slipways and sailing clubs.

General character

Pagham Harbour is predominantly surrounded by agricultural land with some holiday development on the north shore. The harbour and shingle ridge are important nature conservation areas. There is a strip of residential development along the ridge northeast of the harbour.

The coast between East Head and Pagham Harbour is characterised by the contrasts between the urban areas of Selsey, Bracklesham and the Witterings and the adjoining undeveloped areas. Of particular local importance is the National Trust site at East Head and West Wittering, valued for informal recreation including bird watching, sea bathing, walking and sail boarding. The farmland to the west of Selsey is predominantly Grade 3 land. Caravan sites are located at Selsey and Marsh Farm. The existing development in Selsey and Bracklesham abuts the foreshore in many places.

The Hayling Island open coast comprises two contrasting frontages. To the west, the Beachlands area and Sinah Common support a wide range of informal and low key recreational uses, including golf, sea bathing, walking and sail boarding. For much of this section the open space is in close proximity to the developed area, though this is mainly set well back from the coast. To the east, the Eastoke residential and holiday area abuts the coastline, with further open space at Eastoke Point.

The open coast of Portsea Island is dominated by public open space, with Southsea Common and beach providing important tourist attractions. The Solent Way follows the coastline along this frontage. The Ministry of Defence have developed much of the eastern end of the coastline, including Eastney Barracks, the MEME Depot and Fort Cumberland. South Water Services Ltd currently have an underground sewerage treatment works adjacent to Fort Cumberland. To the west, Old Portsmouth abuts the shoreline and includes many sites of historic interest.

The frontage from Portsmouth Harbour to Hill Head is a mixture of urban development and open space. At Lee-on-the-Solent the frontage is characterised by a broad promenade and cliff top grasslands which provide a

continuous area of open space along the coastline. The shingle foreland at Browndown supports an army training establishment and provides an undeveloped frontage which continues into the Stokes Bay and Gilkicker areas, both important sites for a range of informal recreation activities. On the Haslar peninsula there are a number of Ministry of Defence establishments, including the HMS Dolphin submarine base and RNH Haslar.

The coastal plain between Hook Lake and Hill Head Harbour is predominantly high grade agricultural land (Grade 2) and is used for arable farming and horticulture. The Solent Way, located on the cliff tops provides extensive views across the Solent to the Isle of Wight and Fawley. Beach houses at Meon Shore, caravans and houses at Solent Breezes and the National Grid tunnel headworks are the only non-agricultural buildings on this coastline. In the east the beaches are heavily used in the summer months, with public access adjacent to Hill Head. Further west the beach is only accessible by a rough track at Solent Breezes and, hence, is less frequented. Slipways are located at Salterns in Hill Head, the Hill Head Sailing Club, Solent Breezes and Warsash. Sea angling is a popular activity at Hill Head. Limited moorings are available for small craft at Solent Breezes and at Hill Head Harbour. The National Grid transmission cable from the Fawley power station passes under the coast just north of Solent Breezes.

In 1991 Hampshire County Council produced "A Strategy for Hampshire's Coast" which sets out their approach to integrated coastal planning and management. Amongst the key issues identified in this document are pollution, the effects of dredging and marine aggregate extraction on the coastal zone, erosion and flooding risks, land recreation and access, water-based recreation, maritime archaeology, historic sites, nature and landscape conservation, and commercial activity (e.g. shipping, boatyards, fishing). Through its strategy the County Council promotes the following policies:

(i) prevent development on the open parts of the coastline;

(ii) guide development which requires a coastal location, including tourist facilities to existing development areas;

(iii) safeguard waterside sites in built-up areas, which have access to the water, from changes to uses which do not require such access;

(iv) protect important wildlife sites from development;

(v) normally resist reclamation proposals;

(vi) conserve buildings and sites of historic interest in an appropriate setting;

(vii) give high priority to conserving and enhancing the coastal landscape;

(viii) resist the development of new marinas.

West Sussex County Council produced " A Coastal Strategy for West Sussex" in 1994, setting out their aims and detailed objectives for conservation, public safety, social and economic well-being and recreation with respect to the coast.

The strategy for the development of the coastal area is set out in the Structure Plans prepared by Hampshire County Council and West Sussex County Council (Tables 9 and 10). These plans draw attention to the special character of the coastal zone and the complexity of development issues.

Table 9 Hampshire County Structural Plan (Review) - Strategic policies for the coast

C3	On the **built-up coast** delineated in local plans permission may be granted for development which: (i) is consistent with other policies in the Plan; and (ii) is designed to a high standard having regard to views from land and sea taking account of retaining or opening up views of the water and has particular regard to the effects of the proposal on the townscape, landscape and seascape; and (iii) incorporates public pedestrian access to the water where practical and in a form suited to the site and the requirements of the proposed development; and (iv) has particular regard to the effect of the proposal on nature conservation; except that development not requiring access to the water may be refused permission if: (a) the site is specially suited by reason of location, facilities or other features to use for purposes requiring access to the water; and (b) there is an insufficiency of sites to meet realistically foreseen requirements in the general locality. Other than for exceptional social, economic or health reasons permission will not be granted for development on intertidal areas of nature conservation value.
C4	On the **undeveloped coast and estuaries** delineated in local plans development, except within areas allocated for port development and associated infrastructure, will not be permitted if it detracts from the landscape, wildlife or historic value. Permission for redeveloped and change of use, including existing boatyards and marinas, will normally only be granted for uses needing direct access to the water and which are: (i) designed to a high standard having regard to views from land and sea and taking account of retaining or opening up views of the water; and (ii) have particular regard to the effect of the proposal on the landscape and seascape and to the effect on nature conservation.
C5	The provision of **new moorings** may be permitted on the built-up coast provided that the proposed development does not have a detrimental effect on the townscape, seascape or areas of nature conservation and archaeological importance; the amenities of local residents; other recreational users; or commercial port operations; and will not: (i) cause or increase water pollution; or (ii) result in access and boat and car parking requirements which are detrimental to the local environment. Any restrictions on the growth of moorings will be based on advice from the harbour authorities on navigational safety and the ability of the local environment to accommodate development.
C6	Permission will not be granted for development involving the **reclamation of land from the sea or the reclamation, excavation or permanent flooding of intertidal areas of conservation value** unless the local authority is satisfied that the proposal: (i) has no undesirable hydrological effects locally, or on the coast as a whole; (ii) would not damage the landscape character or sites of historic, archaeological or nature conservation interest; and (iii) is well related to the existing built-up area.

Table 10 West Sussex County Structure plan (Deposit Draft) - Shoreline Policies for the Coast

The coastal environment CO1	(a)	The character and resources of the coast and coastal waters will be conserved and enhanced. Only in compelling circumstances will development be permitted:- (1) if it would harm the landscape of the Chichester Harbour AONB (policy C2). (2) it would harm coastal or marine habitats or species (policy C3)41 (3) it would be damaging to geological or geomorphological features (4) it would damage maritime archaeological or coastal heritage features (5) it would have an adverse effect on the hydrological regime, water quality or coastal defences, locally or further along the coast (6) it would be damaging to the amenity of nearby residential areas or town centres; or (7) if it would be harmful to coastal commercial activities including the ports, tourism or fishing.
	(b)	These criteria will be applied rigorously, especially where the proposals include land reclamation.
	(c)	The undeveloped coastline will be protected firmly from development (including recreational development) by policies C2, C3 and C5
Coastal defence CO2	(a)	Built development, including the intensification of development, will not be permitted in areas expected to be at risk during the life of the building from flooding, coastal erosion, land instability, wind, waves, sea spray or wave-borne debris, whether in normal or storm surge conditions.
	(b)	No development (or intensification of development) will be permitted:- (1) where it would require enhanced coastal defences; (2) where it would inhibit the maintenance of existing coast protection or flood defence works; or (3) where it would prohibit or add to the expense of adopting a managed retreat solution to coastal defence, should that be an option.
	(c)	The construction of essential new or replacement sea defence or coast protection works will be permitted provided that they would be working with natural processes, and would minimise detrimental visual impact, enhance natural or heritage features, and where possible accommodate recreational use of the coast.
The Built-up Coastline CO3	(a)	Subject to Policies C011 and C02, appropriate development within built up areas will be encouraged under policy G5 and, at the ports, policy T14. The distinctive character of the core seafront and river estuary areas will be conserved and enhanced under policies G7 and B5, taking account of special coastal features. Sea views will be retained and new ones opened up wherever suitable opportunities allow.
	(b)	Development not requiring coastal access may be refused permission if the site is particularly suited to uses for which access is essential and for which there are few other possible sites.
Coastal Recreation CO4	(a)	Development for coastal recreation, including marinas and other boat launching and parking facilities, will be permitted in appropriate locations within the built up part of the coast, subject to compliance with other relevant policies (particularly policies C01 and C02) and to the avoidance of conflict with commercial shipping. Marina proposals should allow for the realisation of the full potential of the site for moorings, and should provide for visitor moorings.
	(b)	Access by walkers, riders and cyclists to the coast will be encouraged. Development (including redevelopment) of coastal sites for any purpose should wherever possible make provision for improved access to and along the coast for the public on foot. This will be associated with the aim of creating a coastal path and cycle track, linking into the adjoining rights of way network.

The Government's policy for the development and use of the East Solent over the period 1991-2011 is addressed in "Regional Planning Guidance for the South East" (RPG, DoE, 1994) Alongside policy guidance set out in

PPG's and MPG's it provides a broad framework for guiding the region's development. It identifies the special issues associated with the conservation status of much of coastal zone and the need for regeneration of many communities. At Portsmouth, for example, it is essential that provision is made for economic development to reduce unemployment caused by structural changes in the local economy, such as the run down of the defence industry. It is recognised that there is scope for redevelopment in the docks and ex-defence lands. The emphasis is placed on taking maximum advantage of those development opportunities which become available within the constraints imposed by countryside and nature conservation, for the recycling and redevelopment of under used and derelict land. Regional guidance is also given through SERPLAN's "Coastal Planning Guidelines", promoting the development of shoreline management strategies and setting out the approach to be followed in relation to the maintenance of existing defences, encouragement of soft engineering approaches and considerations of new development proposals.

Constraints to development

The future development of the open coast area is constrained by:

- areas of international, national and local nature conservation importance (Figures 20-22)
- high grade agricultural land, with much of the area identified as Grade 1 or Grade 2 land (Figure 26). This land should not be built on unless there is no other site suitable for the particular purpose (DoE Circular 16/87)
- an Area of Outstanding Natural Beauty (AONB) around Chichester Harbour (Figure 27)
- historic buildings and archaeological sites, including marine sites and conservation areas (Table 7 and Figure 27)
- designated "strategic gaps" to preserve the balance between the rural and urban landscape. These gaps are intended to protect the individual identity and amenity of settlements by ensuring that they do not coalesce (Table 11)
- designated "coastal zones" to preserve the character and attractiveness of the undeveloped coastline (Figures 28-30).

Opportunities for development

In general terms, the objectives for the future development of the East Solent SMP area, in sofar as they relate to coastal defence strategies, are:

- to locate new development away from the undeveloped coast and the open countryside
- to maintain or improve access to and along defences
- to permit small-scale "infill" development within existing coastal zone communities
- to restrict the development of new caravan sites, the expansion of existing sites and the extension of occupation periods into the winter season
- to conserve and enhance the natural, historical and archaeological features of the area
- to maintain and enhance the built environment
- to maintain and improve the available public open space and leisure facilities
- to control the re-use of Ministry of Defence establishments if and when they become surplus to requirements.

The approved land use trends, as set out in the relevant development plans, are presented in Figures 26, 27 and 28. There are only limited opportunities for further built development within 1km of the open coast, as follows:

1. Land for Housing; the allocated sites are:
   - the north eastern side of Lee-on-the-Solent (Gosport Borough)
   - the Eastney Barracks area (Portsmouth City)
   - at Selsey Bill, on the northern side of Selsey and on the landward fringe of Bracklesham (Chichester District).

- Sandy Point Hospital, Suntrap School and several small sites along the sea front road of South Hayling (Havant Borough)

2. Land for Industry, Business and Services; the safeguarded sites are:
   - Fort Cumberland underground treatment works, the former MEME Depot site and a berth for the removal of sewage sludge by ship for disposal elsewhere (Portsmouth City). Hampshire County Council would prefer the sewage sludge to be transported to a treatment works elsewhere by pipeline.
   - The northern side of Selsey (Chichester District).

3. Land for Mineral Extraction; the proposed sites are:
   - HMS Daedelus, a proposed sand and gravel extraction and waste disposal site. Restoration to countryside with potential for nature conservation and recreation benefits (Fareham Borough).

Implications for shoreline management

It is not anticipated that there will be significant changes to the future value of coastal assets within 1km of the open coast. As a consequence it is unlikely that there will be requirements for new coastal defences over and above the existing needs.

Table 11 Strategic and local gaps

Fareham Borough	
Strategic Gap	between Locks Heath and Heathfield stretching south to HMS Daedalus between Hill Head and Warsash stretching south to coast
Local Gaps	Warsash/Sarisbury/Segensworth from Locks Heath
Gosport Borough	
Strategic Gaps	Stubbington from Gosport Lee-on-the-Solent from Gosport
Local gaps	Haslar Lake/Walpole Park
Havant Borough	
Strategic Gaps	
Local Gaps	Hermitage Stream Langstone
Chichester District	
Strategic Gaps	Selsey/Pagham Selsey/Bracklesham East Wittering/West Wittering Bognor Regis/Chichester
Arun District	Selsey/Pagham Bognor Regis/Chichester

Appendix 1 References

Appendix 1 References

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Appendix 2 Existing defences

Appendix 2 Existing defences

The tables contained within this Appendix present information on the existing defences along the open coast and within Pagham Harbour. The information is based on the MAFF Coast Protection Survey (CPS) and the NRA (now Environment Agency) Sea Defence Survey (SDS), updated and modified following site visits and consultations.

The tables include:

- Ordnance Survey coordinates for the starting point of the defence element (working from east to west)
- the total length of the defence element
- the maintaining authority
- the structure type (wall, revetment, gabions, groynes, embankment, recharged beach or unprotected)
- the condition of the defence, classified as:

  1 as built
  2 some wear, needs monitoring
  3 moderate works required to retain effectiveness
  4 significant works required.

- residual life, classified as:

  < 5 years
  5-10 years
  > 10 years

- CPS or SDS code.

An asterisk (*) indicates that the CPS or SDS information has corrected, updated or expanded.

The Pagham Harbour table is broken by location references to assist the reader.

Unit 1 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS/SDS code
SZ89159720	1.55	Arun. D.C. N/A	Groynes[1] Unprotected	1 N/A	> 10 N/A	New Work
SZ88059610	0.18	Env. Agency	Training Wall	3*	< 5	074/2231
SZ87989603	1.27*	Env. Agency	Groynes [2]	3	< 5*	074/2101
SZ87389491	0.65*	Chich. D.C.	Breastwork [1] Groynes	2 3	> 10 > 10	574/3401

1 not on full length of element
2 ongoing beach management

Unit 2 Defence elements (east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS Coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ87239433	0.5	Chich. D.C.	Gabions/ breastwork [1] Groynes	2 3	> 10 > 10	574/3401
SZ86999389	1.87	Chich. D.C.	Wall Groynes Recharge[2]	2 3 2	> 10 > 10 5 - 10*	574/3402
SZ85959243	0.27	Chich. D.C.	Wall Groynes	2 - 3 2	> 10 > 10	574/3403
SZ85819222	0.04	Chich. D.C.	Wall Groynes	2 2	> 10 > 10	574/3404
SZ85829218	0.25	Chich. D.C.	Groynes	2	> 10	574/3405
SZ85569214	0.07	Chich. D.C.	Wall Groynes	3 2	> 10 > 10	574/3406
SZ85499215	0.17	Chich. D.C.	Gabions Groynes	3* 2	5 - 10 > 10	574/3407
SZ85339220	0.3	Chich. D.C.	Wall Groynes	1 1	> 10 > 10	574/3408
SZ85079235	0.32	Chich. D.C.	Wall Groynes	2 2	> 10 > 10	574/3409
SZ84819255	0.04	Chich. D.C. / Private	Wall/armour	2 - 3	> 10	574/3410
SZ84789259	0.1	Private	Wall	2	> 10	574/3411
SZ84709265	0.07	Chich. D.C.	Wall / revetment / armour Groynes	1 - 3 2	> 10 > 10	574/3412
SZ84689271	0.14	Chich. D.C. / Private	Wall Groynes	3 2	5 - 10* > 10	574/3413
SZ84609282	0.25	Chich. D.C.	Wall Groynes	2 2	> 10 > 10	574/3414

1 not on full length of element
2 ongoing beach management

Unit 3 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ84459309	0.30	N/A	Unprotected	N/A	N/A	*
SZ84409305	0.29	Env. Agency	Groynes Recharge[2]	4 4*	< 5 < 5*	074/2004
SZ83919354	0.38	Env. Agency	Wall Groynes Recharge[2]	2 2 4*	< 5[1] 5 - 10 < 5*	074/2003
SZ83729380	0.23	Env. Agency	Groynes Recharge[2]	2 4*	5 -10 < 5*	074/2002
SZ83659387	3.04	Env. Agency	Groynes Recharge[2]	3 4*	5 - 10 < 5*	074/2001

1 ongoing beach management

Unit 4 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ81459571	0.16	Chich. D.C.	Wall Groynes	2 3	5 - 10 5 - 10	574/3415
SZ81339579	0.63	Chich. D.C. [1]	Wall Groynes	3 3	5 - 10 5 - 10	574/3416
SZ80809612	0.56	Chich. D.C.	Wall Groynes	3 3	5 - 10 5 - 10	574/3417
SZ80339640	0.46	Chich. D.C.	Wall Groynes	3 3	5 - 10 5 - 10	574/3418
SZ79939662	0.59	Chich. D.C.	Breastwork Groynes	4 4	5 - 10 < 5	574/3419
SZ79389685	0.43	Chich. D.C.	Breastwork Groynes	2 2	> 10 > 10	574/3420
SZ78999702	0.43	Chich. D.C. & Private	Breastwork Groynes	2 2	> 10 > 10	574/3421
SZ78619718	0.12*	Chich. D.C.	Breastwork Groynes	3 3	> 10 > 10	574/3422

1 short length of private upper wall

Unit 5 Defence elements (east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordnates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ78509720	0.15*	Chich. D.C.	Breastwork Groynes	3* 3*	5 - 10* 5 - 10*	574/3422
SZ78379728	2.36	Chich. D.C.	Breastwork[1] Gabions [1] Groynes	2 - 4 3 3	5 -10 < 5* 5 - 10	574/3423
SZ76489853	1.0	N/A	Unprotected[2]	2	N/A	N/A

1 not on full length of element
2 ongoing dune management

Unit 6 Defence elements (east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ75069910	0.21	Private	Wall/ Breastwork Groynes	3/4 4	<5 <5*	571/3330
SZ75089890	0.34	Private	Wall Groynes	4 3	< 5 5 - 10	571/3331
SZ75069856	0.11	Hamp. C.C/ Private	Wall Groynes	3 3	5 - 10* 5 - 10*	571/3332
SZ75099838	0.53	Havant C.C. Hamp C.C.	Revetment [1] Groynes	2 2	> 10 > 10	571/3333
SZ74789800	1.82	Havant B.C.	Wall Groynes Recharge[2]	2/3 3 3	> 10 > 10 5 - 10	571/3334-35
SZ73039843	0.28	Havant B.C.	Breastwork Recharge[2]	3 3	5 - 10* 5 - 10	571/3336
SZ72779850	0.4	Havant B.C.	Groynes Recharge[2]	3 3	> 10 5 - 10	571/3337
SZ72389857	0.89	Havant B.C.	Breastwork Groynes Recharge[2]	2 2 3	5 - 10* > 10 < 5*	571/3338
SZ71509880	1.06	Havant B.C.	Recharge[2]	3	5 - 10	571/3339

1 Not on full length of element
2 Ongoing beach management

Unit 7 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ70559880	0.03	Private	Wall	3	> 10	571/3340
SZ70529881	0.48	Havant B.C./ Private	Revetment Groynes	2* 3	> 10 > 10	571/3341
SZ70049892	1.75	N/A	Unprotected	N/A	N/A	*
SZ68869964	0.32	Private	Wall/gabions Groynes	4 4	< 5 < 5	571/3342
SZ68819995	0.07	Private	Wall	2	> 10	571/3343
SZ68790002	0.09	Langstone Harbour Authority	Wall	3	> 10	571/3344

Unit 8 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ68450008	0.74	Portsm C.C.	Gabions [1] Groynes	4* 3	< 5 5 - 10	571/3223
SZ68539938	0.30	Private	Revetment	4	5 - 10	571/3224
SZ68459911	0.15	MoD	Wall [1] Groynes	4 4	5 - 10 5 - 10	571/3225
SZ68349904	0.42	MoD	Wall [1] Revetment [1] Groynes	4 3 4	5 - 10 5 - 10 5 - 10	571/3226
SZ67939896	0.4	Portsm C.C./ MoD	Revetment [1] Embankment	3 3	5 - 10 5 - 10	571/3227
SZ67459887	2.96	Portsm C.C.	Wall	2*	> 10	571/3328

1 not on full length of element

Unit 9 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ64629803	0.45	Portsm C.C.	Wall [1] Revetment [1]	2 3	> 10 > 10	571/3229
SZ64249803	0.7	Portsm C.C.	Revetment*	3	> 10	571/3230
SZ63789848	0.42	Portsm C.C.	Wall[2]	3	> 10	571/3231
SZ63509878	0.2	Private	Wall*[3]	3	> 10	571/3232
SZ63409894	0.14	Portsm C.C.	Wall Groynes	3 4	5 - 10 < 5	571/3233
SZ63309903	0.21	Portsm C.C.	Revetment	3	5 - 10*	571/3234
SZ63159915	0.11	Portsm C.C.	Revetment	3	> 10	571/3235
SZ63079923	0.07	Portsm C.C.	Wall	3	> 10	571/3236
SZ63039929	0.13	Portsm C.C.	Wall	3	> 10	571/3237
SZ62929935	0.04	Portsm C.C.	Revetment	3	> 10	571/3238
SZ62909938	0.04	Private	Wall	3	5 - 10	571/3239
SZ62899942	0.05	Portsm C.C.	Wall	3	5 - 10	571/3240
SZ62889946	0.04	Portsm C.C.	Wall	3	> 10	571/3241
SZ62879949	0.04	Private	Wall	3	> 10	571/3242
SZ62869952	0.04	Private	Wall Revetment [1]	3 3	> 10 > 10	571/3243
SZ62869957	0.07	Portsm C.C.	Revetment	3	> 10	571/3244

1 not on full length of element
2 ongoing beach management
3 pier acts as groyne

Unit 10 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ62559945	0.28	MoD	Wall Revetment	3 3	> 10 > 10	571/3135
SZ62689929	0.06	MoD	Revetment	3	5 - 10	571/3136
SZ62679924	0.26	MoD	Revetment Groynes	4 4	5 - 10 < 5	571/3137
SZ62459906	0.2	MoD	Revetment	3	> 10	571/3138
SZ62339893	0.29	MoD	Revetment	3	> 10	571/3139
SZ62139875	0.51	MoD	Revetment	3	5 - 10	571/3140
SZ61759840	0.5	MoD	Revetment	3	> 10	571/3141
SZ61429804	0.47	MoD	Revetment	3	< 5	571/3142
SZ61099766	0.21	Gosport B.C.	Revetment Groynes	2 3	> 10 5 - 10	571/3143
SZ60939753	0.26	Gosport B.C.	Wall Groynes	2 3	> 10 > 10	571/3144

Unit 11 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (year)	CPS code
SZ60689745	1.79	N/A	Unprotected*	N/A	N/A	571/3145/6
SZ59329860	0.37	Gosport B.C.	Wall	2	> 10	571/3147
SZ58989875	0.39	N/A[1]	Unprotected[1]	N/A	N/A	571/3148
SZ58599881	1.14	MoD	Unprotected	N/A	N/A	*
SZ57309920	0.4*	MoD	Revetment	4	< 5	571/3149

1 ongoing beach management by Engironment Agency to maintain outfall

Unit 12 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SZ56959949	1.6	Gosport B.C.	Wall Groynes* Recharge*	2 (1) (1)	20 - 50 > 10 > 10	(under construction)
SU56020078	0.4	Gosport B.C.	Wall Groynes	2 3	> 10 > 10	571/3155
SU55240153	0.95	Fareham B.C.	Breastwork Groynes	3 3	> 10 5 - 10*	571/3020
SU54640187	0.13	Fareham B.C.	Wall Groynes	3 3	> 10 5 - 10	571/3021
SU54520189	0.63	Fareham B.C.	Wall [1] Groynes	3 4	5 - 10 < 5	571/3022
SU54020220	0.07	Fareham B.C.	Wall Groynes	3 3	5 - 10 5 - 10	571/3023
SU53950223	0.21	Fareham B.C.	Wall Groynes	2 3	> 10 5 - 10	571/3024
SU53760234	0.26	Fareham B.C.	Wall [1] Wall [1]	3 3	> 10 > 10	571/3025

1 not on full length of element

Unit 13 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SU53470227	0.34	Env. Agency Env.Ag./ Private	Wall [1] Groynes [2]	2 3	10 - 20 5 - 10	571/3026
SU53160227	0.25	Fareham B.C.	Wall	3	5 - 10	571/3027
SU52970242	2.7	N/A	Unprotected	N/A	N/A	*

1 not on full length of element
2 ongoing beach management

Unit 14 Defence elements (from east to west)

(* indicates correction, update or addition to Coast Protection Survey or Sea Defence Survey)

OS coordinates (start of element)	Element length (km)	Maintaining authority	Structure type	Condition	Residual life (years)	CPS code
SU50680381	0.18	Private	Gabions	2*	5 - 10*	571/3028
SU50510388	0.13	Private	Breastwork	4	< 5	571/3029
SU50390393	0.18	Private	Gabions	2*	5 - 10	571/3030
SU50230402	0.42	N/A	Unprotected[1]	N/A	N/A	*
SU49840417	0.05	Private	Wall	4*	< 5	571/3031
SU49790419	0.94	N/A	Unprotected	N/A	N/A	
SU49020472	0.35	Fareham B.C.	Wall	3	5 - 10*	571/3032
SU48830500	0.18	Fareham B.C.	Wall	4	< 5*	571/3033
SU48720514	0.21	N/A	Unprotected	N/A	N/A	*

1 new works planned by National Grid

Pagham Harbour Defence elements (clockwise from harbour entrance)

(* indicates correction, update or addition to Coast Protection Survey and Sea Defence Survey)

OS coordinates (start of element	Element length (km)	Maintaining authority	Structure type	Condition (1-As built 4-Poor)	Residual life (years)	SDS code
Harbour entrance - South spit						
SZ88009605	1.0	N/A	Unprotected	N/A	N/A	*
SZ87409530	0.4	Private*	Embankment	2	> 10	074/2201
SZ87309565	0.2	N/A	Unprotected	N/A	N/A	*
SZ87109610	1.20	Env. Agency	Embankment	2	> 10	*
SZ86129645	0.38	Env. Agency	Embankment	3	> 10	074/2205
SZ85839632	0.21	Env. Agency	Embankment	3	> 10	074/2206
SZ85649630	0.03	Env. Agency	Embankment	2	> 10	074/2207
B2145 bridge, Ferry House						
SZ85659637	0.11	Env. Agency	Embankment	3	> 10	074/2208
SZ85649637	0.2	Env. Agency	Embankment	3	> 10	*
SZ58709650	0.1	Env. Agency	Revetment	2	> 10	New Work
SZ85759656	0.45	Env. Agency	Embankment	3	> 10	*
SZ86089692	0.23	WSCC	Embankment	3	>10	*
SZ86059715	0.12	Env. Agency	Embankment	3	>10	*
SZ86009723	0.11	Env. Agency	Embankment	2	> 10	074/2210
Sidlesham						
SZ86099723	0.08	Sidesham PC*	Wall	3	> 10	074/2211
SZ86169730	0.26	Private-*	Wall	4	5 - 10	074/2212
SZ86459725	0.20	Private	Embankment	3	> 10	*
SZ86599725	0.32	WSCC	Embanknent	3	>10	*
SZ86859730	0.10	WSCC*	Embankment	4	5- 10	074/2214
SZ86979729	0.13	WSCC*	Embankment	3	> 10	074/2215
SZ87099730	0.01	WSCC*	Wall	4	5 - 10	074/2216
SZ87119733	0.20	WSCC*	Embankment	4	5- 10	074/2217
SZ87109750	0.16	WSCC*	Wall	3	> 10	074/2218
SZ87009965	0.28	Env. Agency	Revetment*	3	> 10	074/2219

North Wall						
SZ87119770	0.53	Env. Agency	Revetment	2	> 10	074/2220
SZ87819765	0.12	Private*	Wall	3	> 10	074/2221
SZ87839761	0.39	Private*	Embankment	2	> 10	074/2222
SZ87759724	0.27	Private*	Embankment	3	> 10	074/2223
SZ87959694	0.30	Env. Agency	Embankment	3	> 10	074/2224
Pagham Lagoon						
SZ88219682	0.12	Env. Agency	Embankment & wall	3	5- 10	074/2225/2
SZ88229670	0.08	Env. Agency	Embankment	2	5-10	074/2225/1
SZ88229661	0.04	Env. Agency	Embankment	2	> 10	074/2226
SZ88329655	0.56	N/A	Unprotected	N/A	N/A	*
Harbour entrance - North spit training wall						