Coastal Management

Mapping of littoral cells

J M Motyka
Dr A H Brampton

Report SR 328
January 1993

HR Wallingford

Registered Office: **HR Wallingford Ltd.** Howbery Park, Wallingford, Oxfordshire OX10 8BA, UK
Telephone: 0491 35381 International + 44 491 35381 Telex: 848552 HRSWAL G.
Facsimile: 0491 32233 International + 44 491 32233 Registered in England No. 1622174

Contract

This report describes work commissioned by the Ministry of Agriculture, Fisheries and Food under Contract CSA 2167 for which the MAFF nominated Project Officer was Mr B D Richardson. It is published on behalf of the Ministry of Agriculture, Fisheries and Food but any opinions expressed in this report are not necessarily those of the funding Ministry. The HR job number was CBS 0012. The work was carried out by and the report written by Mr J M Motyka and Dr A H Brampton. Dr A H Brampton was the Project Manager.

Prepared by J M Motyka (name) Author (job title)

Approved by A H Brampton (name) Section Manager (job title)

Date 29th January 1993

Summary

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As a guide for coastal managers a study has been carried out identifying the major regional littoral drift cells in England and Wales. For coastal defence management the regional cells have been further subdivided into sub-cells which are either independent or only weakly dependent upon each other. The coastal regime within each cell has been described and this together with the maps of the coastline identify the special characteristics of each area.

The study was funded by the Ministry of Agriculture, Fisheries and Food during the period 1992-1993. Any queries or comments on the contents of this report should be addressed to Mr J M Motyka or Dr A H Brampton of the Coastal Group at HR Wallingford.

Contents

1 Introduction

1.1 Terms of reference

The objectives of this MAFF research contract are:

- To produce a set of maps covering the coastline of England and Wales, identifying the boundaries of major littoral drift cells. These cells are to be categorised into totally independent, partly dependent cells and cells which vary in time with regard to drift direction changes. Stretches of coastline which have many small independent cells (ie. rocky, strongly embayed stretches of cliffed coast) are also to be identified.

- These maps are to show the nett drift directions and to categorise stretches of the coastline into ones having a low, medium or high rate of littoral drift.

- Particular problem areas (e.g. areas of rapid erosion, accretion) are also to be identified within each coastal cell.

1.2 Sources of data

The study has been carried out using previous reports produced by HR Wallingford and much useful information has also been obtained from site inspections carried out during specific coastal studies by members of HR staff.

1.3 Outline of report

Following this introductory chapter there is a discussion of the concept of coastal cells and of the criteria by which the cell boundaries have been identified. This discussion forms Chapter 2 of the report. The main body of the report, giving a brief description of each coastal cell, forms Chapter 3. This consists of a page of text for each cell accompanied by a corresponding map showing littoral drift directions, littoral drift divides and sediment sinks. There is also a table showing the various cell boundaries at the end of the report.

2 The concept of coastal cells

The importance of interruption of longshore sediment transport can be gauged by the following quotation from an eminent coastal engineer in the USA. Galvin (1990) stated that "... all examples of shore erosion on non subsiding sandy coasts are traceable to manmade or natural interruptions of longshore sediment transport."

This is a rather sweeping statement and doubtless over-states the case in some circumstances. Nevertheless, a strategy for managing, and where appropriate, defending the coastline of the UK, should certainly reflect the importance of sediment transport along the beaches and nearshore seabed. This leads naturally to the concept of "coastal cells", that is to say a division of the coastline into sections within which any changes do not affect adjacent sections, or which have a significantly different character to those adjacent sections (e.g. in terms of geology or biology).

In the present context, the appropriate definition of a "cell" is based on the idea that interruptions to the movement of sand or shingle along the beaches or near shore sea bed within one cell should not significantly affect beaches in an adjacent cell. It should be stressed that the movement of fine grained material, that is, the type of material which does not normally settle out on the beach face has not been used to evaluate coastal cell boundaries.

In defining boundaries we have avoided identifying small coastal cells; along the Atlantic coasts of the UK there are a large number of small bays which satisfy the requirements of a "cell", but do not merit individual identification in the context of a strategic approach to coastal management. The smallest "cell" identified here is about 20km long (measured along the coast).

Boundaries between sediment cells are of two main types, namely: Littoral drift divides and Sediment sinks, defined as follows.

Littoral drift divides

Littoral drift divides usually occur at a point where the orientation of the coast changes abruptly - for example at a rocky headland such as Portland Bill in Dorset. If beach material moves away from such a point, on both sides, then that point is a drift divide. Interfering with the movement of beach sediment on one side of a drift divide will not cause problems on the other.

Sometimes drift divides occur without any dramatic change in the orientation of the coast; there is a drift divide near Sheringham in Norfolk, for example. In this case the position of the drift divide tends to shift from time to time, due to relatively small changes in wave conditions.

There is an obvious tendency for beach erosion near to a drift divide because any mobile sediment will tend to move away from that point.

Sediment Sinks

Here, the opposite situation applies. Sediment sinks are points at which sediment transport paths meet - so that beach material tends to build up. This happens naturally in well sheltered areas such as deeply indented bays. Sediment sinks are also often located in tidal inlets and estuaries. Again, any interference on one side of a sediment sink will not normally affect sediment movements on the other.

Tidal flows, in the vicinity of an estuary, for example, complicate the movement of beach sediment. To cross the mouth of an estuary, sediment may have to travel in and out of the estuary several times and the path may be tortuous as the ebb and flood flows may be concentrated in different channels. It is also quite common to find that the beaches downdrift of an estuary have a "reverse" drift, that is to say opposite to the general direction of longshore transport for that coast.

Bearing the above descriptions of cell boundaries in mind, the coast of England and Wales has been divided into 11 main "cells", as shown in Figure 1 overleaf. Four of the boundaries are in large estuaries (Wash, Thames, Severn, and the Solway), the remaining eight at major headlands (St Abb's Head, Flamborough Head, Selsey Bill, Portland Bill, Land's End, St David's Head, Bardsey and the Great Orme). These major cells not only reflect beach sediment units, but also divide the coast into regions where the geology and general orientation are similar.

For the purposes of coastal defence management, however, these major cells may be rather large, and contain too many local authorities for a single group to manage. Within these major cells, therefore, a number of "sub-cells" have been defined, and the description of the coast in this report is arranged using these smaller units. At many sites, the sediment transport around a headland or a large harbour only moves in one direction, and is often of small volume. Engineering works on the updrift side of such a feature may therefore have some impact on the downdrift coast, but such impacts may be small or totally insignificant. We can regard such sub-cells as being "partly dependent", with the understanding that the cell boundary between them is not totally "sediment-tight".

The definitions of cells and sub-cells in this report are thus derived from the viewpoint of movement of sand and shingle along the beaches, and taking into account the likely consequences of interfering with that movement. As a result, some of the boundaries may split an estuary into two parts. Had the main concern been a division of the coastline into similar units from the viewpoint of biological interest, or even the movement of mud, then such a division would clearly be wrong. Indeed it should be stressed that if estuarine processes are being evaluated then these processes are likely to be affected by coastal works on opposite shores of the estuary. There is clearly no universally applicable division of the coastline into management units. Different boundaries will be needed for different interest groups. The division which is presented in this report is thus strictly applicable for the purposes of coastal defence management on non cohesive beaches.

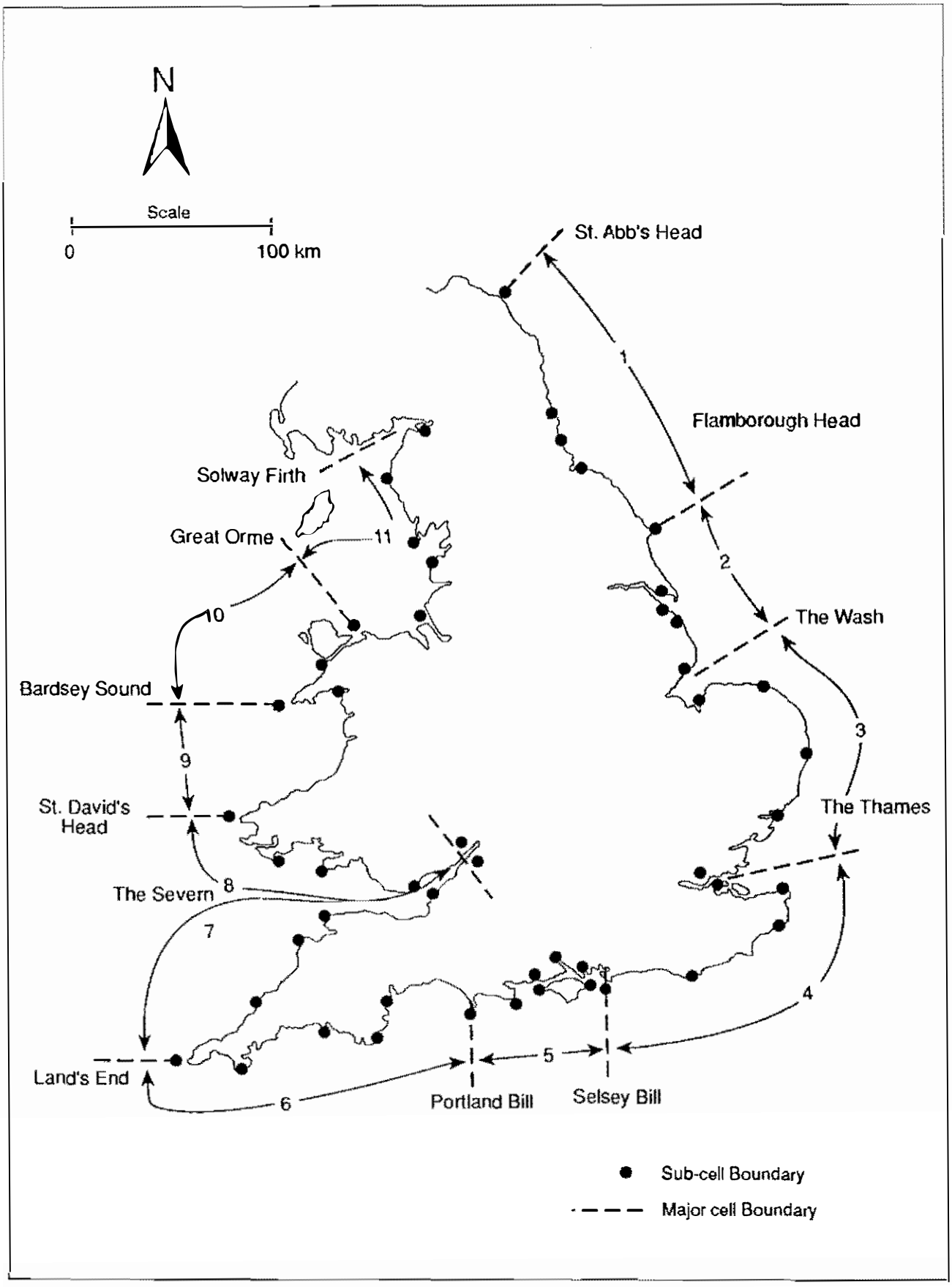


Figure 1 Boundaries of Major Cells

3 Coastline division into sub-cells

3.1 General

A full list of cell and sub-cell boundaries can be found in Table 1. The limits of these sub-cells are also shown on the maps which accompany the text. A description of the boundary conditions (e.g. sediment transport divide, sediment sink, one way boundary) and with arrows showing the nett direction of littoral drift is shown on these maps.

The description of the coastal regime is given in the following Section 3.2 under 8 headings.

The heading "Coastal Authorities" lists the district and county councils covered by the sub-cell and the relevant region of the National Rivers Authority. There are, of course, many other organisations with coast protection interests (private landowners, harbour authorities etc.) which may be involved in the management of coastal defences, but which for the sake of brevity have been excluded from the list.

Under the heading "Erosion" we have identified areas where there is known to be significant beach or cliff erosion. Where this erosion provides an important supply of material to the adjacent beaches, this has been noted.

Under the heading "Accretion" we have identified major sediment "sinks" and where we have local information we have also included areas of natural accretion. With the proliferation of coastal defences, particularly on the southeast coast of England, there is little to be gained by identifying accreting areas within groyne systems, as the condition of such areas is likely to vary with the state of repair of such coastal defences. No attempt has therefore been made to identify presently accreting groyne systems, or beaches which have accreted as a result of artificial nourishment.

Under "Areas of Flood Risk" we have identified stretches of coast where a combination of waves and high tidal levels could cause inundation from the seaward. We have excluded, however, areas where high tidal levels and high fresh water flows can cause rivers to burst or overflow their banks, but where wave action is insignificant.

Under the heading "Littoral Processes" we have highlighted the most important mechanisms affecting the coastal regime. In particular we have identified those beaches where wave action is dominant and where a knowledge of tidal current behaviour is unlikely to significantly effect the design of coastal defence works (e.g. groynes and sea walls). We have also identified those stretches of coastline where tidal currents or tidal current residuals strongly affect beach

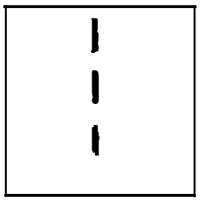
processes. It can be assumed that where both wave and tidal current processes are identified as being of importance, then major coastal impact studies would be needed in the design of coastal defence works. Finally, a number of areas which are important sources of beach material, by virtue of their erosion, have been identified. We have also given a qualitative assessment of the nett rate of littoral drift of sand or shingle. In general it can be assumed that where a moderate rate of drift is indicated then this is of the order of 10,000 cubic metres per year for shingle and 100,000 cubic metres per year for sand. Where a low rate of drift is indicated this may be as small as 1000 cubic metres per year for shingle and where a high rate of drift is given this may be assumed to be as high as 500,000 cubic metres per year for sand. In general however most beaches which are groyned fall in the "central" category.

3.2 Description of sub-cells

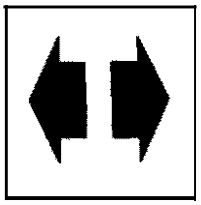
The following description of the sub-cells covers the coastline of England and Wales from St Abb's Head to the Solway Firth. This description should be read in conjunction with Table 1 and with the maps opposite each sub-cell description, in which cell boundaries, littoral drift directions, etc. are shown.

Legend for the following maps

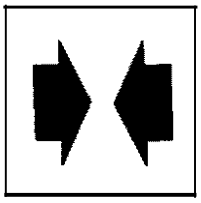
These maps show the coastline in sub-cell sections extending from St Abb's Head clockwise around the coastline of England and Wales to the Solway Firth.



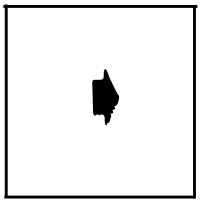
Cell or sub-cell boundary.



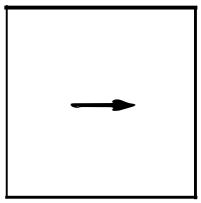
Drift divide. Boundary for regional cell.



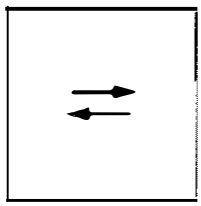
Sediment sink. Boundary for regional cell.



Partial or "one way drift". Boundary for sub-cell in some instances.



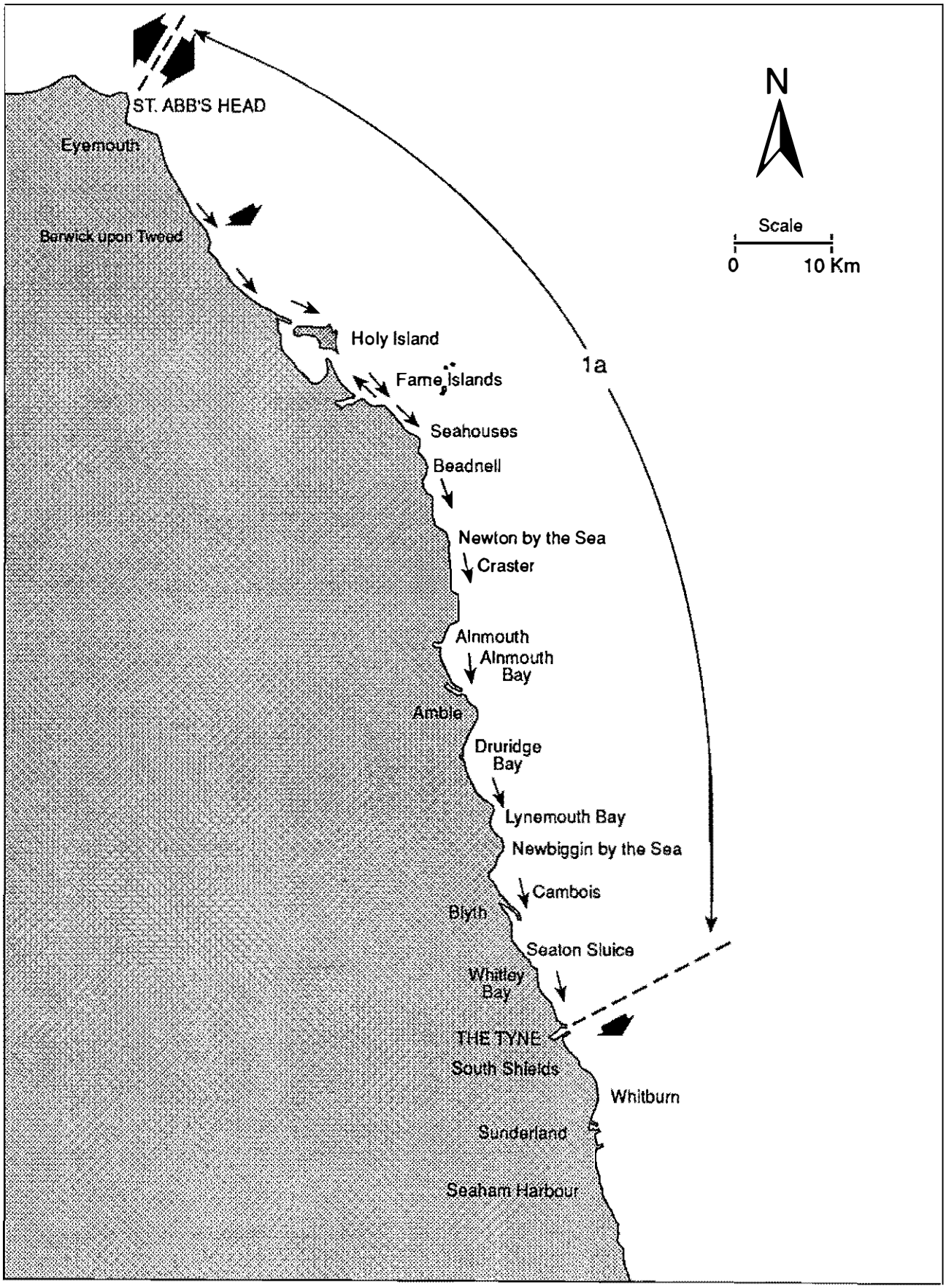
Nett drift direction.



Variable nett drift direction

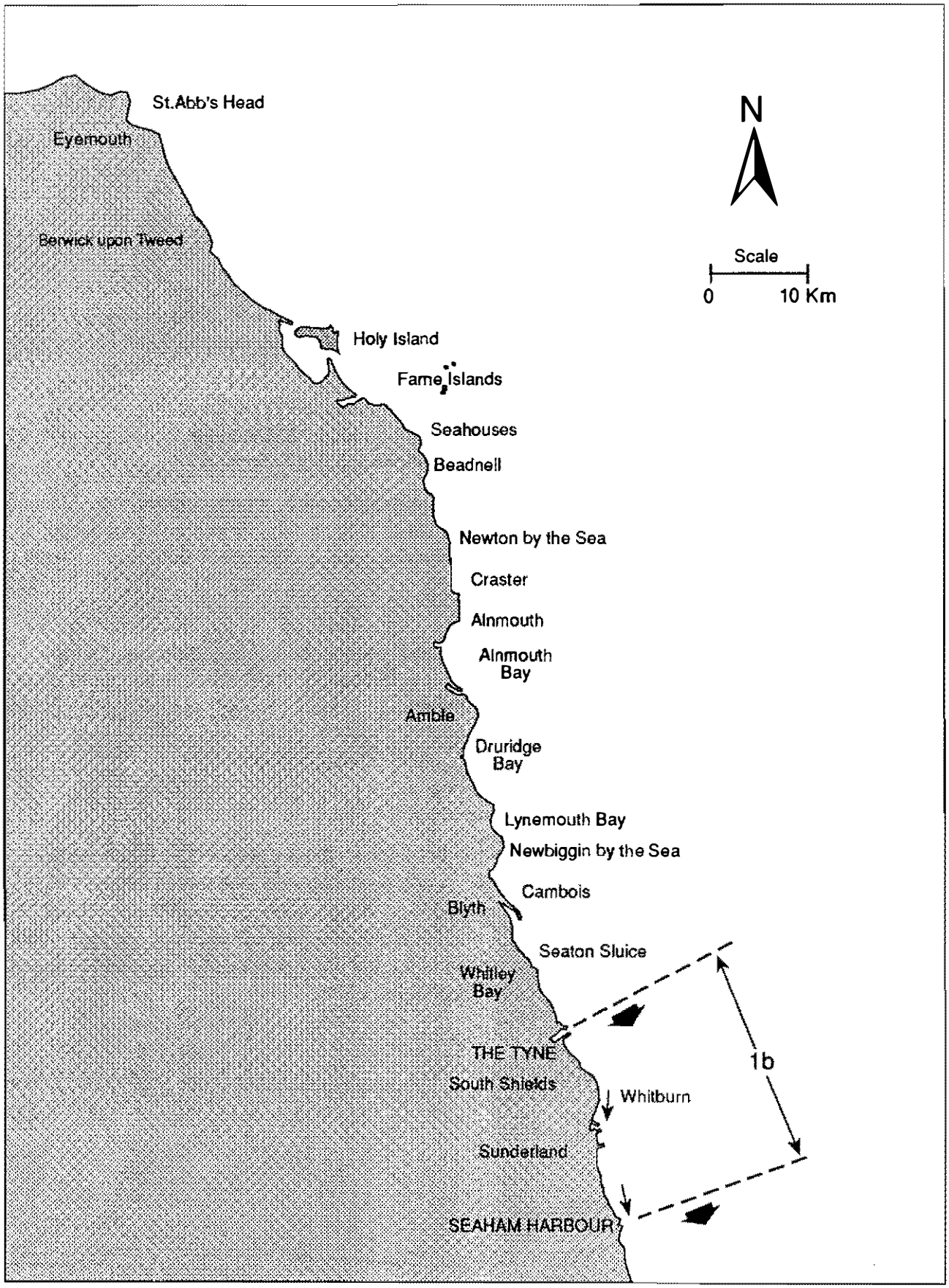
NB Where there are no arrows, drift is insignificant

Sub-cell 1a St. Abb's Head to The Tyne



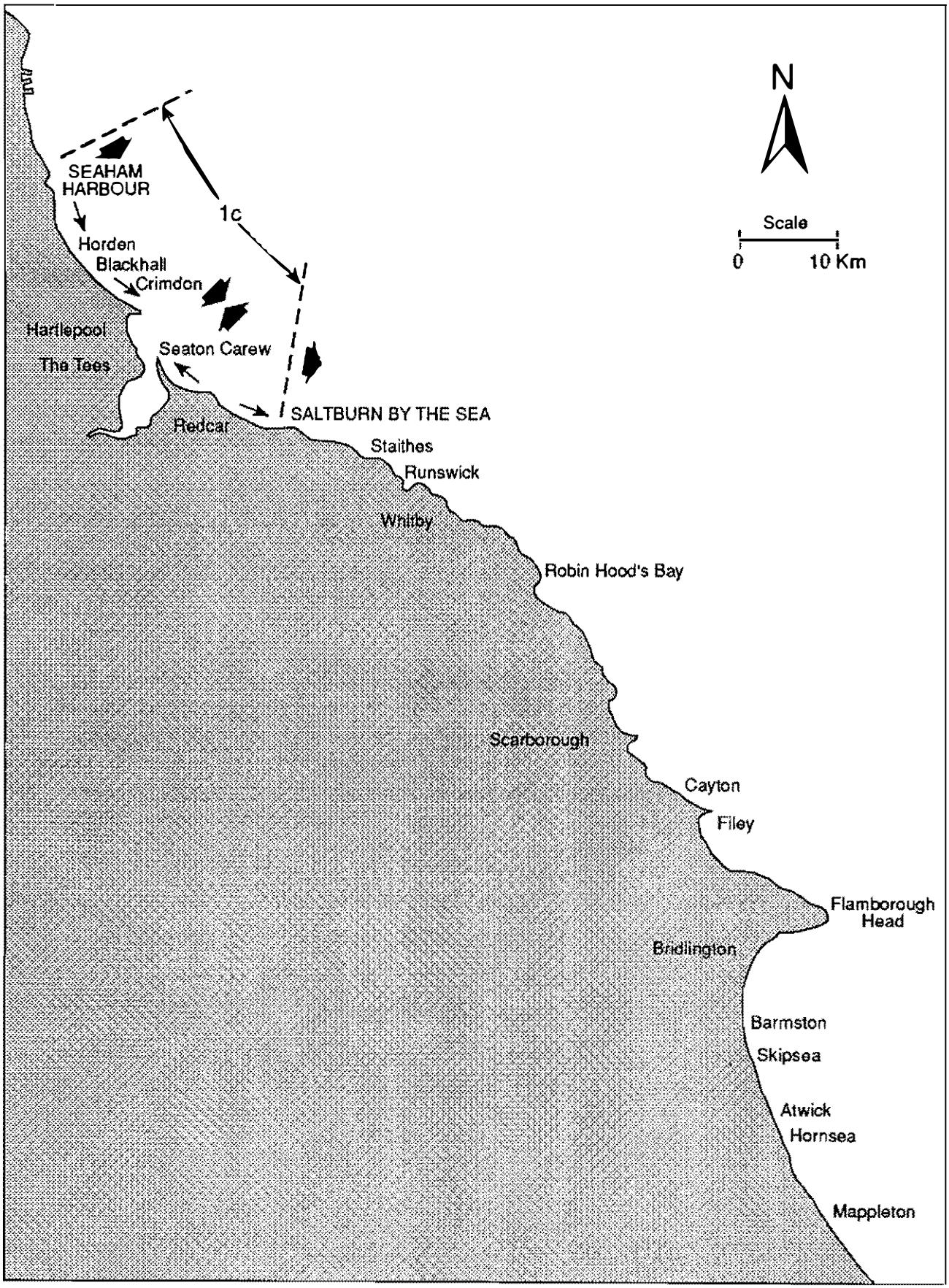
CELL 1	St Abb's Head to Flamborough Head
SUB-CELL 1a	St Abb's Head to The Tyne
COASTAL AUTHORITIES	
District Councils:	Berwick on Tweed, Alnwick, Castle Morpeth, Wansbeck, Blyth Valley, North Tyneside
County Councils:	Borders Region (S), Northumberland, Tyne and Wear
NRA Regions:	Northumbrian
GENERAL	Coast largely undeveloped from St Abb's to Lynemouth, principal towns being Eyemouth, Berwick, Alnmouth and Amble. Heavy development at Newbiggin, Blyth and almost continuously from Seaton Sluice to the Tyne.
BEACHES	Rock platforms south to Berwick. Extensive sand beaches fringed by reefs and backed by low cliffs/dunes south to Seaton Sluice. Sand beaches broken by rock reefs south to the Tyne.
BACKSHORE	Sandstone and limestone cliffs to Berwick. Low limestone cliffs with many igneous intrusions south to Alnmouth. Shales and sandstones with thick cover of boulder clay form headlands and cliffs south to the Tyne.
EROSION	Beach/cliff erosion at Newbiggin and Blyth. Beach despoliation due to erosion of colliery waste from Lynemouth Bay and Cambois. Seabed instability due to mining e.g. Newbiggin. Clay cliffs prone to erosion from Seaton Sluice to the Tyne.
ACCRETION	Sand/silt accretion at Holy Island.
AREAS OF FLOOD RISK	Flood banks near Holy Island.
LITTORAL PROCESSES	Littoral drift is low and intermittent. Sand transport interrupted by rock reefs and headlands. Only a weak dependency between adjacent sand bays. Wave action produces strong seasonal onshore/offshore sand movement. Dunes provide a landward reservoir of beach material. Tidal currents have a southerly residual and reinforce southerly sand transport on the beach and nearshore sea bed.

Sub-cell 1b The Tyne to Seaham Harbour



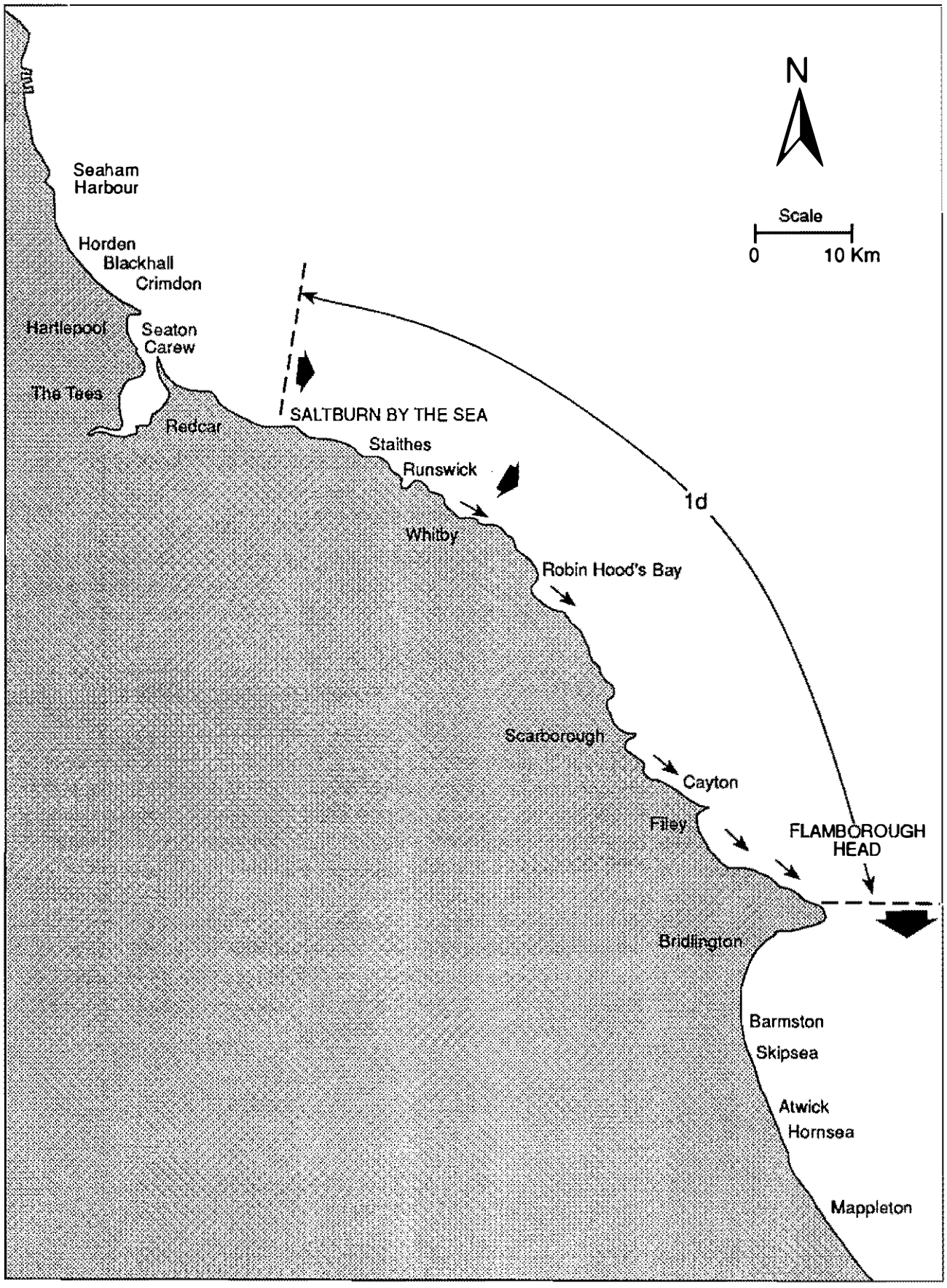
CELL 1	St. Abb's Head to Flamborough Head
SUB-CELL 1b	The Tyne to Seaham Harbour
COASTAL AUTHORITIES	
District Councils:	South Tyneside, Sunderland, Easington
County Councils:	Tyne and Wear, Durham
NRA Regions:	Northumbrian
GENERAL	Partly developed, cliffed coast. Can be treated as one unit for planning purposes, but actually forms two cells, The Tyne to Sunderland, Sunderland to Seaham.
BEACHES	Sand at South Shields and Whitburn. Sand and pebbles (the latter from cliff erosion) from Sunderland to Seaham.
BACKSHORE	Magnesian limestone cliffs with heavy overburden of boulder clay which increases in thickness southwards.
EROSION	Localised sand dune erosion at South Shields. Cliff erosion widespread from South Shields to Seaham.
ACCRETION	Accretion of cliff derived pebbles between Sunderland and Seaham.
AREAS OF FLOOD RISK	None.
LITTORAL PROCESSES	Low and intermittent southward drift, with beaches divided by rock headlands and harbour arms. Weak dependency between adjacent beaches. However eroding cliffs provide beach building material, particularly to the south of Sunderland. Wave action produces strong seasonal onshore/offshore sand movement. Tidal currents have a southerly residual and reinforce the southward transport on the lower beach and on the nearshore sea bed.

Sub-cell 1c Seaham Harbour to Saltburn



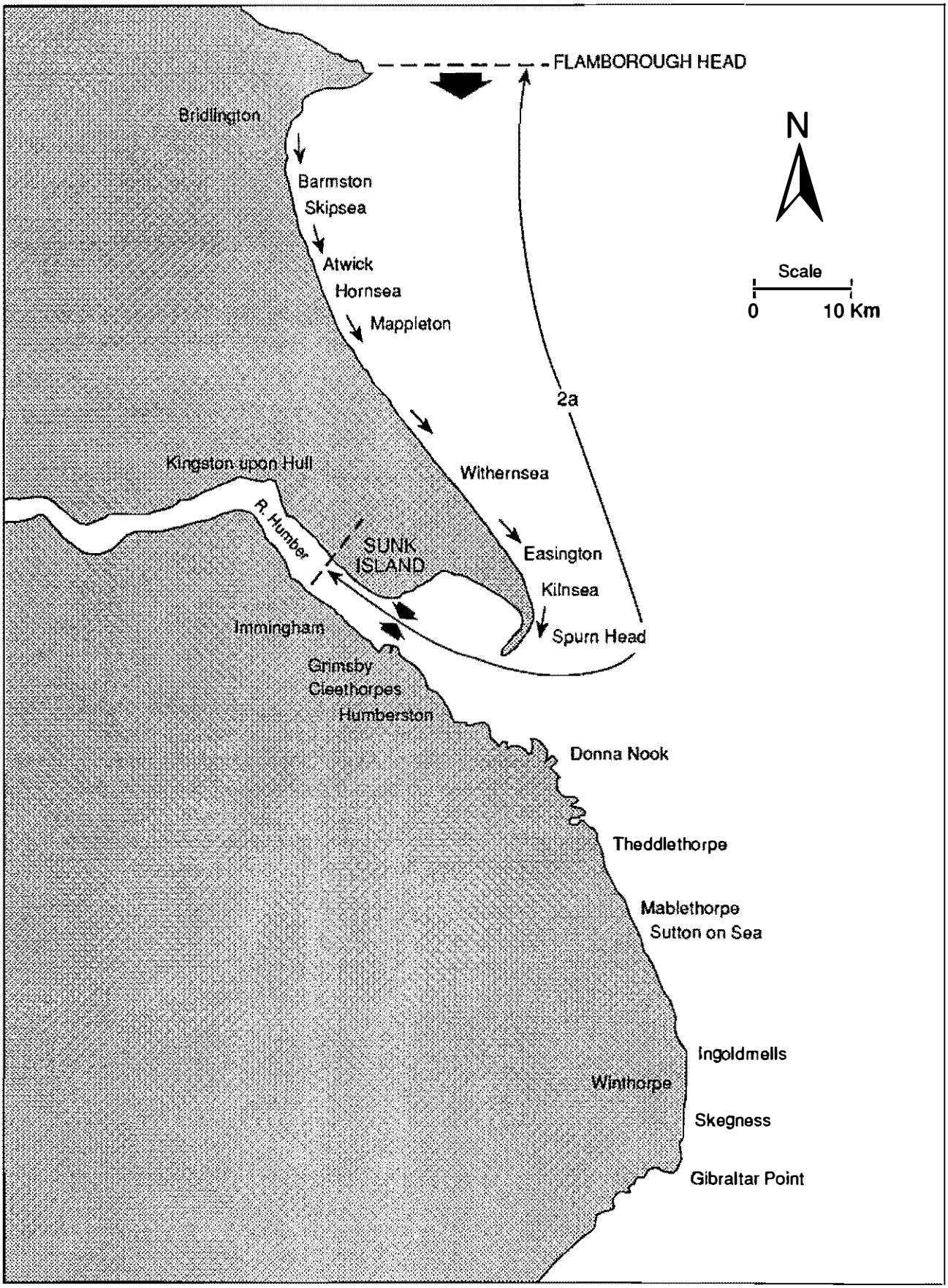
CELL 1	St Abb's Head to Flamborough Head
SUB-CELL 1c	Seaham Harbour to Saltburn
COASTAL AUTHORITIES	
District Councils:	Easington, Hartlepool, Langbaurgh on Tees
County Councils:	Durham, Cleveland
NRA Regions:	Northumbrian
GENERAL	Cliffed coastline is largely undeveloped but both cliffs and beaches marred by colliery workings from Seaham to Blackhall. Major urban and industrial development in Hartlepool and Tees bays.
BEACHES	Sand beaches contain a high proportion of shales, limestones and coal particles, between Seaham and Crimdon. Sand beaches from Crimdon to Saltburn.
BACKSHORE	Magnesian limestone cliffs with heavy overburden of boulder clay from Seaham to Crimdon. Sand dunes to Hartlepool. Low lying land to Redcar. Low shale/clay cliffs to Saltburn.
EROSION	Disintegration of colliery spoil causing beach retreat between Seaham and Blackhall Rocks. Dune erosion from Crimdon Park to Northsands, Hartlepool. Beach erosion in Tees and Hartlepool bays (seasonal).
ACCRETION	Sand accretion at the mouth of the Tees.
AREAS OF FLOOD RISK	Potential flood problems at Carr House Sands, in Hartlepool Bay.
LITTORAL PROCESSES	Moderate southward drift (Shale transport high). Wave action produces seasonal onshore/offshore sand movement and a southerly transport of beach material. Beaches extend beyond the natural coastline due to large scale colliery waste disposal. Cliffs therefore only partly interrupt drift. Tidal currents have a southerly residual and reinforce the southward transport of sand and colliery waste on the lower beach and on the nearshore sea bed. Heavily polluted beaches erode due to natural disintegration of waste. Only short stretches of cliff subject to erosion, hence provide only a limited supply of beach building material. Strong dependence between adjoining coasts and coastal works likely to have a strong knock-on effect downdrift.

Sub-cell 1d Saltburn to Flamborough Head



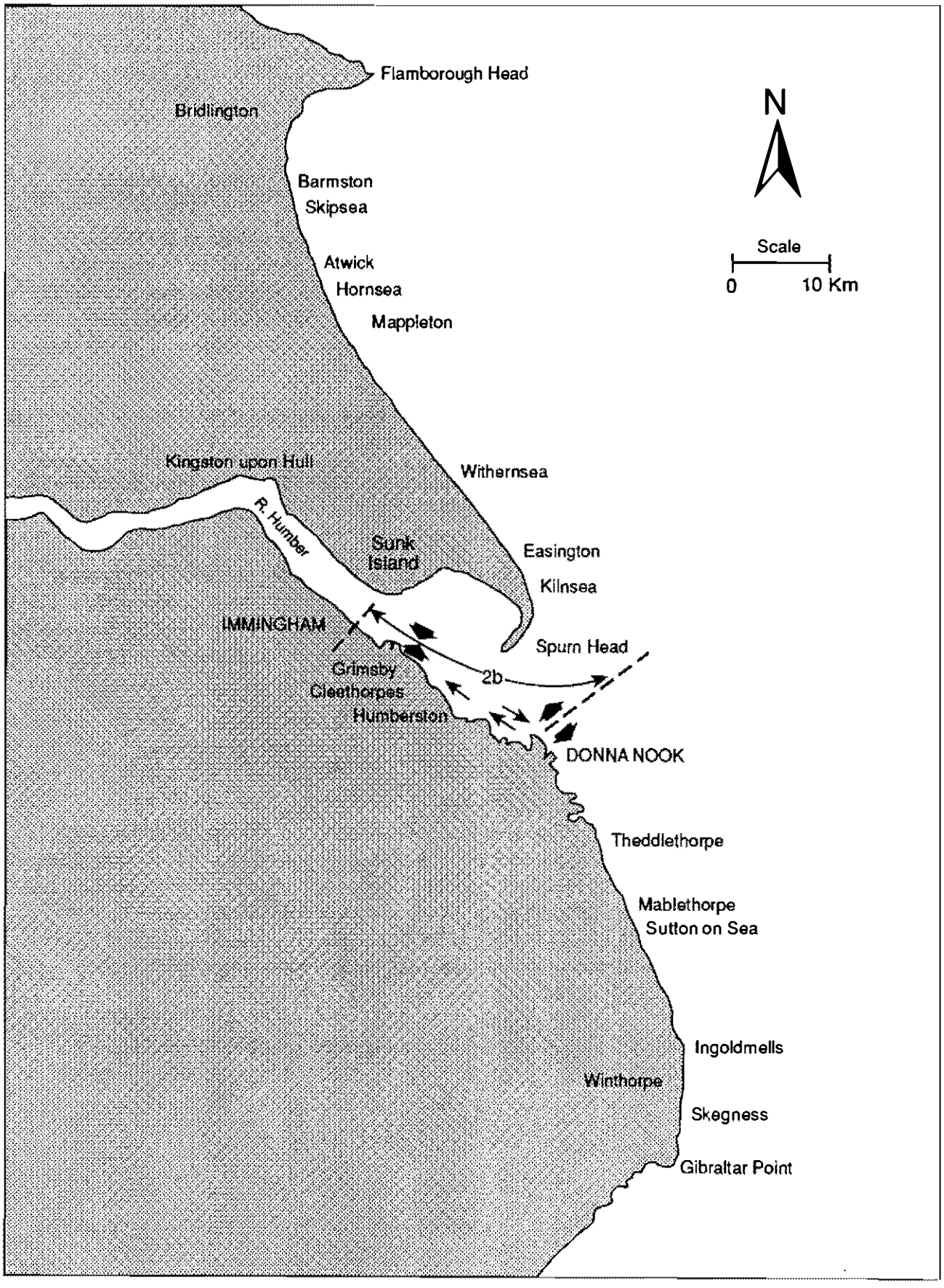
CELL 1	St Abb's Head to Flamborough Head
SUB-CELL 1d	Saltburn to Flamborough Head
COASTAL AUTHORITIES	
District Councils:	Langbaurgh on Tees, Scarborough, East Yorkshire
County Councils:	Cleveland, North Yorkshire, Humberside
NRA Regions:	Yorkshire
GENERAL	Generally unspoilt, cliffed coastline with major population centres only at Whitby, Scarborough and Filey.
BEACHES	Sandy bays formed generally where the boulder clay outcrops at sea level. Otherwise the foreshore at foot of cliffs is rocky with little beach material.
BACKSHORE	Shale/clay cliffs with overburden of boulder clay over virtually the whole length, but with chalk cliffs at Flamborough Head.
EROSION	Cliff erosion along most of the coastline. Cliff instability, weathering and toe scour occur in most of the bays e.g Runswick, Whitby, Robin Hood's Bay, Scarborough and Filey.
ACCRETION	Not known if any significant accretion is taking place.
AREAS OF FLOOD RISK	No known areas at risk.
LITTORAL PROCESSES	Littoral drift is low and intermittent. Wave action produces seasonal onshore/offshore movement but material is generally retained within bays which are strongly indented. Tidal currents dominate the southward transport of material in the nearshore zone. Erosion of cliffs provides an important supply of sand in bays. A large amount of fines is also transported offshore and then southwards by currents. There would appear to be little interaction between embayments because of the isolated nature of the beaches.

Sub-cell 2a Flamborough Head to Sunk Island



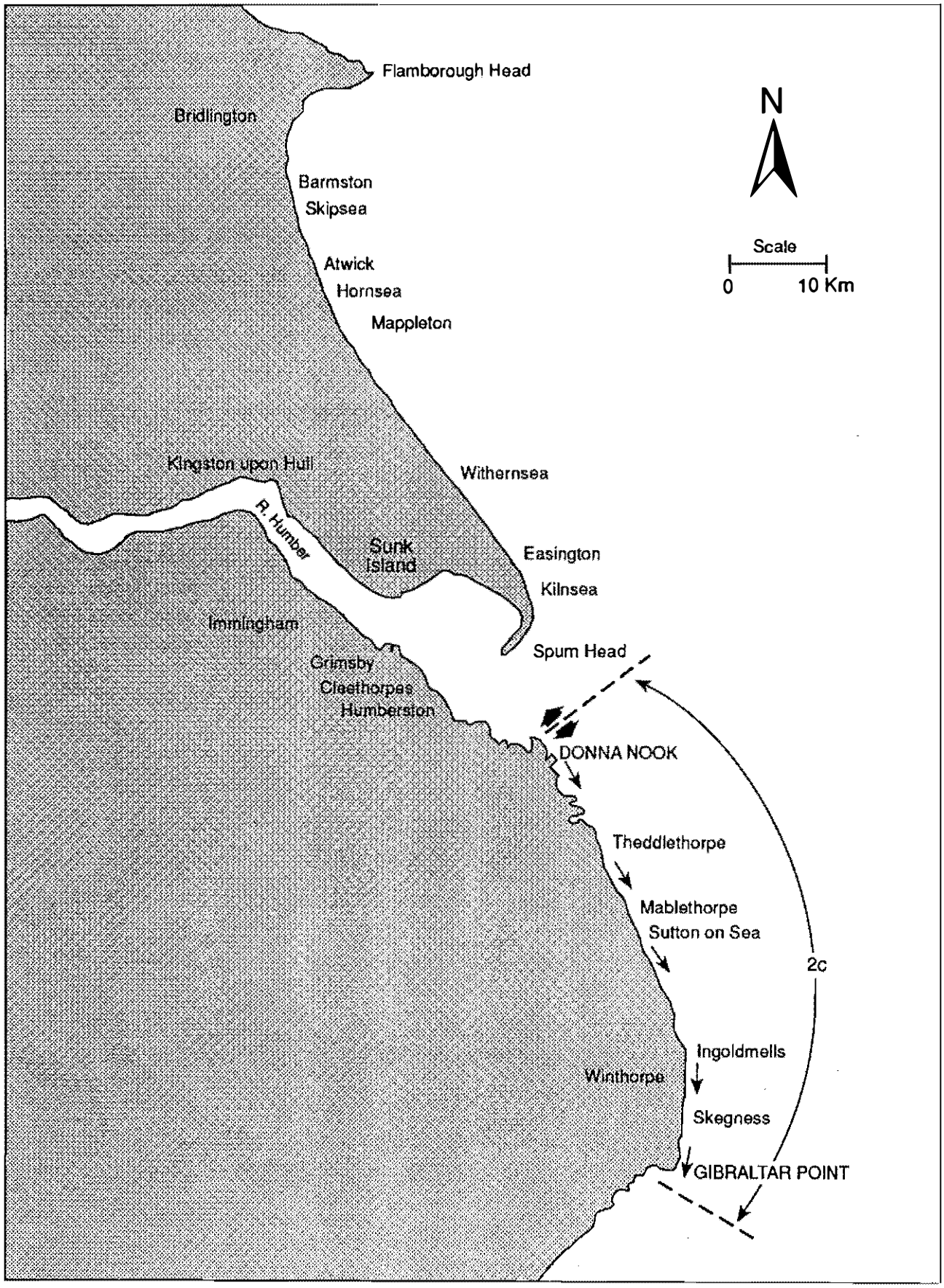
CELL 2	Flamborough Head to The Wash
SUB-CELL 2a	Flamborough Head to Sunk Island
COASTAL AUTHORITIES	
District Councils:	East Yorkshire, Holderness
County Councils:	Humberside
NRA Regions:	Yorkshire
GENERAL	Undeveloped, largely agricultural coastline with urban centres at Bridlington, Hornsea and Withernsea. There are also several clifftop villages which are at risk from cliff retreat (e.g. Barmston, Skipsea, Atwick, Mappleton and Kilnsea) The north shore of the Humber could be treated as a sub-cell. It is included within this cell due to its dependence on the shelter of Spurn Head.
BEACHES	Thin veneer of sand, patches of pebbles over clay substratum. Mud flats on the north shore of the Humber.
BACKSHORE	Chalk cliffs at Flamborough Head. Boulder clay cliffs to Spurn Head, which are subject to weathering and rapid cliff toe erosion. Extensive saltmarshes on the north shore of the Humber.
EROSION	Rapid and persistent cliff and beach erosion over the whole frontage from Bridlington to Spurn Head. Long term retreat causing serious loss of agricultural land. Hornsea and Withernsea are becoming "isolated" by coastal recession and will therefore be at increasing risk of beach erosion.
ACCRETION	Salt marsh accretion on the north shore of the Humber.
AREAS OF FLOOD RISK	Minor flood risk at Barmston, Easington and Kilnsea.
LITTORAL PROCESSES	High southward drift on the open coast. Little nett drift on the north shore of the Humber. Waves in combination with tidal currents transport material derived from cliff erosion seawards and southwards. Deficit of material and coastal retreat causing a permanent lowering of clay substratum and persistent beach erosion. Where stretches of coast are defended there are serious downdrift erosion problems, including accelerated cliff retreat. Erosion provides a feed of sand to the Lincolnshire coast.

Sub-cell 2b Immingham to Donna Nook



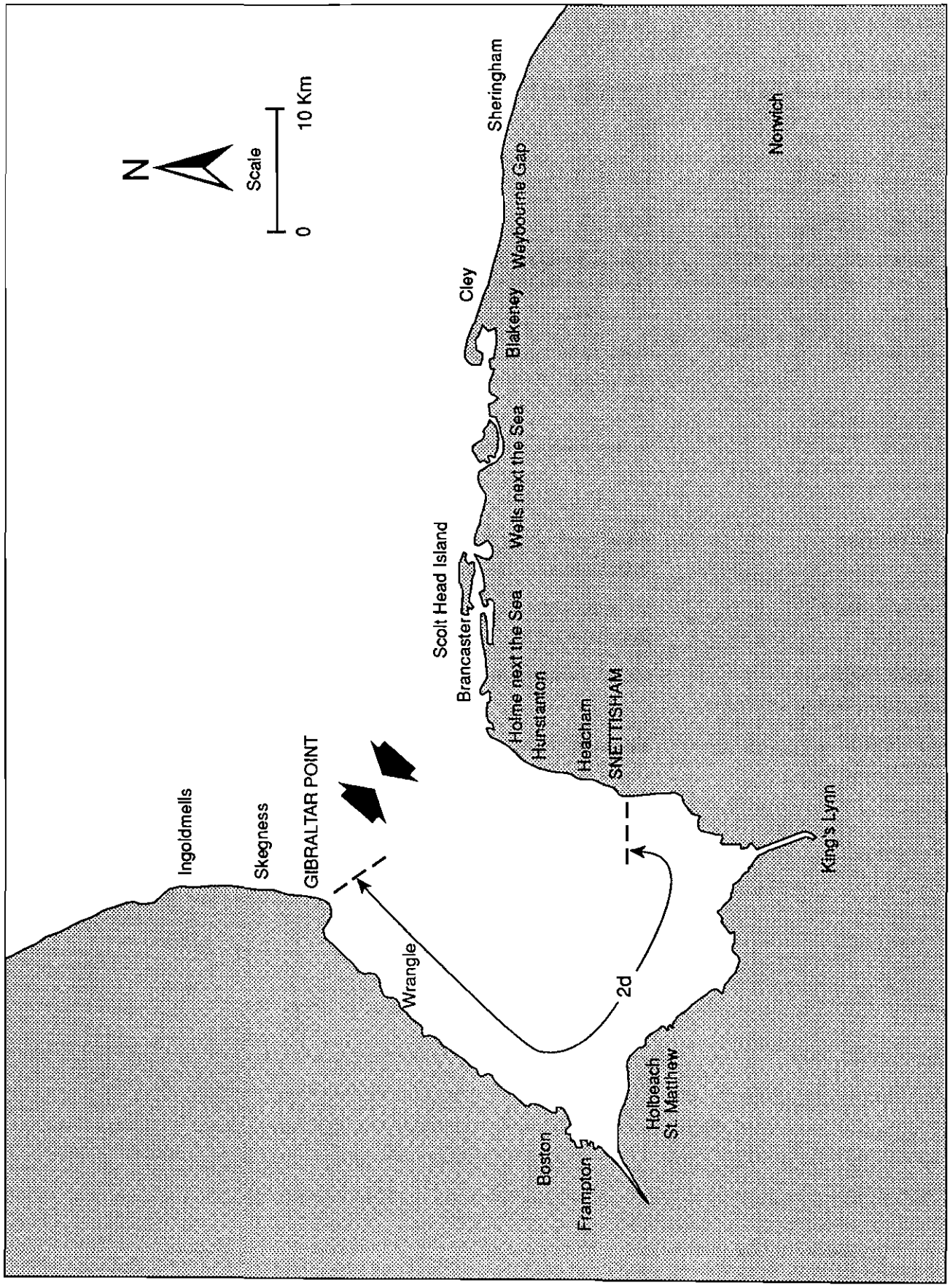
CELL 2	Flamborough Head to The Wash
SUB-CELL 2b	Immingham to Donna Nook
COASTAL AUTHORITIES	
District Councils:	Cleethorpes, East Lindsey
County Councils:	Humberside, Lincolnshire
NRA Regions:	Anglian
GENERAL	Low lying, partly industrial land on the south shore of the Humber.
BEACHES	Mud and sand on the south shore of the Humber east to Grimsby, gives way to sand at Cleethorpes and wide sands backed by salt marshes towards Donna Nook.
BACKSHORE	Low lying marshland.
EROSION	Minor local dune erosion south of Cleethorpes.
ACCRETION	Extensive sand accretion and salt marshes at Donna Nook.
AREAS OF FLOOD RISK	Immingham to Donna Nook.
LITTORAL PROCESSES	Low littoral drift of sand into Humber estuary from Donna Nook. Waves and tidal currents supply and redistribute material from the coast north of the Humber across the Humber estuary to Lincolnshire. The accretion of sand at Donna Nook and the adjacent sea bed provide a source of sand to the Lincolnshire coast. There are no coastal works in this area which affect this process significantly.

Sub-cell 2c Donna Nook to Gibraltar Point



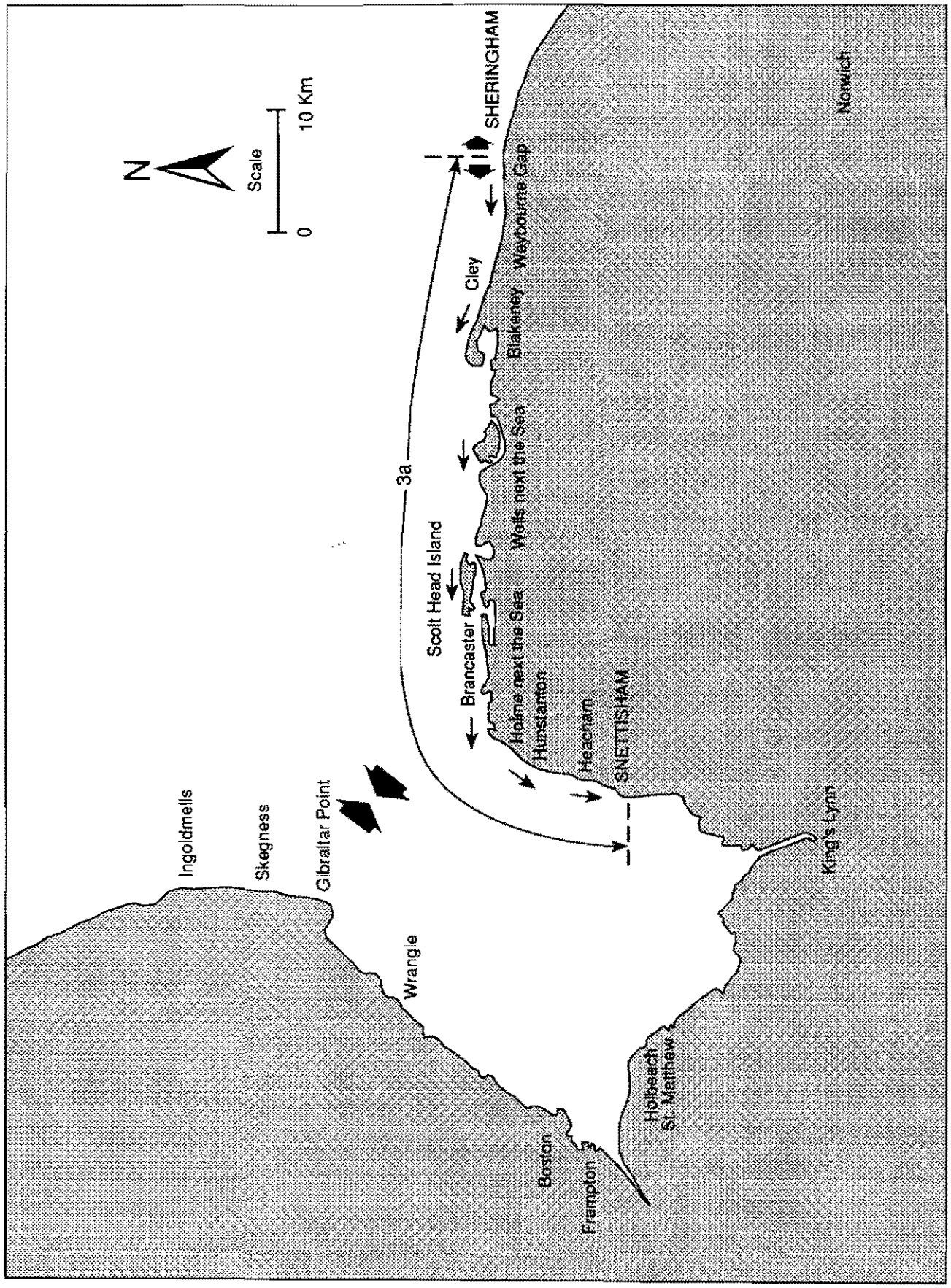
CELL 2	Flamborough Head to The Wash
SUB-CELL 2c	Donna Nook to Gibraltar Point
COASTAL AUTHORITIES	
District Councils:	East Lindsey
County Councils:	Lincolnshire
NRA Regions:	Anglian
GENERAL	Lightly developed low lying land susceptible to both flooding and erosion. Hard defences (e.g. seawalls) concentrated from Mablethorpe to Skegness.
BEACHES	Wide sand beach from Donna Nook to Mablethorpe. From here to Skegness, beach becomes less healthy and very narrow in places.
BACKSHORE	Extremely low lying land. Marshes at Donna Nook give way to sand dunes from Theddlethorpe south to Mablethorpe. Sea bank separates land from sea from Mablethorpe south to Skegness. Sand dunes in front of salt marsh from Skegness south to Gibraltar Point.
EROSION	Sand beaches underlain by clay substratum. Erosion of this causing beach steepening from Mablethorpe to Skegness.
ACCRETION	Wide accreting sand flats at Donna Nook. Seaward extension of sand beach and dune build up south of Skegness.
AREAS OF FLOOD RISK	Whole frontage prone to flooding.
LITTORAL PROCESSES	Moderate southward littoral drift of sand. Wave action is working on an easily erodible low lying coast. Deficit of supply and erosion of clay substrate lead to beach lowering and steepening. Some feed to the coast believed to be taking place via flood dominant currents from the offshore banks northeast of Skegness. Tidal flows in and out of the Humber and the Wash modify sediment processes at either end of the coast.

Sub-cell 2d Gibraltar Point to Snettisham



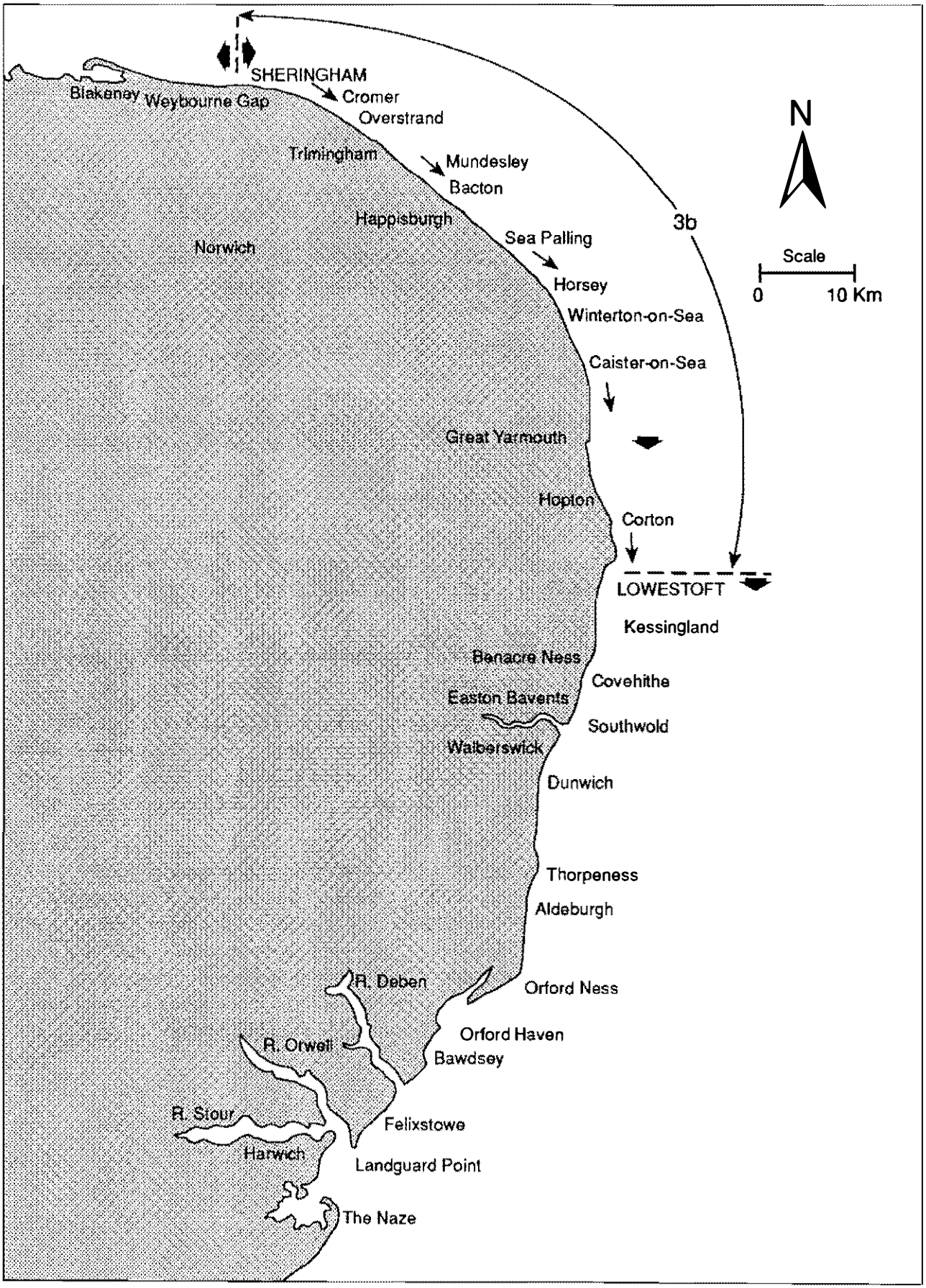
CELL 2	Flamborough Head to The Wash
SUB-CELL 2d	Gibraltar Point to Snettisham
COASTAL AUTHORITIES	
District Councils:	East Lindsey, Boston, South Holland, King's Lynn and West Norfolk
County Councils:	Lincolnshire, Norfolk
NRA Regions:	Anglian
GENERAL	Low lying undeveloped land reclaimed from the sea, fronted by saltmarshes.
BEACHES	Saltmarsh fronted by sand and mudflats.
BACKSHORE	Flood bank with low lying agricultural land to the landward (protected by 2nd and 3rd line banks).
EROSION	No significant areas of erosion.
ACCRETION	Siltation by current borne sediments is enhanced by alluvial deposits discharged by rivers. Saltmarsh colonisation in progress.
AREAS OF FLOOD RISK	The whole coastal frontage is low lying. At risk from extreme high tides between Gibraltar Point and Frampton.
LITTORAL PROCESSES	No significant drift, fine sands and silts being brought in predominantly by tidal action. Tidal currents distribute fine sediments and provide impetus for salt marsh development, particularly on west and south margins of the Wash.

Sub-cell 3a Snettisham to Sheringham



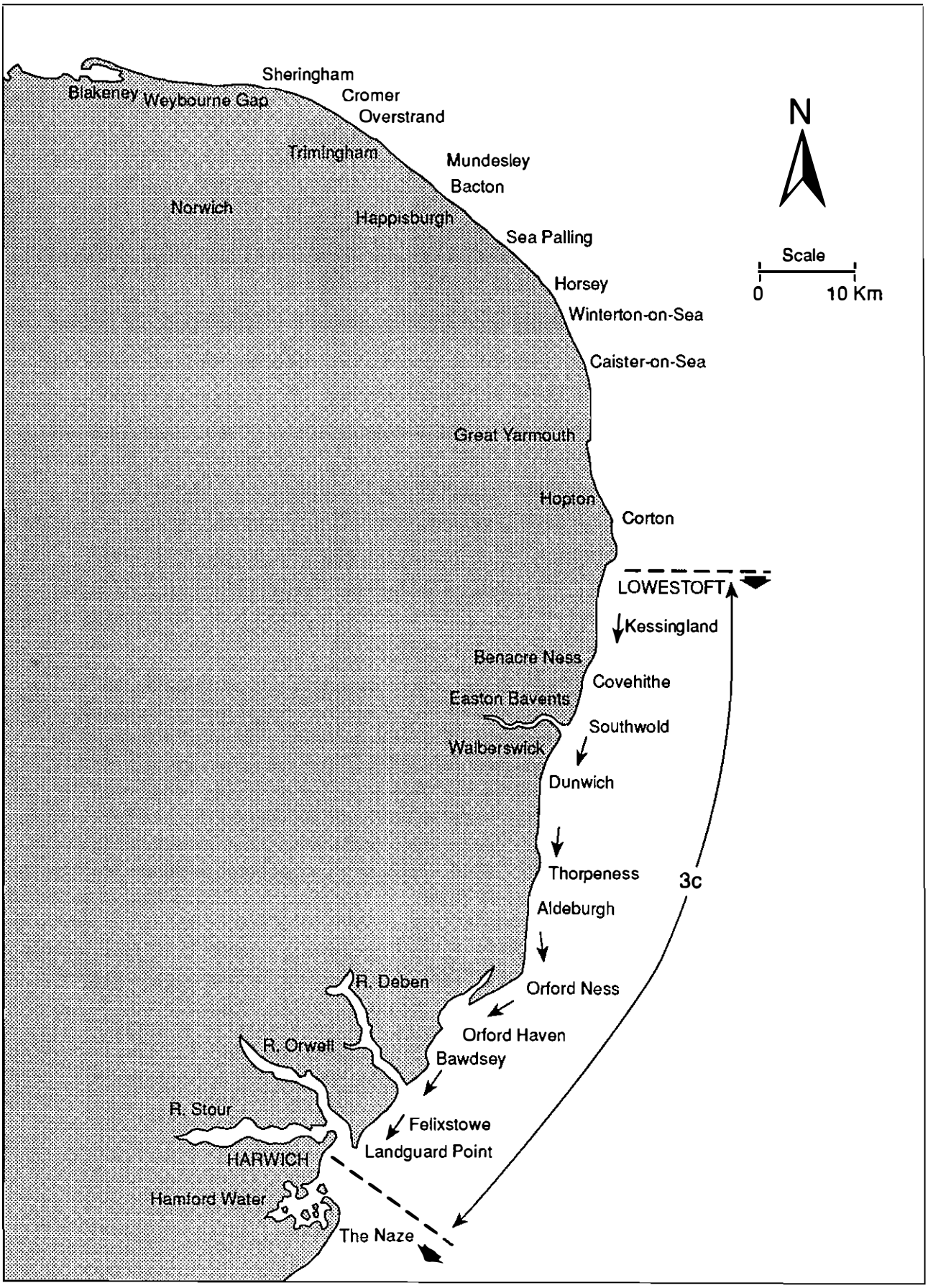
CELL 3	The Wash to The Thames
SUB-CELL 3a	Snettisham to Sheringham
COASTAL AUTHORITIES	
District Councils:	King's Lynn and West Norfolk, North Norfolk
County Councils:	Norfolk
NRA Regions:	Anglian
GENERAL	Low lying land which is undeveloped, with the exception of Heacham to Hunstanton to the west and Sheringham to the east. Large areas reclaimed in past centuries.
BEACHES	Mainly sand but with discontinuous shingle spits from Scolt Head Island to Weybourne.
BACKSHORE	Predominantly low lying marshland but with sand dunes between Hunstanton and Holme; also at Brancaster and Wells. Chalk cliffs at Hunstanton. Shingle bank from Cley to Weybourne. Sand/clay cliffs from Weybourne to Sheringham.
EROSION	Sand dunes suffer seasonal erosion between Hunstanton and Holme. Some evidence of landward retreat of shingle ridges, particularly from Cley to Weybourne. Continuous erosion of soft sand/clay cliffs east of Weybourne.
ACCRETION	A generally accretionary coastline between Hunstanton and Blakeney with salt marsh developing in the lee of shingle spits.
AREAS OF FLOOD RISK	Coastline from Snettisham to Hunstanton has floodbanks/seawalls. Natural coastline from Hunstanton to Weybourne. Floodbanks generally on old coastline from Hunstanton to Cley. Natural shingle banks, sand dunes and spits form the front line of defence against the sea from Hunstanton to Weybourne Gap.
LITTORAL PROCESSES	Moderate rate of westward drift from Sheringham to Hunstanton, then reducing to near zero at Snettisham. A predominantly accretionary coastline with an offshore supply of sand and silt, together with a supply of pebbles from the east. Both waves and currents are important in present day processes. Waves dominate coastal processes east of Blakeney. From here to Snettisham, tidal flows become increasingly important, particularly on the lower part of the foreshore.

Sub-cell 3b Sheringham to Lowestoft



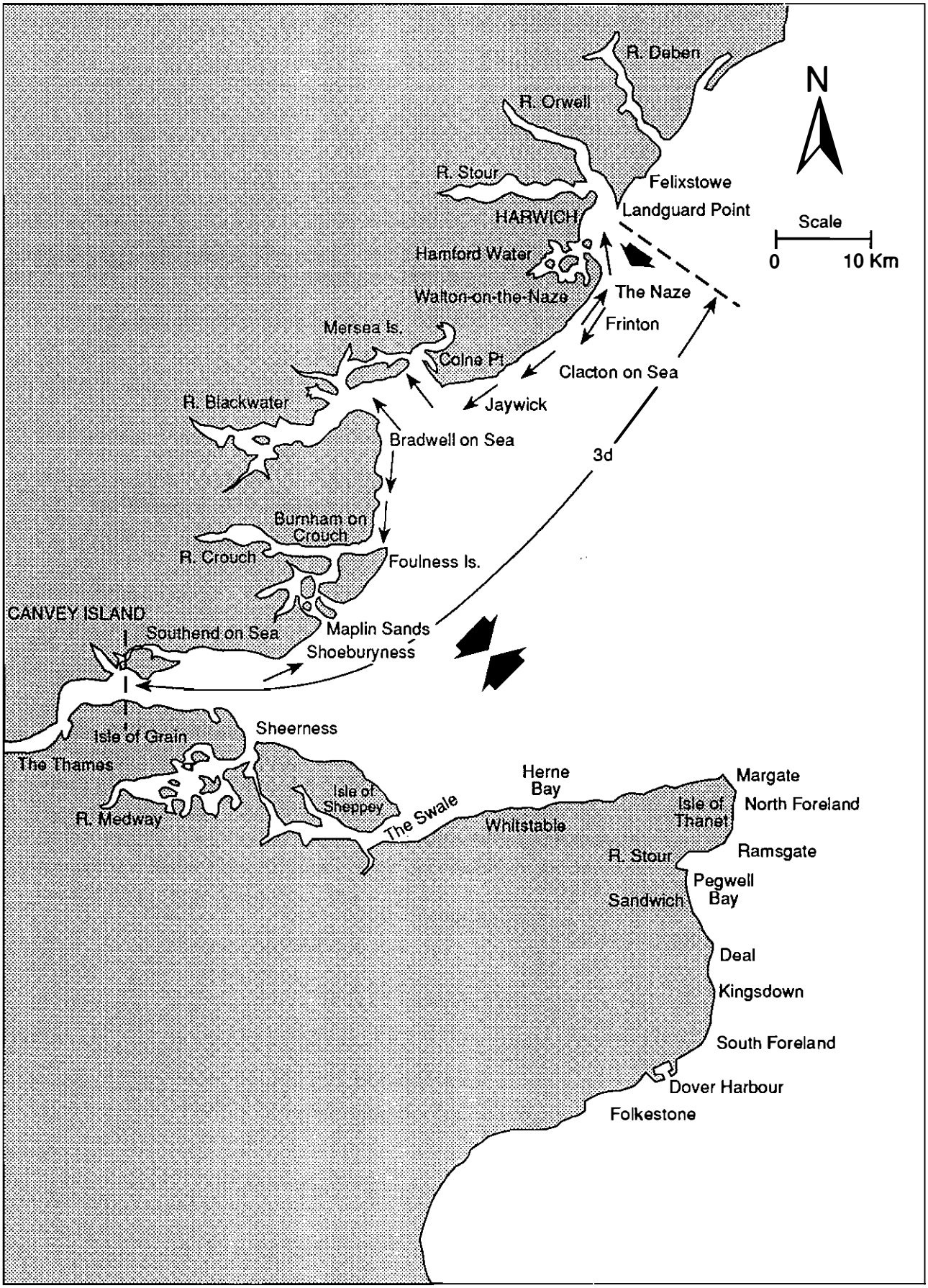
CELL 3	The Wash to The Thames
SUB-CELL 3b	Sheringham to Lowestoft
COASTAL AUTHORITIES	
District Councils:	North Norfolk, Great Yarmouth, Waveney
County Councils:	Norfolk, Suffolk
NRA Regions:	Anglian
GENERAL	A vulnerable coastline with many towns and villages spread along a frontage of sand/clay cliffs or sand dunes.
BEACHES	Predominantly sand with areas of pebbles derived from cliff erosion.
BACKSHORE	Sand/clay cliffs interspersed by lower lying land, fronted in most places by sand dunes and hard defences.
EROSION	Fairly rapid and widespread cliff erosion while sand dune areas and nesses are also liable to fluctuate. Considerable erosion over past 1000 years indicated by 'lost' villages.
ACCRETION	Nesses are accretionary points, but they may migrate in an alongshore direction, or may in some instances lack a contemporary supply.
AREAS OF FLOOD RISK	Much of the frontage between Happisburgh and Winterton is at risk. This length of coast also protects Broadland from direct flooding from the North Sea.
LITTORAL PROCESSES	High drift rate to east and south Both waves and tidal currents play an important role in fashioning the coast. Waves transport material southwards from eroding cliffs, providing a vital source of supply for downdrift beaches. Residual tidal currents form a link between the movements of the nearshore system of sand banks and beach changes. Impact of major works is likely to be widespread and to a large extent unpredictable. Major coastal works north of Lowestoft could have an impact to the south, in which case the frontage from Sheringham to Harwich (sub-cells 3b and 3c) may in some instances need to be treated as an interdependent unit. Coastal works to the south of Lowestoft are not likely to have a significant impact on the coast to the north, unless they are on such a scale as to impact on the nearshore sand bank behaviour.

Sub-cell 3c Lowestoft to Harwich



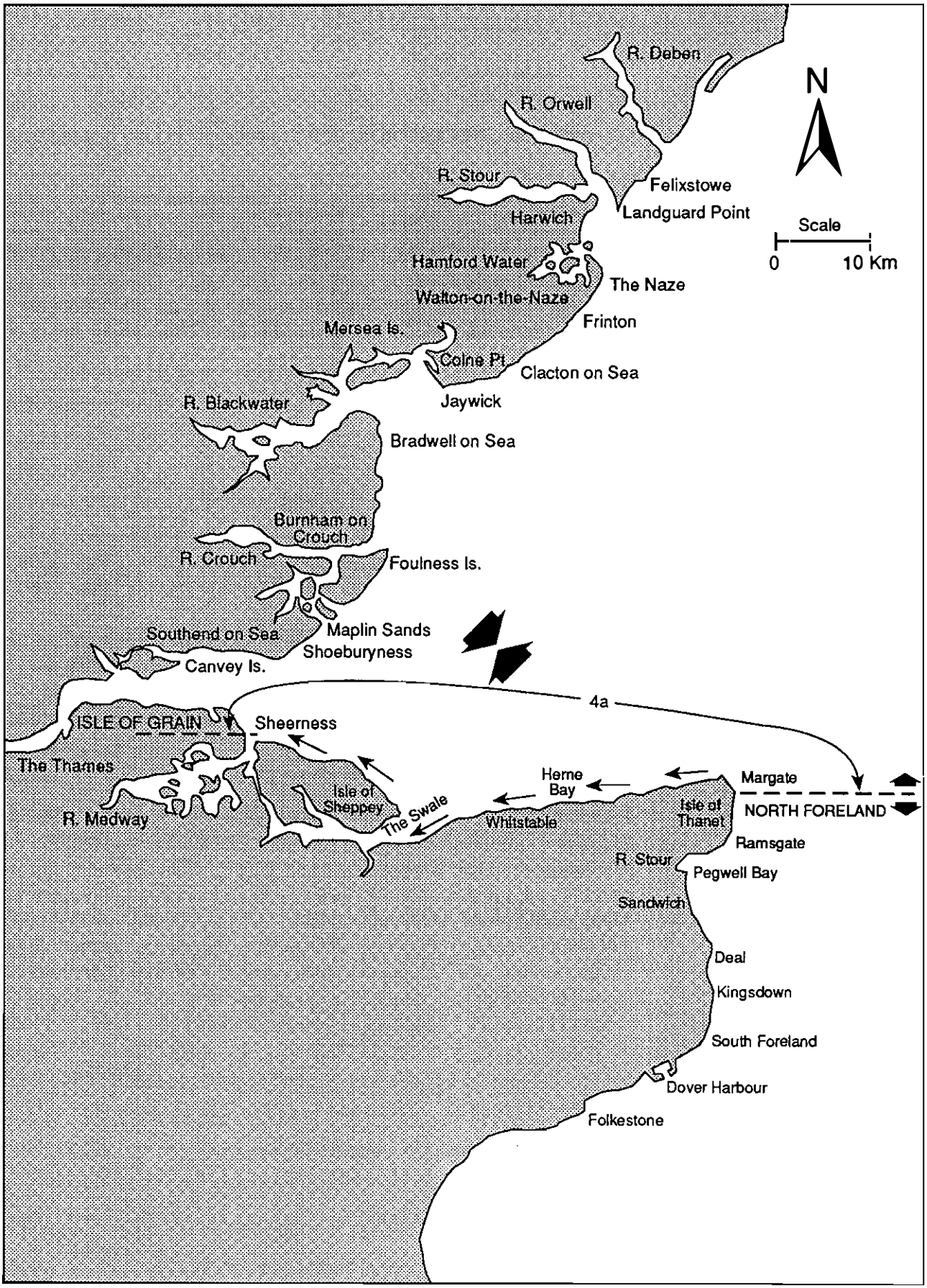
CELL 3	The Wash to The Thames
SUB-CELL 3c	Lowestoft to Harwich
COASTAL AUTHORITIES	
District Councils:	Waveney, Suffolk Coastal, Babergh
County Councils:	Suffolk
NRA Regions:	Anglian
GENERAL	A vulnerable coastline with many towns and villages situated on glacial cliffs or on low lying land fronted by shingle ridges.
BEACHES	Sandy beach at Lowestoft. Sand and shingle beaches south to Landguard Point.
BACKSHORE	Low glacial cliffs with intervening low ground separated from the sea by substantial shingle ridges.
EROSION	Cliff erosion at Covehithe, Easton Bavents and Dunwich. Erosion of beach south of Aldeburgh. Coastal slope instability from Bawdsey to Felixstowe. Beach erosion from Felixstowe to Landguard Point.
ACCRETION	Local accretion at Benacre Ness and from Thorpeness to Aldeburgh
AREAS OF FLOOD RISK	Flood risk widespread. From Walberswick south, shingle storm beaches form the line of defence as far south as Orford Haven. Low lying areas of Felixstowe at risk.
LITTORAL PROCESSES	Littoral drift is southward with a high sand transport and a moderate shingle transport. Both waves and tidal currents play an important role in fashioning the coast. Waves transport material southwards from eroding cliffs providing an important supply for downdrift beaches. Offshore banks are tidally formed - processes are complicated by tidal flows at mouths of the Deben, and Orwell/Stour Estuaries. Residual currents form a link between the movements of the nearshore system of sand banks and beach changes. Impact of major works is likely to be widespread. Coastal works north of Lowestoft (Cell 3b) may have an impact on this frontage.

Sub-cell 3d Harwich to Canvey Island



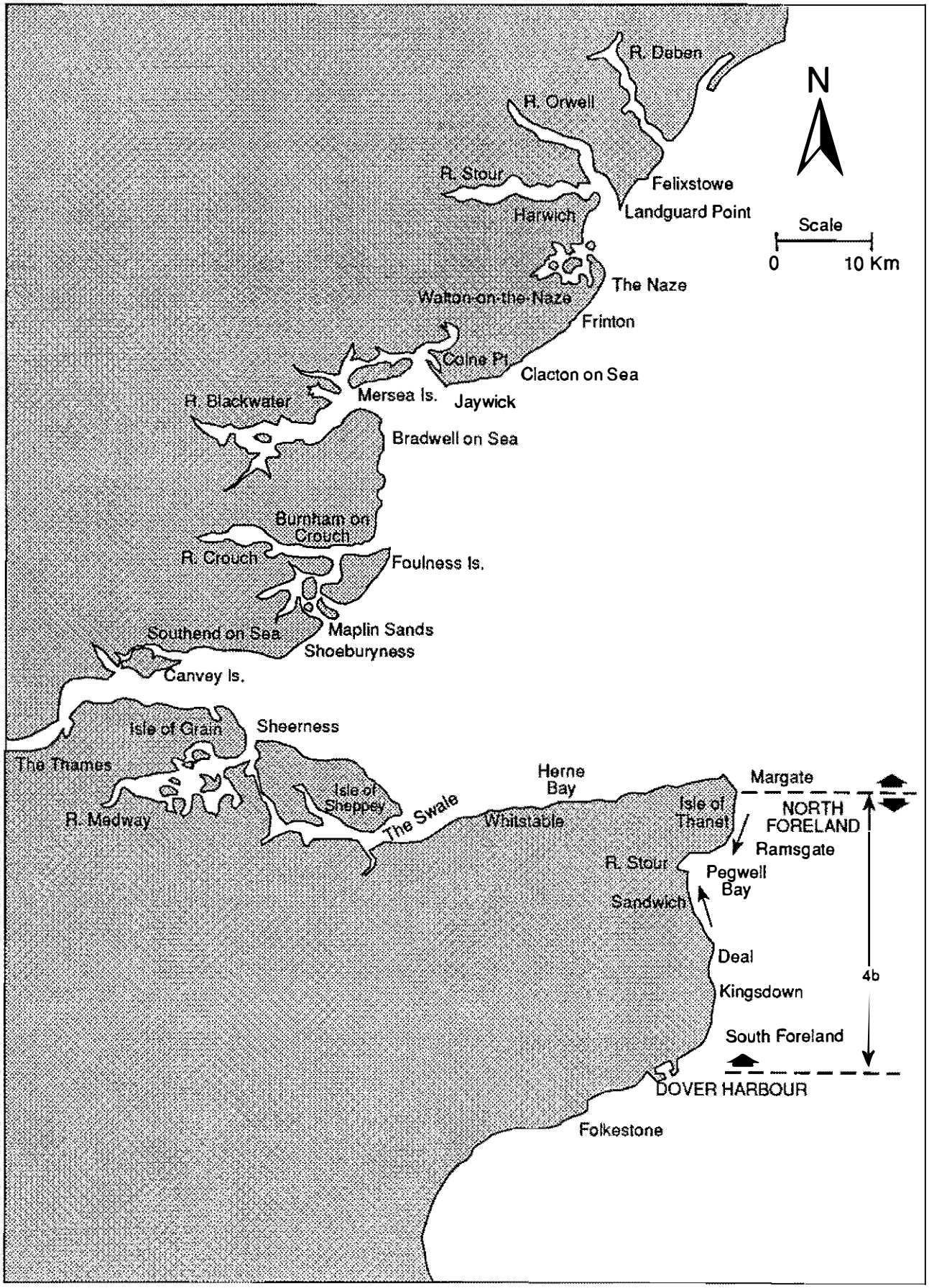
CELL 3	The Wash to The Thames
SUB-CELL 3d	Harwich to Canvey Island
COASTAL AUTHORITIES	
District Councils:	Tendring, Colchester, Maldon, Rochford, Southend on Sea, Castle Point
County Councils:	Essex
NRA Regions:	Anglian
GENERAL	Low lying "soft" coastline has extensive frontages protected by flood banks within creeks and around islands. The coast is inaccessible and undeveloped except for the Tendring Peninsula (e.g. Clacton frontage). Little interaction between frontages separated by rivers, creeks etc.
BEACHES	Beaches have a thin veneer of sand from Harwich to River Blackwater. To the south there is a wide intertidal zone of sands, silts and muds with saltmarsh to landward.
BACKSHORE	Predominantly marshland or low lying agricultural land but with clay cliffs at Walton on the Naze, Frinton and Clacton on Sea.
EROSION	Cliff erosion at Walton on the Naze. Thin sand cover makes beaches susceptible to erosion between the Naze and Colne Point. General decline of saltmarshes in Hamford Water and south of river Blackwater.
ACCRETION	Maplin Sands and other intertidal banks probably accreting.
AREAS OF FLOOD RISK	Much of the coastline is at risk, especially as many of the flood banks are in a poor state of repair and are vulnerable to breaching/flooding. Canvey Island which is heavily populated and which has high value industrial development to the south, is protected by substantial flood defences, but is at potential risk during high surges.
LITTORAL PROCESSES	Moderate southward drift from the Naze to Colne Point. Low southward rate of drift south to the Thames. Erosion of the soft coast produces little beach building material. Estuary mouths break up the coast into many, almost self-contained, frontages. The decline of beaches between Walton and Jaywick can be attributed to the lack of supply from the north (sand and shingle from the north shore of the Orwell/Stour appears to be swept seawards into the approaches to Harwich Harbour). Tidal currents appear to be dispersing silts and muds seawards after erosive events.

Sub-cell 4a Isle of Grain to North Foreland



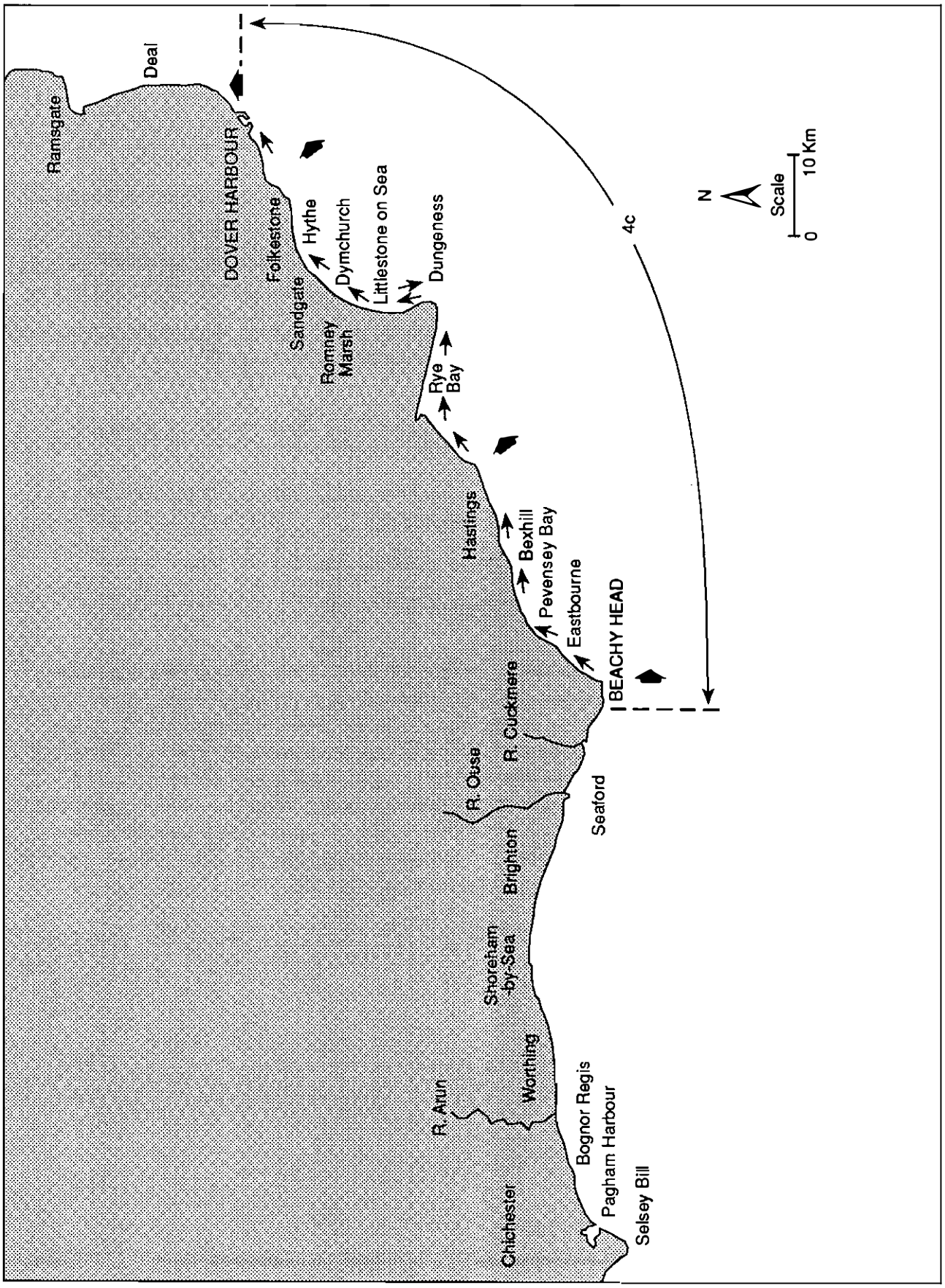
CELL 4	The Thames to Selsey Bill
SUB-CELL 4a	Isle of Grain to North Foreland
COASTAL AUTHORITIES	
District Councils:	Rochester upon Medway, Swale, Canterbury, Thanet
County Councils:	Kent
NRA Regions:	Southern
GENERAL	Predominantly low lying coast with clay cliffs to west and chalk cliffs to east. Urban frontages separated by stretches of low lying agricultural land.
BEACHES	Extensive mud flats with sand or shingle upper beaches. Chalk reefs outcrop on Isle of Thanet.
BACKSHORE	Boulder clay cliffs and areas of saltmarsh/reclaimed land from Isle of Sheppey to Isle of Thanet. Chalk cliffs on the Isle of Thanet.
EROSION	Cliff slippage at Isle of Grain and Isle of Sheppey and at east end of Herne Bay. Inadequate supply of sand and shingle causes widespread beach erosion.
ACCRETION	No significant beach build up.
AREAS OF FLOOD RISK	Low lying parts of coastline protected in places by old flood banks. Flood risk is widespread from the Isle of Grain to Thanet.
LITTORAL PROCESSES	Wave induced erosion is widespread. Moderate, but strongly uni-directional, westward drift which rapidly diminishes in strength west of Whitstable. The demand for shingle exceeds supply. Coastal defences likely to have a 'knock-on' effect from Thanet to Whitstable. Shingle nourishment is used to make up deficit. Onshore sand supply (via tidal currents) from Sandwich Bay to Thanet is inadequate for present day needs.

Sub-cell 4b North Foreland to Dover Harbour



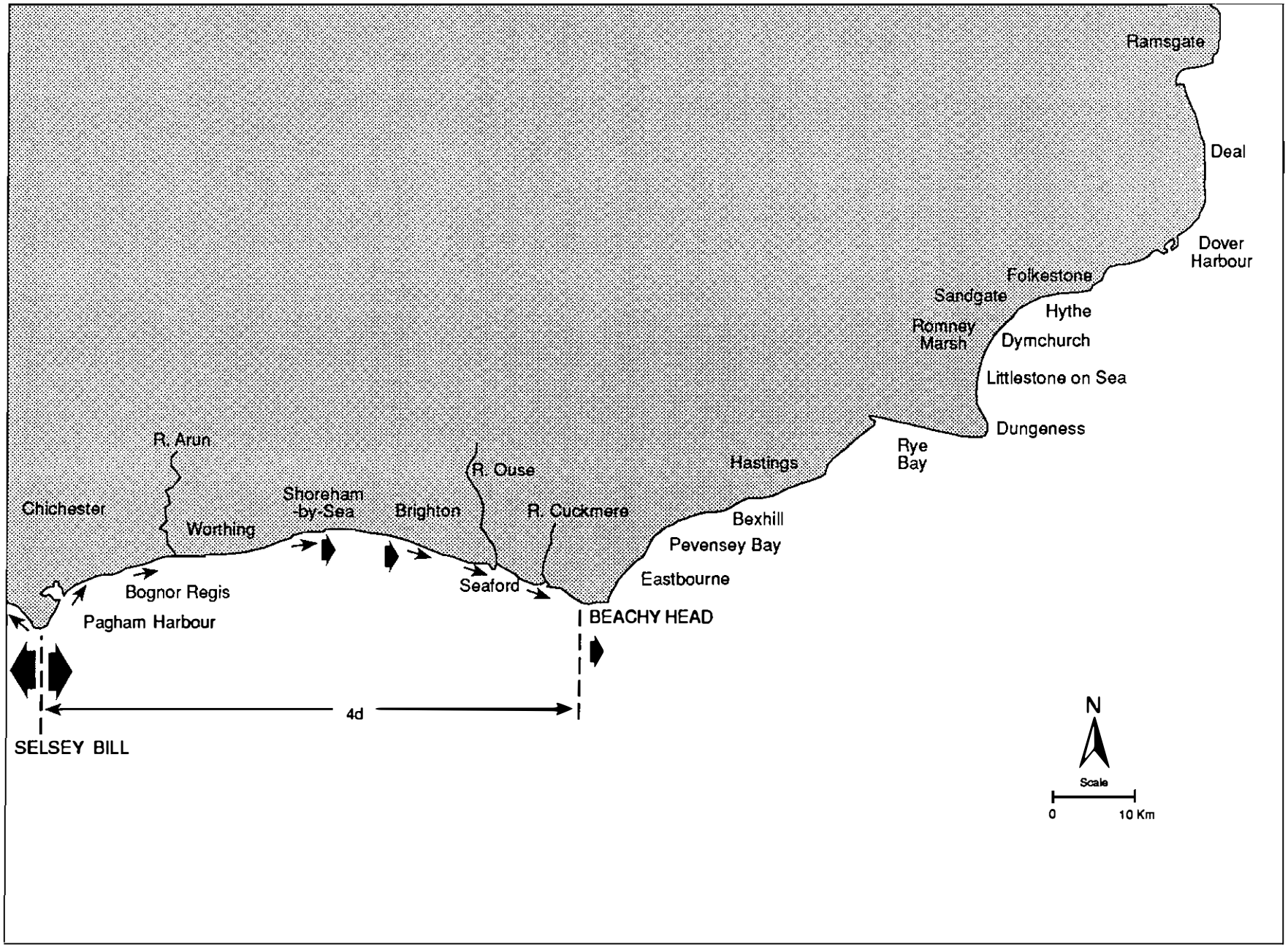
CELL 4	The Thames to Selsey Bill
SUB-CELL 4b	North Foreland to Dover Harbour
COASTAL AUTHORITIES	
District Councils:	Thanet, Dover
County Councils:	Kent
NRA Regions:	Southern
GENERAL	Urban cliffed coast on Isle of Thanet. Relatively undeveloped low lying coast in Pegwell Bay. Undeveloped cliffed coast to Dover and beyond.
BEACHES	Thin sand cover over chalk on Isle of Thanet. Sand/mudflats in Pegwell Bay. Sand and increasing quantities of shingle from river Stour to Kingsdown.
BACKSHORE	Chalk cliffs, except in Sandwich Bay where backshore is saltmarsh and sand dunes.
EROSION	Chalk cliff recession at a slow rate in Thanet. Shingle ridge recession between Deal and Kingsdown.
ACCRETION	Sand and silt build up on the intertidal flats in Pegwell Bey.
AREAS OF FLOOD RISK	No known areas of serious flood risk.
LITTORAL PROCESSES	Generally low southward drift rate in Thanet due to rock headlands interrupting drift. Moderate northward shingle transport between Kingsdown and entrance to Stour. No perceivable transport around South Foreland but there is a potential eastward drift from Dover to Kingsdown. Wave induced "unidirectional drift" results in coastal defences having a significant knock-on effect between Kingsdown and Pegwell Bay. Tidal currents bring in sand and silt as suspended load into Pegwell Bay. Tidal currents also transport sand in small quantities across Sandwich Bey to North Foreland.

Sub-cell 4c Dover Harbour to Beachy Head



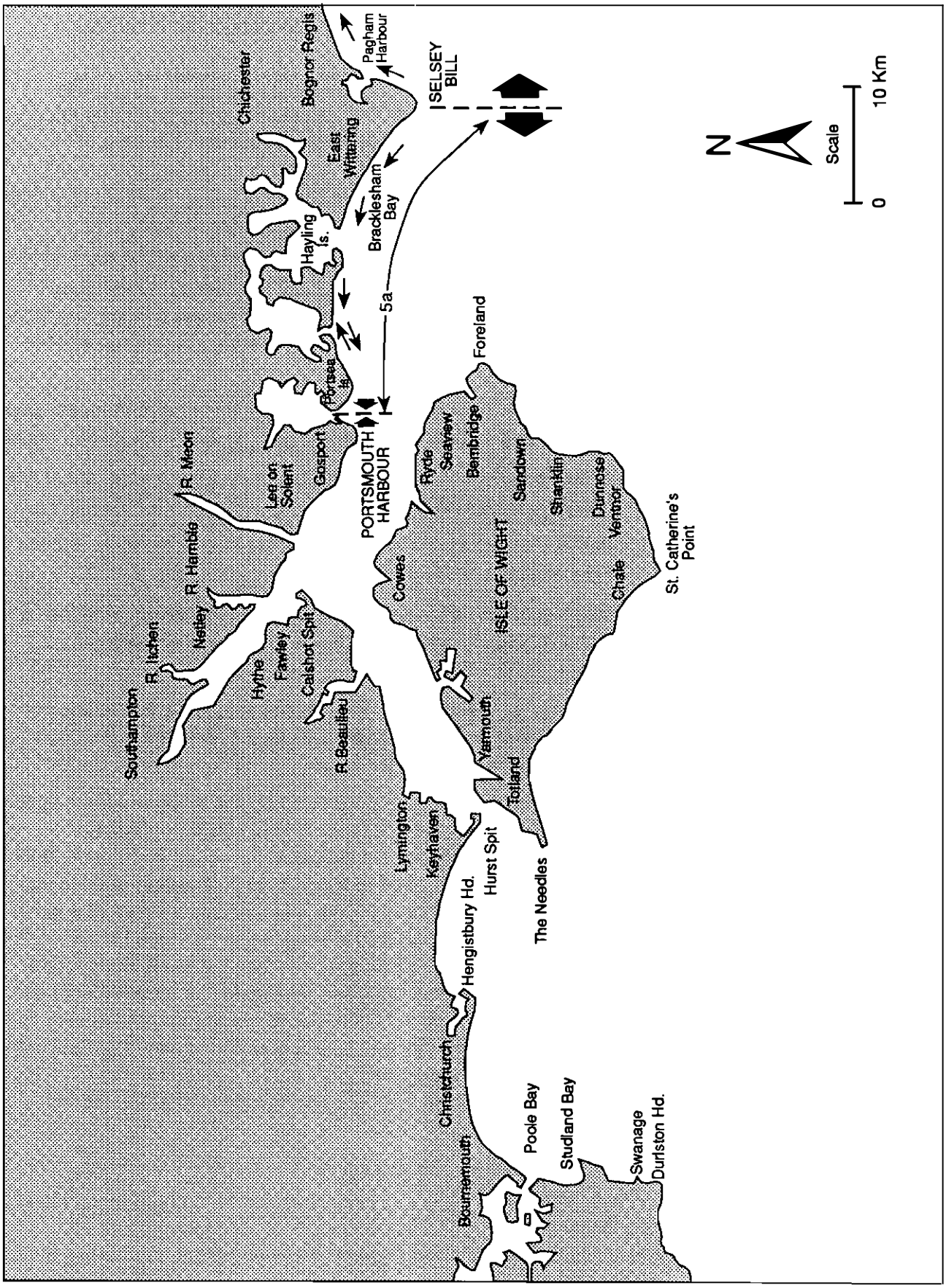
CELL 4	The Thames to Selsey Bill
SUB-CELL 4c	Dover Harbour to Beachy Head
COASTAL AUTHORITIES	
District Councils:	Dover, Shepway, Rother, Hastings, Wealden, Eastbourne
County Councils:	Kent, East Sussex
NRA Regions:	Southern
GENERAL	Heavily developed frontages contrasting with long frontages of marshland or low lying agricultural land.
BEACHES	Shingle beaches overlying wide sand lower foreshores.
BACKSHORE	Chalk/gault clay cliffs giving way to sands and clays from Dover to Sandgate. Low lying land to near Hastings. Sandstone cliffs to Bexhill. Low lying land to Eastbourne, terminating at the chalk promontory of Beachy Head.
EROSION	Erosion prevalent over the major part of the frontage with coastal defences/harbour works having a knock-on effect on the littoral drift.
ACCRETION	Natural shingle accretionary features at Dungeness and at Crumbles (between Eastbourne and Pevensey). Localised accretion wherever drift is interrupted by harbour arms.
AREAS OF FLOOD RISK	Much of the low lying coast at risk (Sandgate to Littlestone, Rye Bay and Pevensey Bay being risk areas).
LITTORAL PROCESSES	Moderate eastward transport of sand and shingle by predominant south-westerly waves, with local reversal on the east face of Dungeness foreland. Coastal defences and harbours have a widespread 'knock-on' effect. As a result of offshore losses at Dungeness the coastline to east is suffering from a deficit of beach material supply. This is a very large subcell because of the continuity of shingle drift and consequent widespread 'knock-on' effect of coastal works.

Sub-cell 4d Beachy Head to Selsey Bill



CELL 4	The Thames to Selsey Bill
SUB-CELL 4d	Beachy Head to Selsey Bill
COASTAL AUTHORITIES	
District Councils:	Eastbourne, Wealden, Lewes, Brighton, Hove, Adur, Worthing, Arun, Chichester
County Councils:	East Sussex, West Sussex
NRA Regions:	Southern
GENERAL	Heavily developed stretch of coastline and one requiring very heavy expenditure on coast protection. Continuity of shingle drift and knock-on effect of coastal works make it necessary to treat this long frontage as one sub-cell.
BEACHES	Predominantly shingle storm ridges on sands, overlying chalk to the east and boulder clay to the west.
BACKSHORE	Chalk cliffs from Beachy Head to Brighton. Low lying land to Selsey Bill, where low sand/clay cliffs form the Bill.
EROSION	Erosion of shingle beaches very widespread. Losses made up in some areas by artificial nourishment.
ACCRETION	Localised accretion wherever drift is interrupted by harbour arms and at river mouths (e.g. Cuckmere and Ouse). Significant accretion at Pagham Harbour entrance.
AREAS OF FLOOD RISK	Widespread. Low lying land in Seaford Bay was prone to flooding prior to artificial beach nourishment. Main areas of flood risk are frontages between Shoreham and Bognor Regis.
LITTORAL PROCESSES	Moderate eastward transport of sand and shingle by predominant south-westerly waves is interrupted by a number of harbours. Coastal defences and harbours have a widespread 'knock-on' effect. Very little present day supply from coast erosion due to proliferation of defences. Supply of shingle from Selsey Bill now considerably reduced as a result of protection of cliffs at the Bill. However, there is believed to be onshore shingle movement from the nearshore banks off the Bill. The feed is variable and occurs in pulses, by wave action from the south. Kelp rafted transport of shingle can also occur over the frontage between Brighton and Pagham. The supply is very small but may constitute the only natural present day source.

Sub-cell 5a Selsey Bill to Portsmouth Harbour

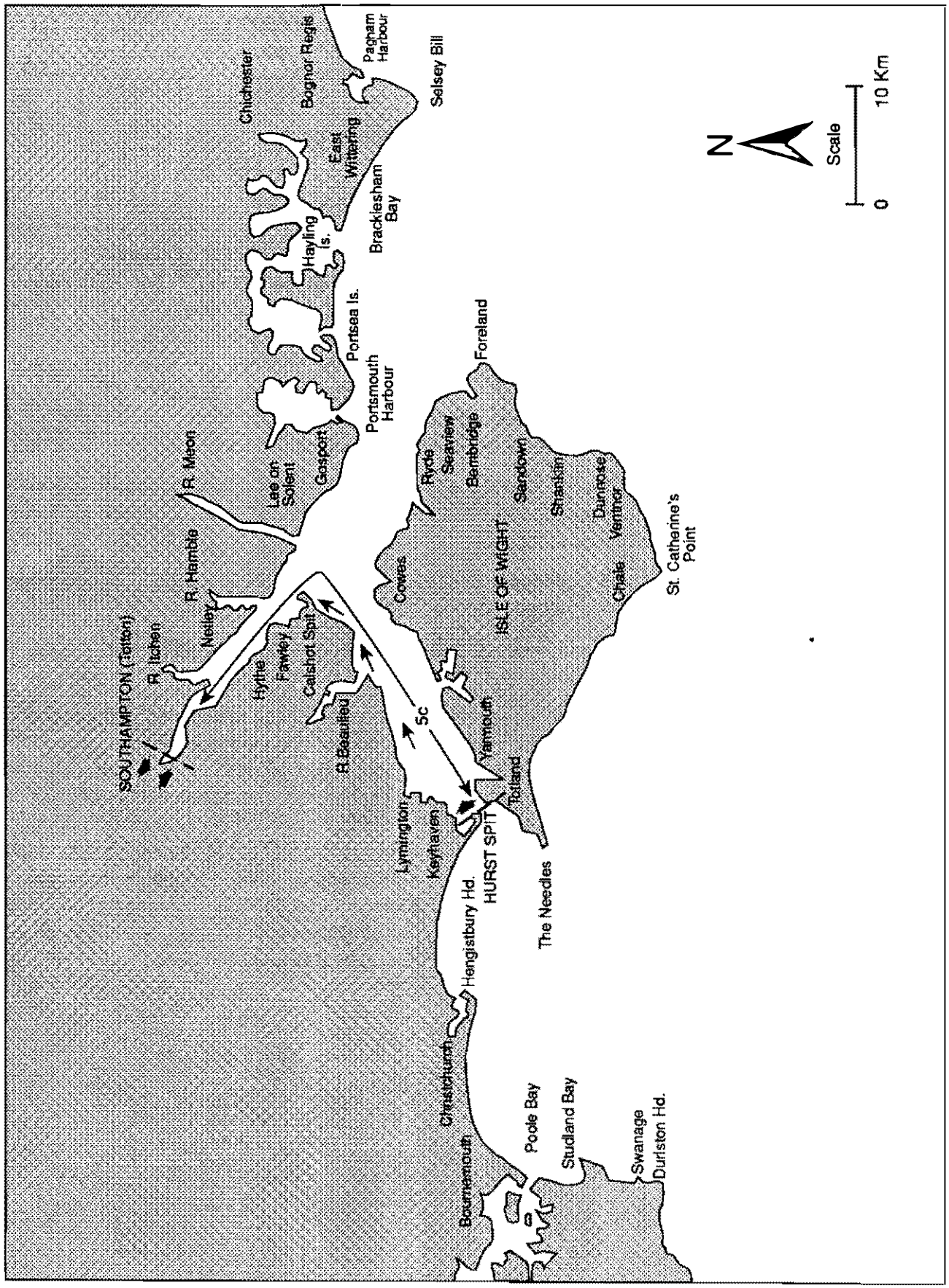


CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5a	Selsey Bill to Portsmouth Harbour
COASTAL AUTHORITIES	
District Councils:	Chichester, Havant, Portsmouth
County Councils:	West Sussex, Hampshire
NRA Regions:	Southern
GENERAL	The urban centres along this frontage, (e.g. Bracklesham, East Wittering, Hayling and Portsmouth) are all on low lying land. Selsey Bill is on higher ground. The coast is an eroding one and coast protection works have a knock on effect.
BEACHES	Shingle storm ridges over sand lower foreshores.
BACKSHORE	Predominantly low lying land or marshland. Sand/clay cliffs over short frontage at Selsey Bill.
EROSION	Beach erosion prevalent as this is a "soft" coastline.
ACCRETION	East Head at west end of Selsey peninsula. Gunner Point at west end of Hayling Island. Eastney at east end of Portsea Island.
AREAS OF FLOOD RISK	Bracklesham Bay. East end of Hayling Island. Coast road between Southsea and Eastney (Portsea Island).
LITTORAL PROCESSES	A moderate westward drift due to southerly and easterly waves (predominant southwesterly waves diffracted towards north by the Isle of Wight). Rate of drift in recent years has been considerably reduced due to coast protection works and the diminution of beach material supply has been causing erosion from Selsey to Hayling. The drift is intercepted by harbour mouths and beach material is transported offshore onto tidal deltas by rapid ebb currents. Some evidence of an onshore supply of material along this frontage but supply is very small compared with 'demand'. Portsmouth Harbour entrance forms an effective boundary with little interaction between beaches to the west and those to the east. Littoral processes complex but 'knock-on' effect of coastal works is clear from evidence of downdrift erosion problems.

Sub-cell 5b Portsmouth Harbour to Southampton (Totton)

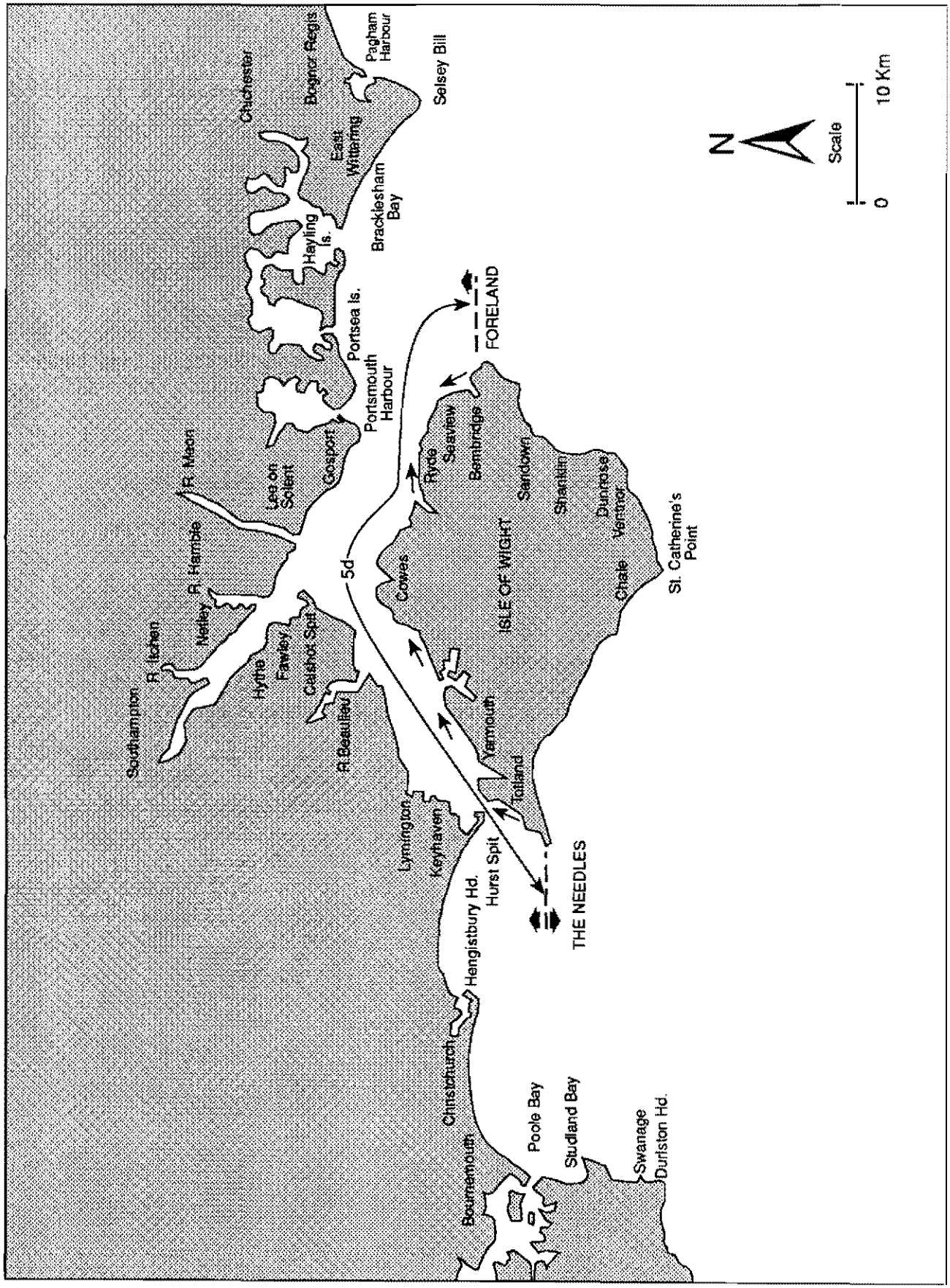
CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5b	Portsmouth Harbour to Southampton (Totton)
COASTAL AUTHORITIES	
District Councils:	Gosport, Fareham, Eastleigh, Southampton
County Councils:	Hampshire
NRA Regions:	Southern
GENERAL	Coastline is generally low lying but with low pebble and sandy cliffs between Lee on Solent and Netley. Wave exposure is not severe and drift effects felt mainly southeast of the river Hamble.
BEACHES	Narrow sand or shingle beaches.
BACKSHORE	Sea walls protect most of the Gosport frontage. Shingle backshore extends west and north to Lee on Solent and beyond. Sandy cliffs north to Netley. Wharves protect Southampton frontage.
EROSION	Most of the east shore of Southampton Water prone to erosion by locally generated waves. Beach erosion at Lee on Solent. Downdrift erosion at Browndown (southeast of Lee on Solent).
ACCRETION	Local accretion at Hill Head. (Near mouth of river Meon). Shingle ridges are accretionary features southeast of Lee on Solent.
AREAS OF FLOOD RISK	North end of Lee on Solent. Mouth of the river Hamble. Netley to the river Itchen.
LITTORAL PROCESSES	Littoral drift is low. Locally generated wave action (in the Solent) is sufficiently strong to cause cliff erosion between the rivers Meon and Hamble and to transport material northwestwards or southeastwards from a 'drift divide' situated approximately centrally on this frontage (near Solent Breezes). While littoral drift is low it is fairly unidirectional and serious downdrift erosion occurs where this drift is interrupted (e.g. south east of Lee on Solent). Tidal currents generally run parallel to the shore and prevent any significant onshore feed of material by wave action. Littoral processes are very weak northwest of the Hamble and beach behaviour is probably dominated by tidal current action.

Sub-cell 5c Southampton (Totton) to Hurst Spit



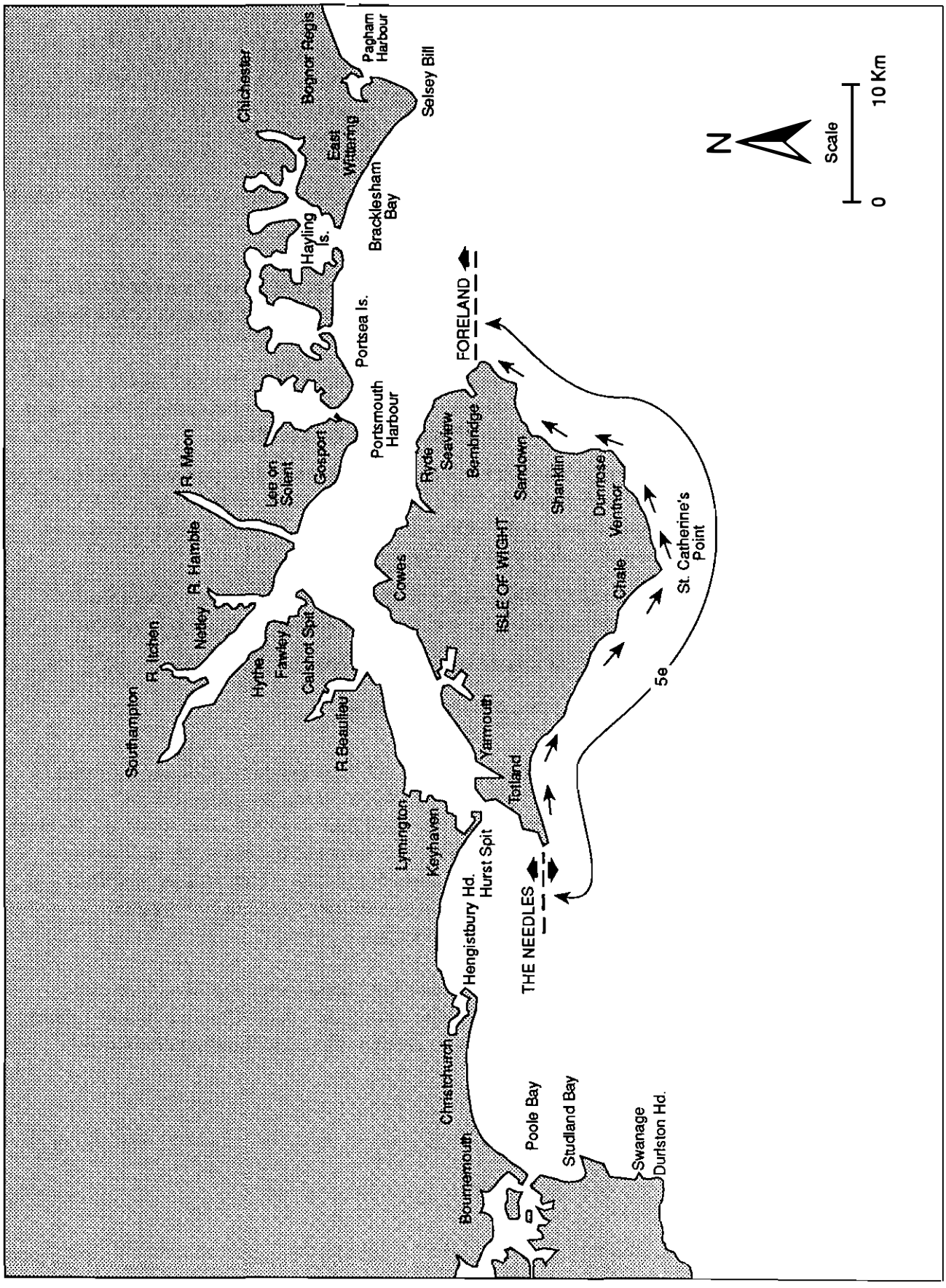
CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5c	Southampton (Totton) to Hurst Spit
COASTAL AUTHORITIES	
District Councils:	New Forest
County Councils:	Hampshire
NRA Regions:	Southern
GENERAL	Low lying land which is largely unprotected, but with urban and industrial development between Hythe and Fawley.
BEACHES	Predominantly intertidal mud flats in Southampton Water and in the West Solent from river Beaulieu to Hurst Spit. Narrow shingle beach extends into the mouth of river Beaulieu from the west and then continues on the east bank to Calshot Spit.
BACKSHORE	Salt marshes, and areas of reclaimed land protected by intermittent stretches of flood bank (between Lymington and Keyhaven).
EROSION	The coastline is a "soft" one and is therefore prone to erosion, particularly from Calshot Spit to Keyhaven.
ACCRETION	Local accretion of shingle in the lee of Hurst Spit.
AREAS OF FLOOD RISK	Much of the area at flood risk, particularly frontages in the West Solent. Industrial developments on west shore of Southampton Water protected by flood banks (eg. Fawley Power Station). However some 'rural' areas are flooded at high tide (eg. coast road east of Hythe).
LITTORAL PROCESSES	Littoral drift is low and eastwards on the north shore of the West Solent. No discernible drift on the west shore of Southampton Water Tidal processes dominate in areas protected by mudflats (e.g. on the west shore of Southampton Water and from just east of river Beaulieu to Hurst Spit). Locally generated waves produce a strongly unidirectional, if weak, littoral drift from east of Beaulieu river to Calshot Spit. There are extensive areas of intertidal erosion and saltmarsh die back which will probably make present levels of defence inadequate if erosion continues.

Sub-cell 5d The Needles to Foreland (IOW north coast)



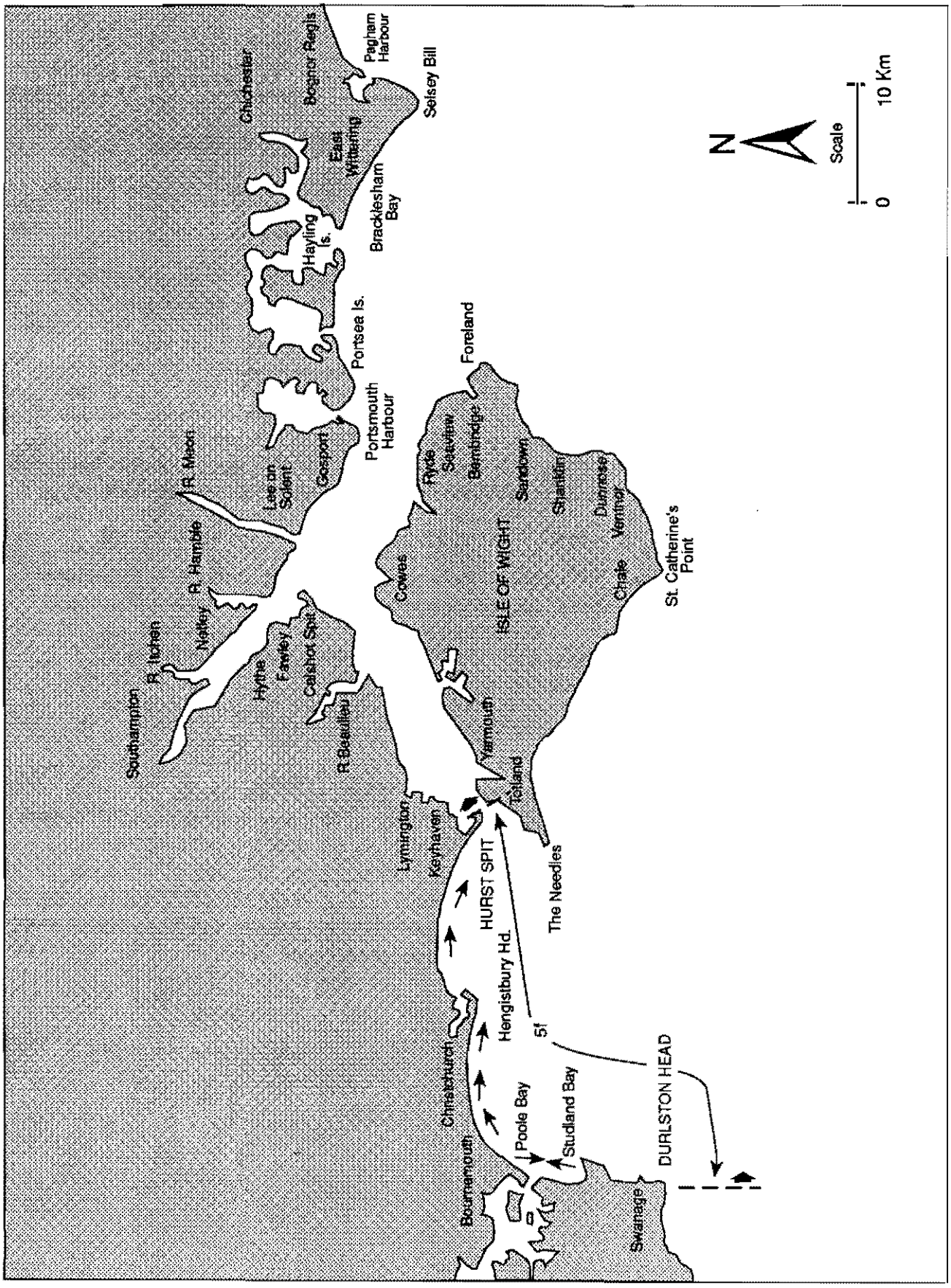
CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5d	The Needles to Foreland (IOW north coast)
COASTAL AUTHORITIES	
District Councils:	South Wight, Medina
County Councils:	Isle of Wight
NRA Regions:	Southern
GENERAL	The coast is mainly undeveloped and relatively sheltered from wave action. Strong tidal currents play a role in the dispersion of fine sands and clays from areas of erosion.
BEACHES	Sand and pebble beaches on the west coast. Narrow pebble beaches over muddy foreshores on the north shore, bordering the Solent. Sand beaches on the east coast from Ryde to Foreland.
BACKSHORE	From the Needles to Cowes cliffs are predominantly sands and clays, prone to slippage. From Cowes to Ryde clay cliffs are less steep and fairly stable. Less stable cliffs of sands and clays overlying limestone extend from Seaview to Foreland.
EROSION	Erosion/cliff slippage affects much of the coast. The frontage worst affected is from Totland to Cowes and from Seaview to Foreland.
ACCRETION	Major zones of sand accretion at Ryde and Bembridge
AREAS OF FLOOD RISK	No known areas of serious flood risk.
LITTORAL PROCESSES	Low northward and eastward drift from Totland to Cowes. Very low eastward drift from Cowes to Ryde. Moderate northward drift from Foreland to Ryde. The dominant processes are wave action on the west and east coasts, and combined waves/tidal currents on north coast. There is little transport across the Medina (between East and West Cowes) so the northwest and northeast coasts can be treated independently for most purposes. Sand accretion at Ryde and Bembridge must be derived from the southeast coast or from the Solent itself. (Cliff erosion between Totland and Yarmouth is probably barely sufficient to feed beaches locally).

Sub-cell 5e Foreland to The Needles (IOW south coast)



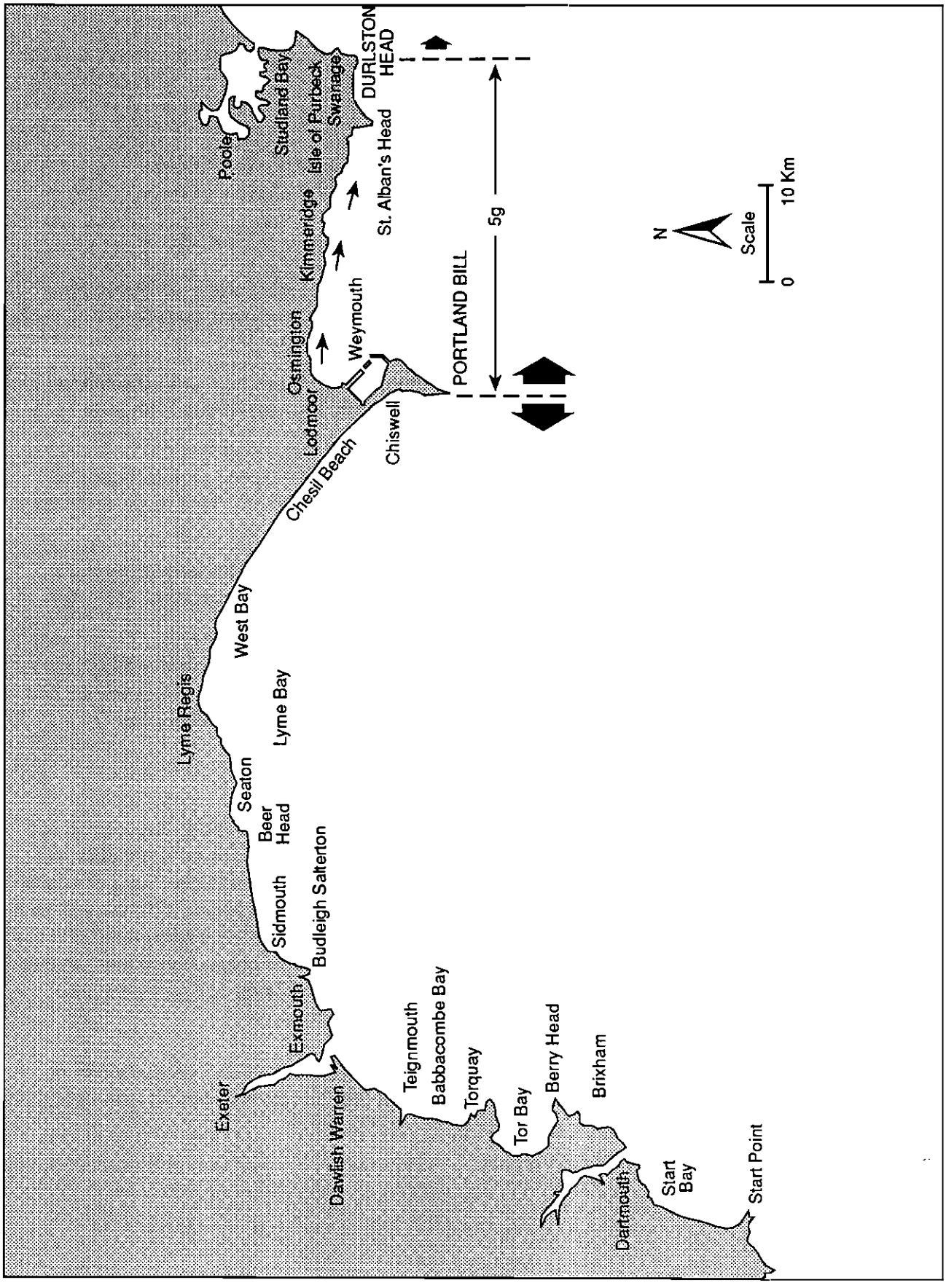
CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5e	Foreland to The Needles (IOW south coast)
COASTAL AUTHORITIES	
District Councils:	South Wight
County Councils:	Isle of Wight
NRA Regions:	Southern
GENERAL	The south coast has a severe wave exposure. Cliff erosion provides beach material (sand and fine shingle) for the southeast coast.
BEACHES	Sand and shingle beaches extend from the Needles to Ventnor. Beaches are predominantly sandy in Sandown Bay.
BACKSHORE	Chalk cliffs at the Needles. Rapidly eroding cliffs of sands, shales and clays extend east to St. Catherine's Point. Terraced cliff slopes of chalk over clay extend to Dunnose. Chalk, clay and sandstone cliffs are found at Dunnose. Sandstone cliffs extend over Shanklin/Sandown frontage.
EROSION	Erosion and cliff slippage is prevalent around most of the coast.
ACCRETION	Sand and pebble accretion on the southwest coast due to cliff erosion. Pocket sand and pebble beaches between St. Catherine's Point and Ventnor due to eastward drift. Sand accretion in Sandown Bay supplied by eastward drift and also from erosion of sandstone cliffs in the Bay, (prior to seawall construction).
AREAS OF FLOOD RISK	No known areas of serious flood risk.
LITTORAL PROCESSES	Moderate to high eastward drift from the Needles to St. Catherine's Point, reducing slightly to the east. Northerly moderate rate in Sandown Bay. Any coastal protection works are likely to significantly affect the process of beach material redistribution. Cliff protection measures in Sandown Bay may well result in deteriorating beaches in the long term. The southwest coast is relatively undeveloped but coast protection works would have a serious 'knock-on' effect downdrift.

Sub-cell 5f Hurst Spit to Durlston Head



CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5f	Hurst Spit to Durlston Head
COASTAL AUTHORITIES	
District Councils:	New Forest, Christchurch, Bournemouth, Poole, Purbeck
County Councils:	Hampshire, Dorset
NRA Regions:	Southern, Wessex
GENERAL	Easily erodible coastline of sand, clays, and gravels. Drift strongly unidirectional in Christchurch and Poole bays and coast protection works likely to have a "knock-on" effect downdrift.
BEACHES	Predominantly sand but with areas of shingle from cliff erosion (e.g. Christchurch Bay, east end of Poole Bay and north end of Swanage Bay).
BACKSHORE	Easily erodible/unstable cliffs of clays, sands and gravels. Areas of saltmarsh in Christchurch and Poole Harbours. Sand dunes in Studland Bay.
EROSION	Recession and breaching at Hurst Spit. Cliff slippage/erosion in the central part of Christchurch Bay, and at east end of Poole Bay. Cliff erosion in Swanage and Durlston Bays.
ACCRETION	Natural build up of shingle at Hordle in the eastern part of Christchurch Bay. Sand and shingle build up at Christchurch Harbour entrance and sand accretion in Poole Harbour entrance and Studland Bay.
AREAS OF FLOOD RISK	Christchurch Harbour.
LITTORAL PROCESSES	Moderate to high easterly drift of sand and shingle in Christchurch and Poole Bays. Little nett drift in Swanage Bay. Waves erode cliffs and transport material eastwards in Christchurch and Poole Bays. There is local drift reversal at the entrance to Poole Harbour. Tidal currents carry sand around Hengistbury Head, some of this being transported offshore and some reaching the Christchurch Bay frontage. Rapid tidal currents also transport shingle from off the end of Hurst Spit seawards onto offshore banks. Coastal defences have a marked downdrift effect. Coastal works in Poole Bay affect the regime of Christchurch Bay, but not vice versa.

Sub-cell 5g Durlston Head to Portland Bill

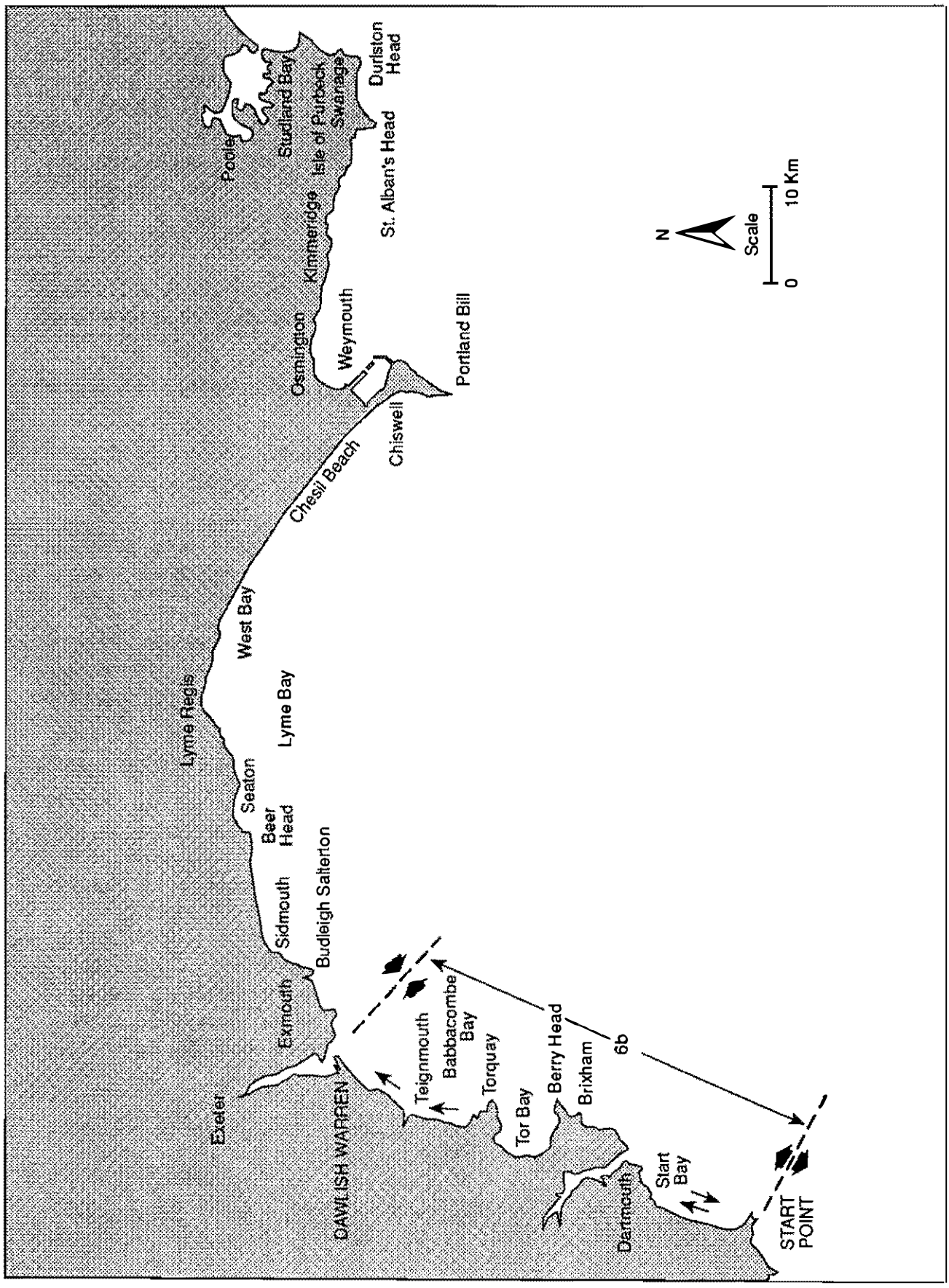


CELL 5	Selsey Bill to Portland Bill
SUB-CELL 5g	Durlston Head to Portland Bill
COASTAL AUTHORITIES	
District Councils:	Purbeck, West Dorset, Weymouth and Portland
County Councils:	Dorset
NRA Regions:	Wessex
GENERAL	Largely undeveloped cliffed coastline. Coast strongly indented and local coast protection works unlikely to have a serious 'knock-on' effect downdrift.
BEACHES	Predominantly pebble beaches, fringed by rock reefs, from St. Alban's Head to Weymouth Bay. (Sand is found in deeply incised bays and sheltered areas.) Wide sand beach north of Weymouth Harbour entrance.
BACKSHORE	Hard limestone cliffs from Durlston to St. Alban's Head. Soft, unstable cliffs of clays, shales, limestone and chalk to the west. Marshland at Lodmoor in Weymouth Bay. Limestone cliffs at Portland Bill.
EROSION	Widespread. The rate varies greatly depending upon location. Generally fairly rapid, due to a combination of weathering, slippage and wave undercutting. The frontage affected by cliff erosion is generaly undeveloped. However there is cliff instability at Nothe Point, Weymouth and cliff erosion northeast of Lodmoor.
ACCRETION	Sand build-up at south end of Weymouth Bay. Pebble beaches predominantly within deeply incised embayments.
AREAS OF FLOOD RISK	Lodmoor, in Weymouth Bay.
LITTORAL PROCESSES	Low and intermittent eastward drift. Wave action and variations in lithology produce differential rates of cliff erosion, forming deeply incised bays and stacks. Coastline has little development and coastal problems are minor. Beaches on the developed frontage of Weymouth appear to be stable. However the shingle beach at Lodmoor to the north of Weymouth is sometimes overtopped, possibly due to the interaction of waves with the seawall to the landward of the beach. Cliff instability causes some problems in Weymouth Bay but those problems do not seem to be due to man's interference with littoral processes. Tidal currents have little impact on the coastline from Osmington to Durlston Head being relatively weak close to the shoreline. Anticlockwise current induced circulation of sand in Weymouth Bay is probably the mechanism by which sand has accumulated on the Weymouth frontage.

Sub-cell 6a Portland Bill to Dawlish Warren

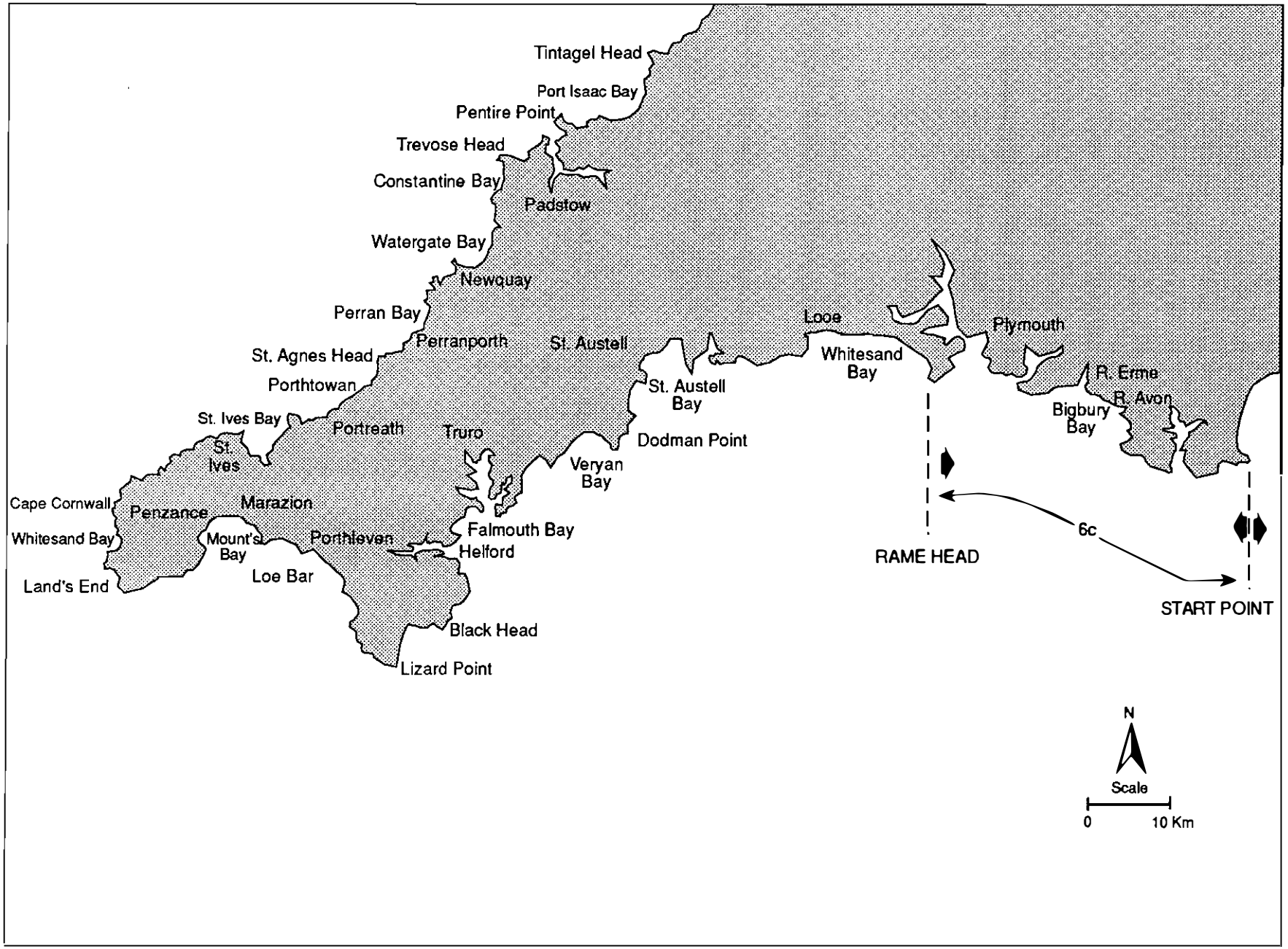
CELL 6	Portland Bill to Land's End
SUB-CELL 6a	Portland Bill to Dawlish Warren
COASTAL AUTHORITIES	
District Councils:	Weymouth and Portland, West Dorset, East Devon, Teignbridge
County Councils:	Dorset, Devon
NRA Regions:	Wessex, South West
GENERAL	Largely undeveloped coastline with short urban frontages at mouths of rivers. With the notable exception of Chesil Beach the urban frontages have little interaction because of low, intermittent littoral drift.
BEACHES	Predominantly shingle with sand at low tide. Lyme Regis and Exmouth have substantial sand beaches.
BACKSHORE	Chesil Beach backed by lagoon, with sand cliffs at western end. Unstable clay, marl, sand, lias and chalk cliffs extend from West Bay to Exmouth.
EROSION	Cliffs subject to rapid erosion and slippage, from West Bay to Exmouth. Cliff instability on the urban frontage of Lyme Regis. Dune erosion at Dawlish Warren.
ACCRETION	Sand and shingle build-up at Lyme Regis due to trapping effect of harbour and consequent downdrift erosion to the east. Sand accretion at mouth of the river Exe, received from Dawlish Warren via estuary mouth bars.
AREAS OF FLOOD RISK	Chiswell, West Bay, Seaton, Sidmouth and Budleigh Salterton are on alluvial plains and are at some risk of flooding.
LITTORAL PROCESSES	Littoral drift is variable in direction but generally eastward. Transport is low and intermittent. Chesil Beach is receding slowly and is now prone to overtopping. It appears to have no contemporary supply of material. Wave action obviously dominates the evolution of the beach. To the west of Chesil the coastline consists of soft, easily erodible cliffs. Waves erode these cliffs and transport fines seaward in suspension within rip currents. This process is particularly marked east of Lyme Regis where the soft, sandy/clay cliffs are prone to slippage on a large scale. Beaches are thus relatively small. There is little interaction between urban frontages because of the long stretches of eroding cliffs between. There is considerable interaction at mouth of the Exe estuary. Sand eroded from Dawlish Warren is transported by waves and tidal currents across the bar at the estuary mouth to accrete at Exmouth.

Sub-cell 6b Dawlish Warren to Start Point



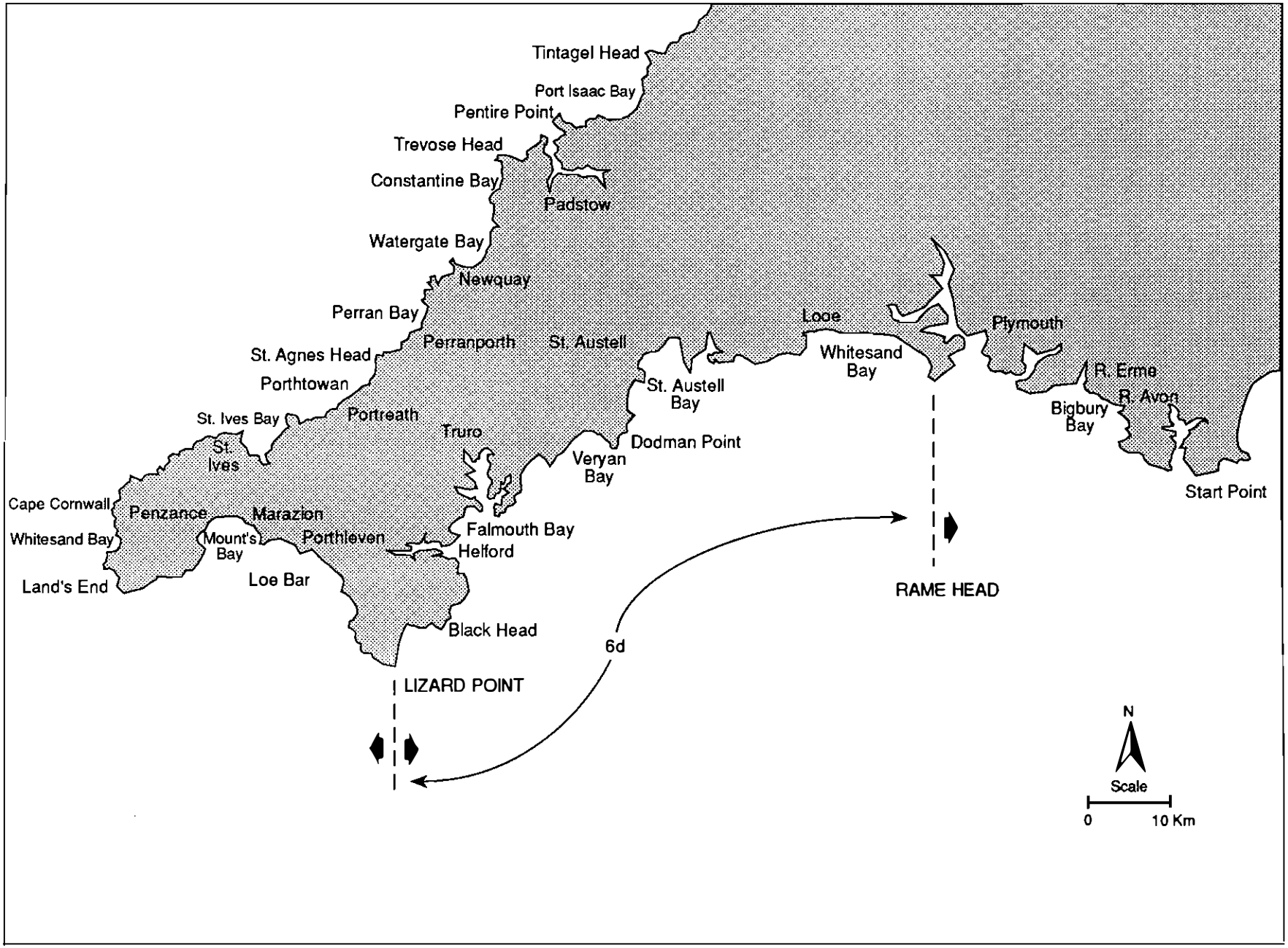
CELL 6	Portland Bill to Land's End
SUB-CELL 6b	Dawlish Warren to Start Point
COASTAL AUTHORITIES	
District Councils:	Teignbridge, Torbay, South Hams
County Councils:	Devon
NRA Regions:	South West
GENERAL	Strongly indented partly developed coastline with a common easterly wave aspect and broadly similar coastal morphology.
BEACHES	Sand beaches predominate from Dawlish Warren to Tor Bay. Shingle beaches predominate from Brixham to Start Point.
BACKSHORE	Sandstone cliffs, with resistant limestones forming headlands (e.g. margins of Tor Bay). Unstable shale cliffs in St Mary's Bay just south of Berry Head. Resistant shales, slates and grits extend from there south to Start Point.
EROSION	The sandstone cliffs to the north of Torquay provide beach sand. Barrier shingle beach in Start Bay prone to strong alongshore and onshore/offshore movement, causing beach drawdown at Beesands and Torcross villages.
ACCRETION	Sand accretion in Tor Bay.
AREAS OF FLOOD RISK	Wave overtopping on Dawlish seafront and in Start Bay.
LITTORAL PROCESSES	Predominantly northward weak drift but the extensive beaches are subject to strong seasonal changes in drift direction. Wave action dominates coastal processes, with onshore/offshore movement being as important as alongshore movement in regulating beach changes in certain areas (e.g. Torcross). In sand filled estuary mouths both waves and tidal currents interact to produce very complex and largely unpredictable patterns of movement. (e.g. Teignmouth). Due to indented nature of coast there is little interaction between adjacent frontages and the coast is only "loosely" linked. However there are certainly major drift movements within the individual bays eg. Babbacombe Bay, Torbay and Start Bay.

Sub-cell 6c Start Point to Rame Head



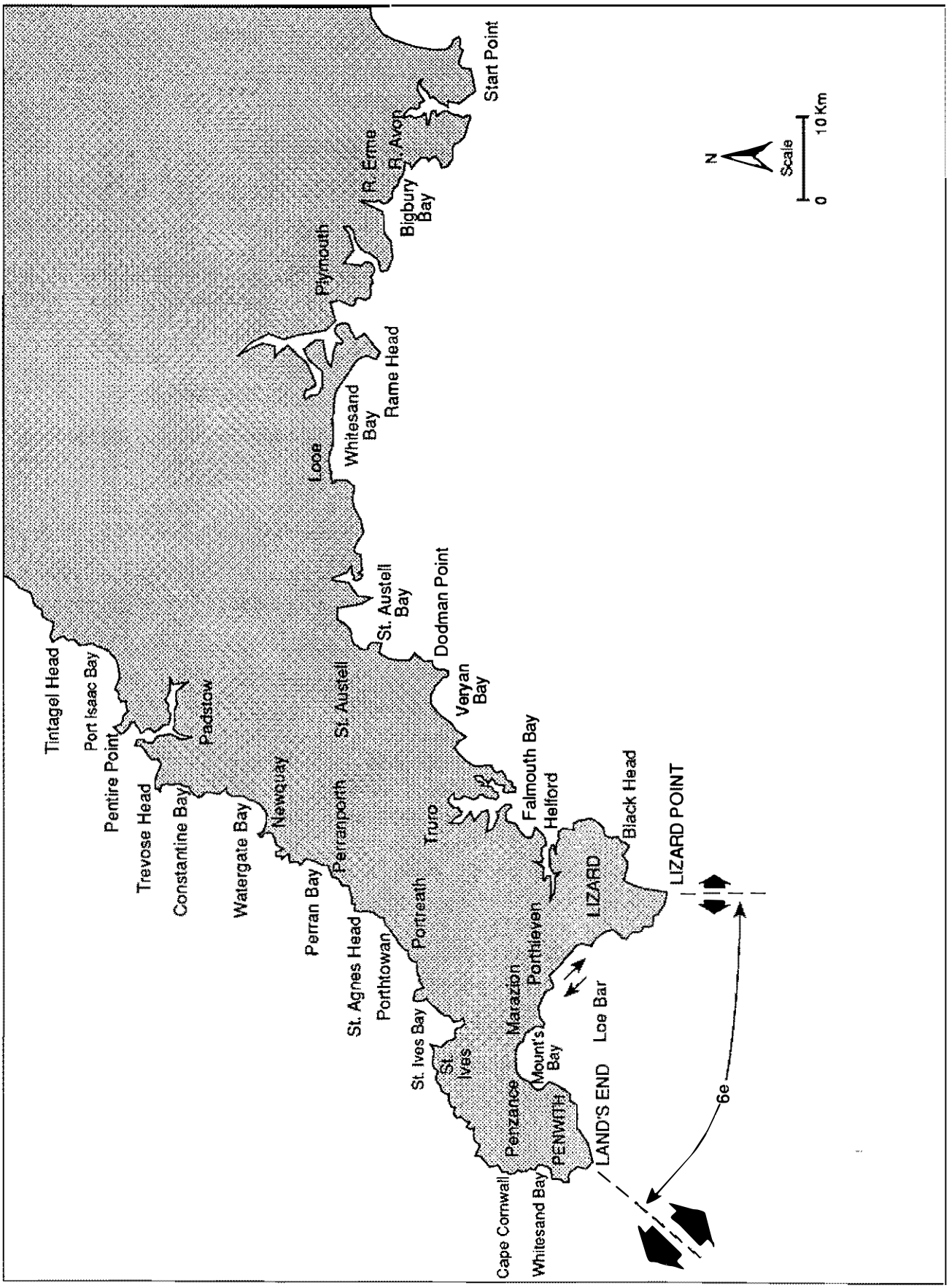
CELL 6	Portland Bill to Land's End
SUB-CELL 6c	Start Point to Rame Head
COASTAL AUTHORITIES	
District Councils:	South Hams, Plymouth, Caradon
County Councils:	Devon, Cornwall
NRA Regions:	South West
GENERAL	A rugged unspoilt cliffed coastline intersected by drowned river valleys. Coastline exposed to some Atlantic wave action.
BEACHES	Predominantly sand beaches.
BACKSHORE	Predominantly slate cliffs extending seawards as rock reefs. Some local cliff instability.
EROSION	Shale/slate cliff subject to weathering and erosion in Hope Cove, Bigbury-on-Sea and Challaborough Bay, all of which are situated in Bigbury Bay.
ACCRETION	Sand accretion at mouths of Avon and Erme.
AREAS OF FLOOD RISK	No flood risk on open coasts.
LITTORAL PROCESSES	Potential drift is eastward but the transport rate is insignificant. Wave action includes an element of Atlantic swell which helps to produce extensive sand beaches in estuary mouths (rivers Avon and Erme). Coastline is strongly dissected by estuary mouths, promontories etc. Very little interaction between adjacent stretches of coast.

Sub-cell 6d Rame Head to Lizard Point



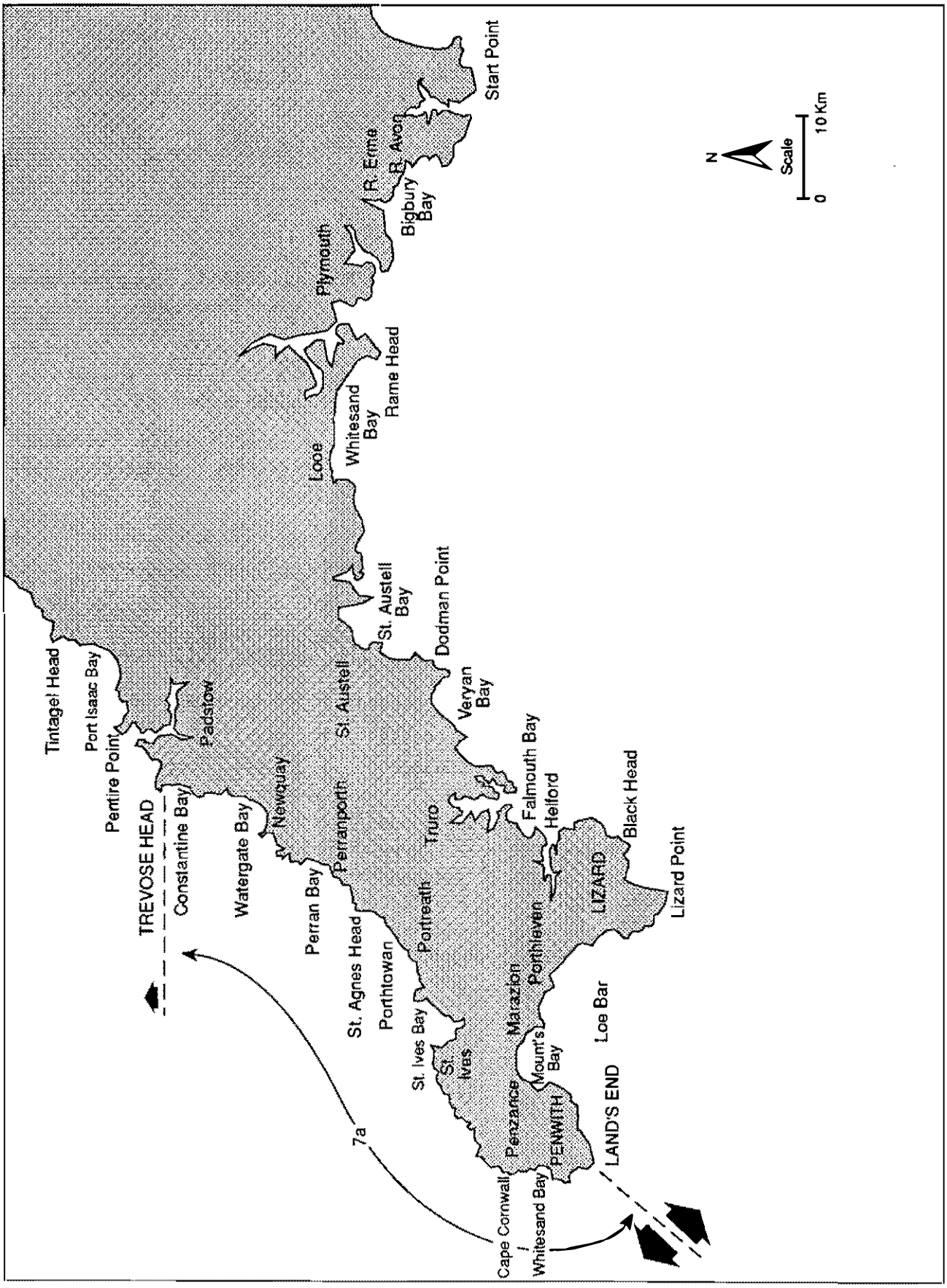
CELL 6	Portland Bill to Land's End
SUB-CELL 6d	Rame Head to Lizard Point
COASTAL AUTHORITIES	
District Councils:	Caradon, Restormel, Carrick, Kerrier
County Councils:	Cornwall
NRA Regions:	South West
GENERAL	A rugged undeveloped cliffed coastline intersected by drowned river valleys which separate the frontage into independent units. The southeasterly exposure, and similar morphology makes it sensible to consider this as one single coastal cell.
BEACHES	Sand or pebble beaches. Generally contained within individual coves.
BACKSHORE	High slate cliffs with extensive promontories and extending seawards as rock reefs.
EROSION	Erosion of boulder clay overburden at west end of Whitesand Bay. Cliff erosion at Seaton/Downderry and Millendreath (between Whitesand Bay and Looe). Cliff erosion at Veryan Bay.
ACCRETION	Major beaches of gritty china clay residual sand in Carlyon Bay and at Par Sands, within St. Austell Bay.
AREAS OF FLOOD RISK	No flood risk on open coast.
LITTORAL PROCESSES	Virtually no nett drift. Wave action generated in the English Channel is an important process which produces local cliff erosion. There is also some swell penetrating to the eastern end of this frontage, producing extensive sand beaches in Whitesand Bay. Tidal currents may help distribute china clay waste within St Austell Bay, but otherwise currents play no significant role in coastal processes. The frontage has been treated as one cell because of similar wave exposure and geomorphology, but in practice there is very little interdependence between adjacent frontages.

Sub-cell 6e Lizard Point to Land's End



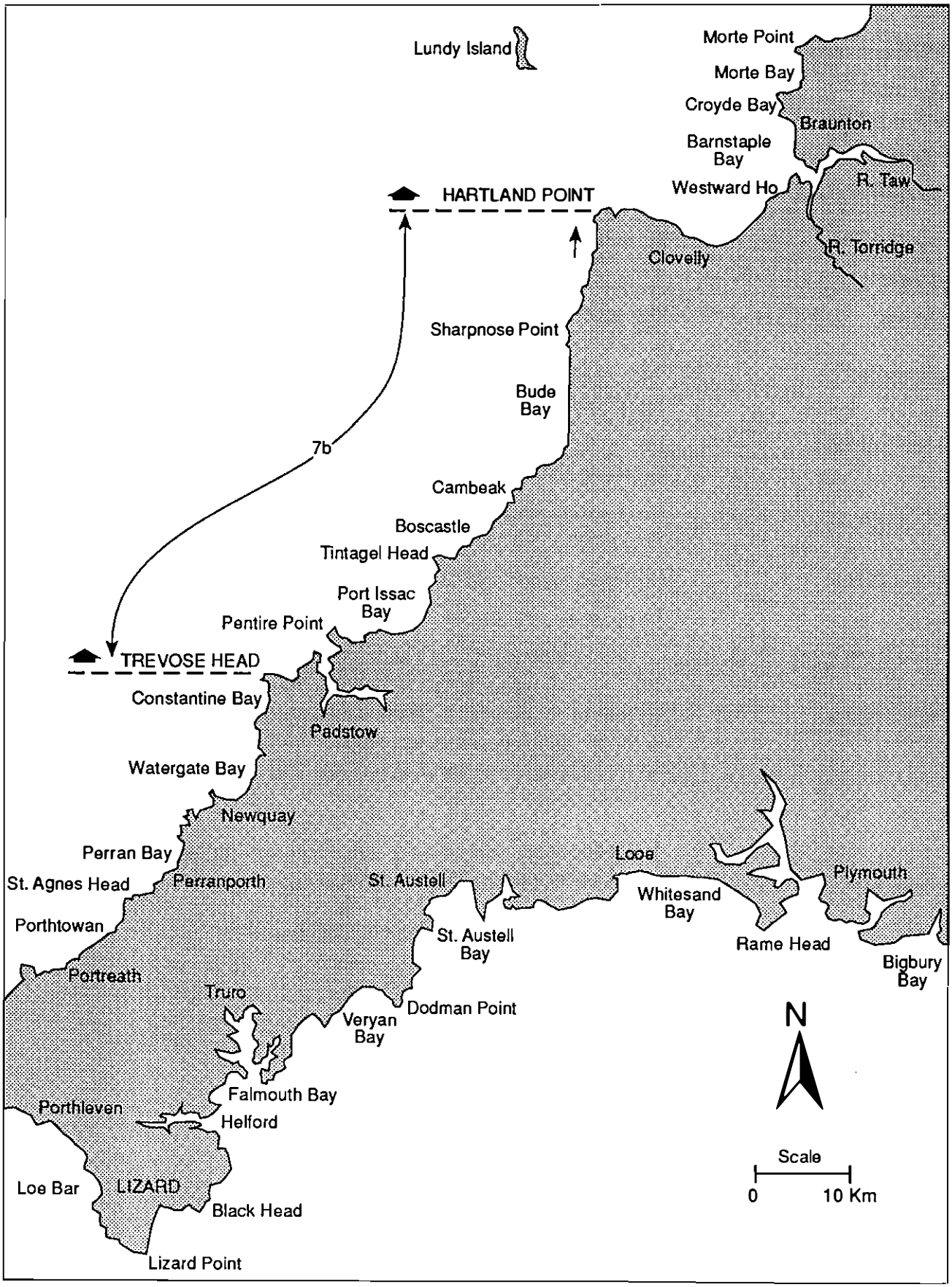
CELL 6	Portland Bill to Land's End
SUB-CELL 6e	Lizard Point to Land's End
COASTAL AUTHORITIES	
District Councils:	Kerrier, Penwith
County Councils:	Cornwall
NRA Regions:	South West
GENERAL	The rocky cliffed peninsulas of the Lizard and Penwith shelter the lower lying land in Mount's Bay. Urban development is concentrated in the west part of the Bay.
BEACHES	Pocket sand or shingle beaches along the cliffed frontage. Shingle beach at Loe Bar. Wide sand flats in west part of Mount's Bay.
BACKSHORE	Cliffs of resistant schists with igneous intrusions on the Lizard peninsula. Slate cliffs covered by boulder clay in Mount's Bay. Granite cliffs on the Penwith peninsula.
EROSION	Cliff and beach erosion in Mount's Bay, especially east of Marazion. Cliff erosion at Porthleven. Beach erosion at Perran Sands (between Marazion and Porthleven).
ACCRETION	Little evidence of recent accretion though one would expect siltation to be taking place in the lee of St Michael's Mount, in Mount's Bay.
AREAS OF FLOOD RISK	Low lying land at Marazion, Long Rock and at Penzance (all in Mount's Bay).
LITTORAL PROCESSES	Very low eastward drift in Mount's Bay. Seasonal alongshore movements along Loe Bar but no apparent nett drift. Wave action is dominant and can cause significant onshore/offshore beach movements but little net alongshore movement. The role of tidal currents is poorly understood - one would expect active siltation to be taking place in Mount's Bay.
	The bay forms a natural coastal cell.

Sub-cell 7a Land's End to Trevose Head



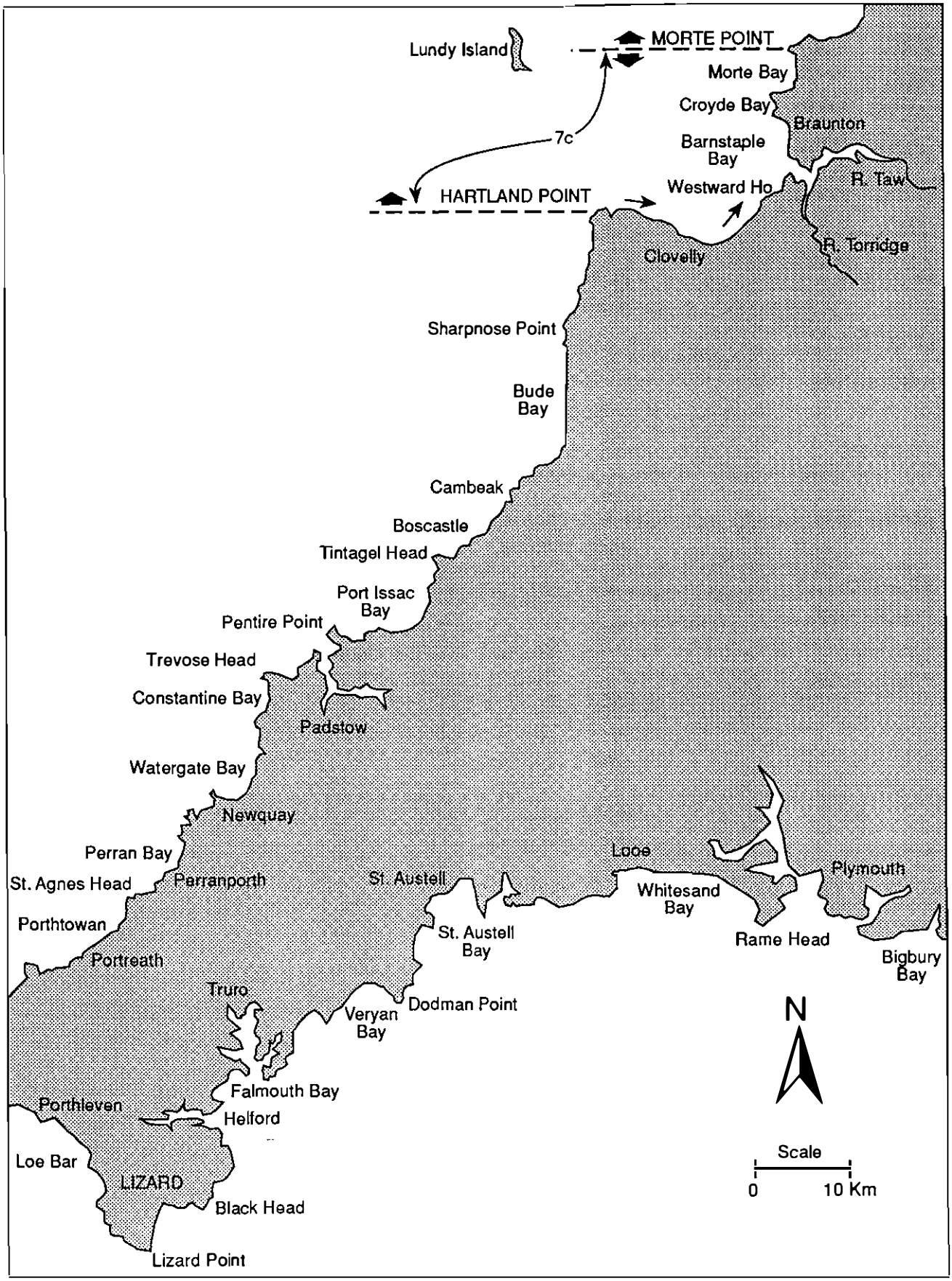
CELL 7	Land's End to The Severn
SUB-CELL 7a	Land's End to Trevose Head
COASTAL AUTHORITIES	
District Councils:	Penwith, Kerrier, Carrick, Restormel, North Cornwall
County Councils:	Cornwall
NRA Regions:	South West
GENERAL	A rugged, largely undeveloped, cliffed coastline with extensive stretches of sand separated by rocky foreshore. The major urban areas are found at these beaches (e.g. St Ives, Perranporth and Newquay).
BEACHES	Wide, gently shoaling sands backed by dunes. Extensive stretches of rocky foreshore.
BACKSHORE	Slate cliffs forming an irregular coast with headlands. Rocks extending seawards as reefs and stacks.
EROSION	Dune erosion widespread (e.g. Whitesand Bay, St. Ives Bay, Porthtowan, Perranporth). Cliff erosion at Newquay's Towan beach.
ACCRETION	No known present day accretion.
AREAS OF FLOOD RISK	Portreath and Perranporth.
LITTORAL PROCESSES	The coastline is exposed to Atlantic swell and the active beach zone extends to a considerable depth. Waves cause strong seasonal onshore/offshore movements. There is no evidence of any significant northward drift i.e. no areas of accretion linked to littoral transport and no areas of downdrift erosion. The role of tidal currents is not well understood, but is probably secondary to wave induced currents. Little interaction between adjoining stretches of coast.

Sub-cell 7b Trevose Head to Hartland Point

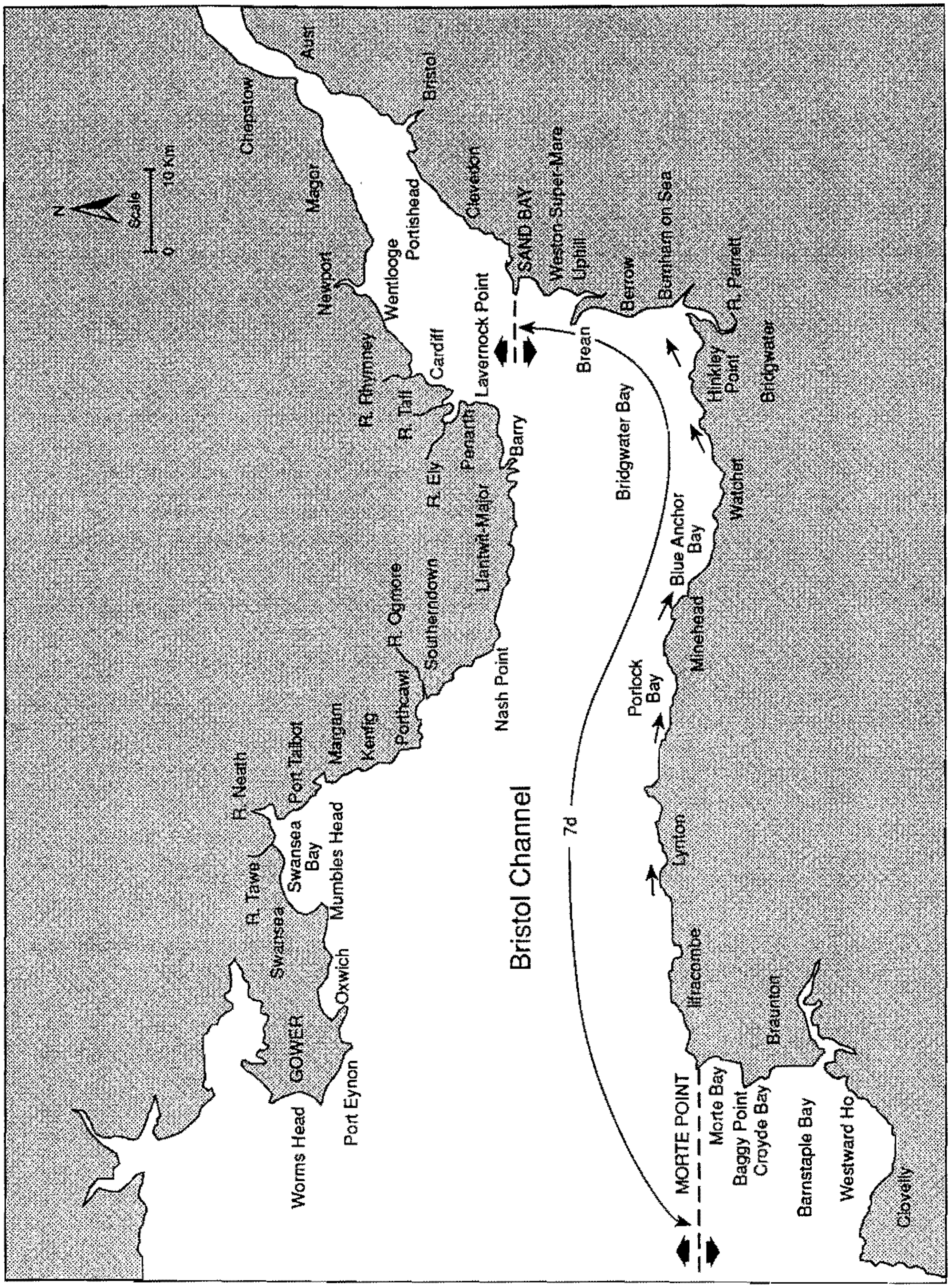


CELL 7	Land's End to The Sevem
SUB-CELL 7b	Trevose Head to Hartland Point
COASTAL AUTHORITIES	
District Councils:	North Cornwall, Torridge
County Councils:	Cornwall, Devon
NRA Regions:	South West
GENERAL	A rugged undeveloped cliffed coast with fine sand beaches separated by long stretches of boulder-strewn beaches.
BEACHES	Sand beaches fringed by rock reefs. Some beaches backed by dunes.
BACKSHORE	Slate cliffs extend north to Boscastle. Shale and sandstone cliffs extend from Boscastle to Hartland Point.
EROSION	Erosion of boulder clay overburden at the southern end of Bude Bay. Dune erosion at Polzeath in Padstow Bay and also in Bude Bay.
ACCRETION	No steady accretion but strong seasonal variations in beach level. Large areas of intertidal sand in the Camel estuary (e.g. near Padstow).
AREAS OF FLOOD RISK	No flood risk on open coast.
LITTORAL PROCESSES	Very low northward drift. The coastline is exposed to Atlantic swell and the active beach zone extends to a considerable depth. Waves cause strong seasonal onshore/offshore movements. The role of tidal currents is not well understood, but is probably secondary to wave induced currents. Little interaction between stretches of cliffed coast which separate the major sand beaches.

Sub-cell 7c Hartland Point to Morte Point



CELL 7	Land's End to The Severn
SUB-CELL 7c	Hartland Point to Morte Point
COASTAL AUTHORITIES	
District Councils:	Torridge, North Devon
County Councils:	Devon
NRA Regions:	South West
GENERAL	The coastline in Barnstaple Bay forms a distinct cell but the smaller bays of Croyde and Morte, separated by large promontories, can be considered as independent units within this sub-cell.
BEACHES	Pebble and boulder strewn beaches from Hartland Point to Westward Ho! Pebble ridge of Westward Ho! encloses saltmarsh. Massive sand dune system of Braunton Burrows encloses saltmarsh on the estuary's north shore. Wide sand beaches in Croyde Bay and Morte Bay.
BACKSHORE	Cliffs of sandstones and shales form the north facing coast to Westward Ho! and the westward projecting headlands separating Croyde and Morte bays. Dunes at bay heads.
EROSION	Rapid recession of the pebble ridge at Westward Ho! Sand spit erosion at Crow Point at the southern end of Braunton Burrows, which may be attributable to sand and gravel extraction. Dune erosion at Putsborough and Woolacombe (in Morte Bay).
ACCRETION	Siltation in the Taw-Torridge estuary.
AREAS OF FLOOD RISK	No flood risk on open coast.
LITTORAL PROCESSES	Low eastward drift from Hartland Point to Westward Ho! Elsewhere there is little netl drift. Waves dominate the movement of pebbles on the upper beach, which are found from Hartland to Westward Ho! Tidal currents bring fine sediments into Barnstable Bay out of the Bristol Channel (via a large anticlockwise eddy on the ebb tide). Sand circulation in the mouth of the Taw-Torridge estuary is very complex and not well understood, but both waves and tidal currents are important mechanisms. Waves produce onshore/offshore sand movement on the west facing beaches. Despite this movement the headlands of Baggy Point and Morte Point project sufficiently far seaward to make Morte Bay an independent unit.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Scale
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Chepstow
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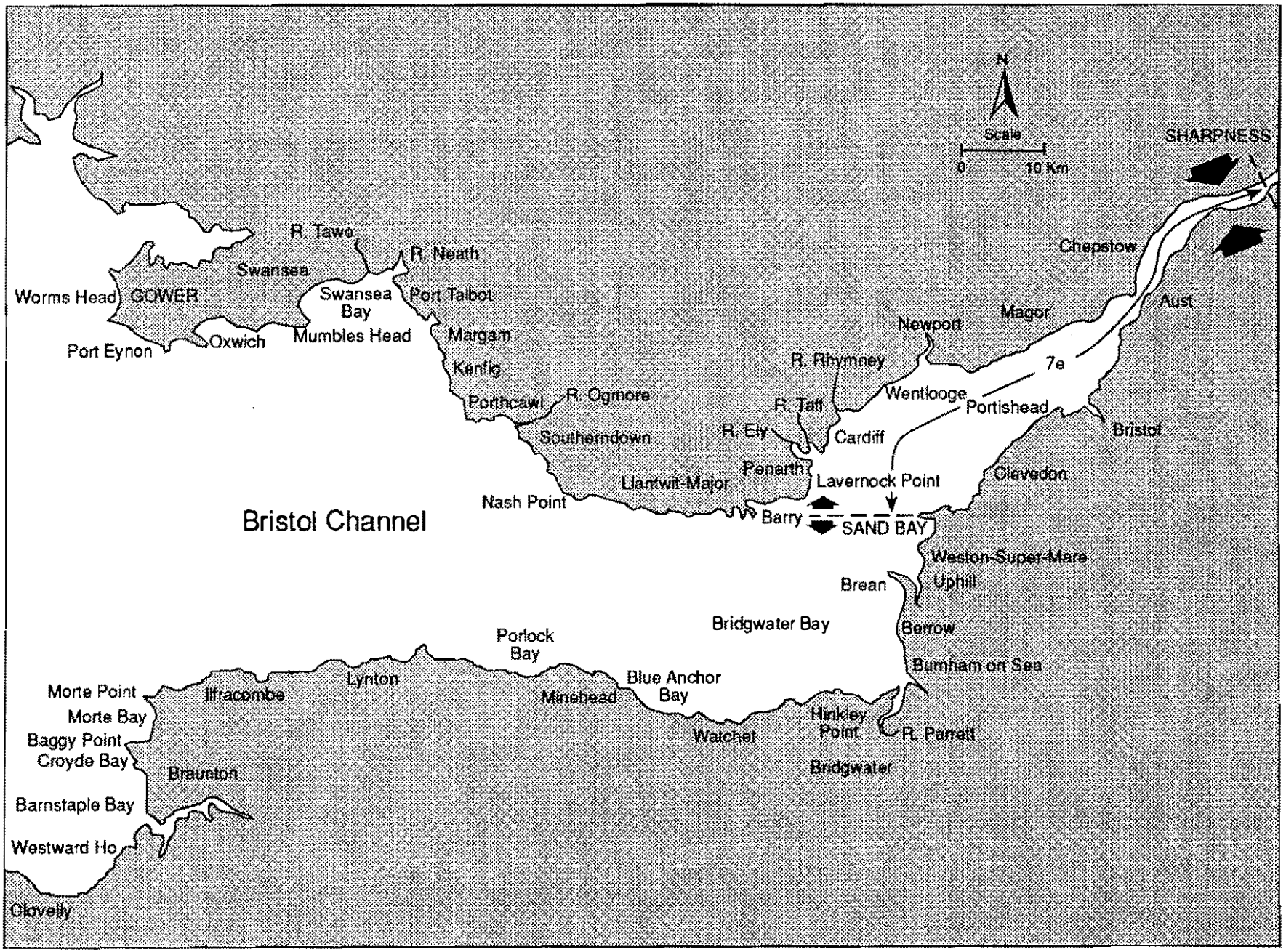
Bristol
Magor
Portishead
Clevedon
SAND BAY
Weston-Super-Mare
Uphill
Newport
Wentlooge
Lavernock Point
Berrow
Burnham on Sea
R. Parrett
R. Rhymney
Cardiff
Brean
Hinkley Point
Bridgwater
R. Taff
Penarth
Barry
Bridgwater Bay
R. Ely
Llantwit-Major
Watchet
Blue Anchor Bay
Southerndown
R. Ogmore
Nash Point
Minehead
Porlock Bay
Porthcawl
Kenfig
Margam
Port Talbot
R. Neath
Bristol Channel
7d
Lynton
Swansea Bay
Mumbles Head
R. Tawe
Swansea
Oxwich
Ilfracombe
Braunton
GOWER
Port Eynon
Worms Head
MORTE POINT
Morte Bay
Baggy Point
Croyde Bay
Barnstaple Bay
Westward Ho
Clovelly

CELL 7	Land's End to The Severn
SUB-CELL 7d	Morte Point to Sand Bay
COASTAL AUTHORITIES	
District Councils:	North Devon, West Somerset, Sedgemoor, Woodspring
County Councils:	Devon, Somerset, Avon
NRA Regions:	South West, Wessex
GENERAL	A contrasting coastline with hard cliffs from Morte Point to Minehead, softer cliffs east to Hinkley Point and low lying land beyond to Sand Bay. The connecting factor is continuity of eastward drift. Coast protection works can cause serious downdrift erosion, particularly east of Minehead.
BEACHES	Shingle or boulder strewn beaches to Porlock Bay. Shingle and sand beaches over flat rocky lower foreshore east to Stolford, east of Hinkley Point. Muddy foreshore to river Parrett. Extensive sand beaches with mudflats at low water northwards from Burnham-on-Sea to Sand Bay.
BACKSHORE	Relatively hard sandstone and shale cliffs to Minehead. Softer cliffs of limestones, shales and clays from Minehead to east of Hinkley Point. Low lying alluvial clay land stretches northwards from east of Hinkley Point, intersected by limestone headlands at Brean, Weston and Sand Bay. Dunes at bay heads.
EROSION	Cliff erosion from Minehead to Hinkley Point (notably Blue Anchor Bay and Watchet). Dune erosion at Brean.
ACCRETION	Mud accretion in Bridgwater Bay.
AREAS OF FLOOD RISK	Porlock, Minehead, Watchet, Brean, Uphill, Weston-Super-Mare.
LITTORAL PROCESSES	Low, strongly unidirectional, eastward drift (sand and shingle) extending to Bridgwater Bay. Lower foreshores relatively stable between Morte Point and Hinkley Point. Storm surges at high spring tides can produce overtopping at Porlock, Minehead, Watchet, Brean, Uphill, Weston-Super-Mare and Sand Bay as well as low lying coast east of Hinkley Point. The coastal regime in Bridgwater Bay itself is affected by tidal currents. The upper beach however is dominated by wave action. Windblown sand also an important factor on west facing beaches from Burnham-on-Sea to the north end of Sand Bay. The headlands at Brean, Weston and Sand Bay make the intervening bays independent units.


N
Scale
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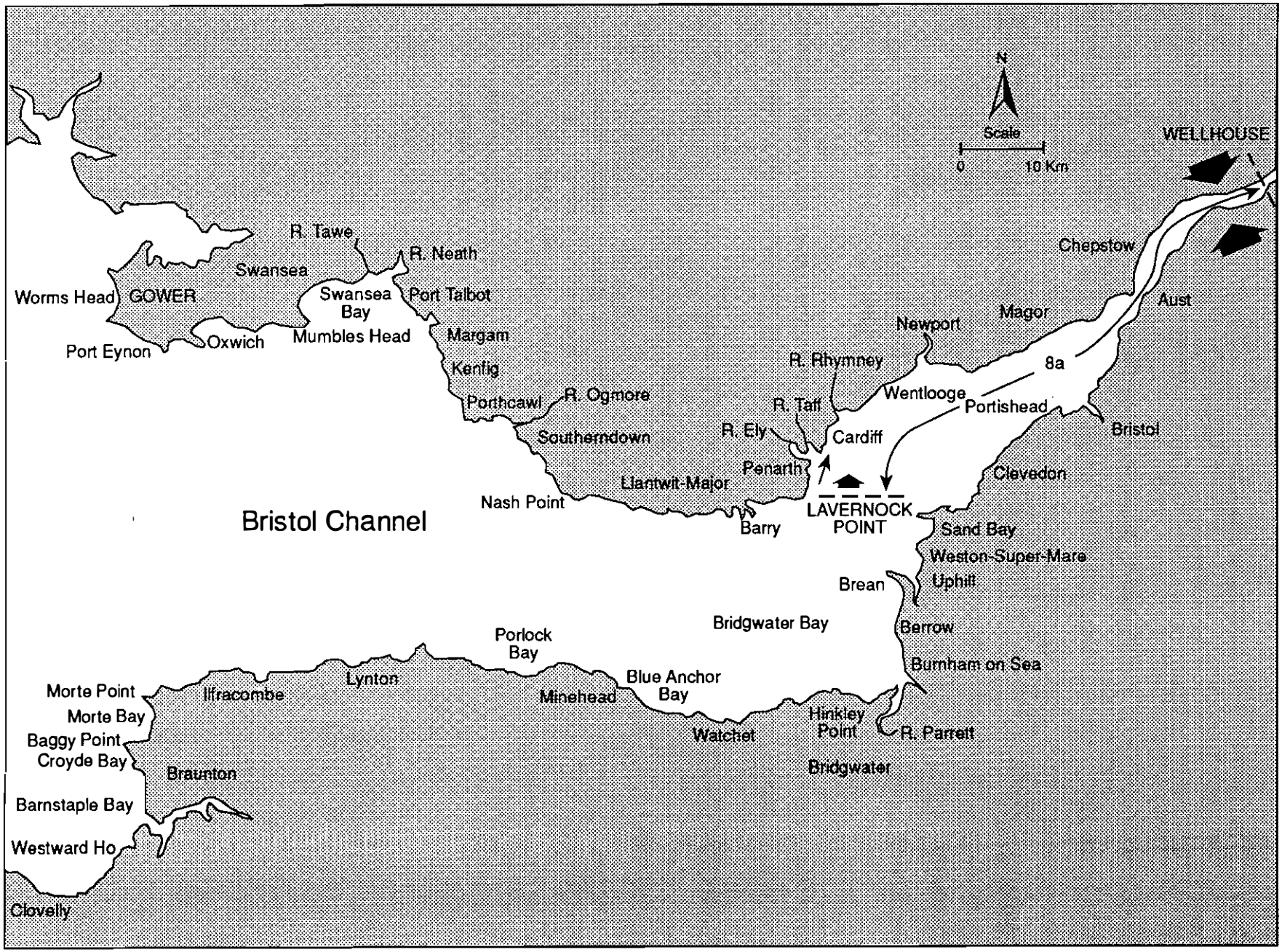
SHARPNESS
Chepstow
Aust
Magor
Newport
7e
Wentlooge
Portishead
Bristol
Clevedon
Lavernock Point
SAND BAY
Barry
Penarth
Cardiff
R. Rhymney
R. Taff
R. Ely
Llantwit Major
Nash Point
Southerndown
Porthcawl
R. Ogmore
Kenfig
Margam
Port Talbot
Swansea Bay
Mumbles Head
Oxwich
Port Eynon
Worms Head
GOWER
Swansea
R. Tawe
R. Neath
Bristol Channel
Weston-Super-Mare
Uphill
Brean
Berrow
Burnham on Sea
Bridgwater Bay
Hinkley Point
R. Parrett
Bridgwater
Watchet
Blue Anchor Bay
Minehead
Porlock Bay
Lynton
Ilfracombe
Morte Point
Morte Bay
Baggy Point
Croyde Bay
Braunton
Barnstaple Bay
Westward Ho
Clovelly

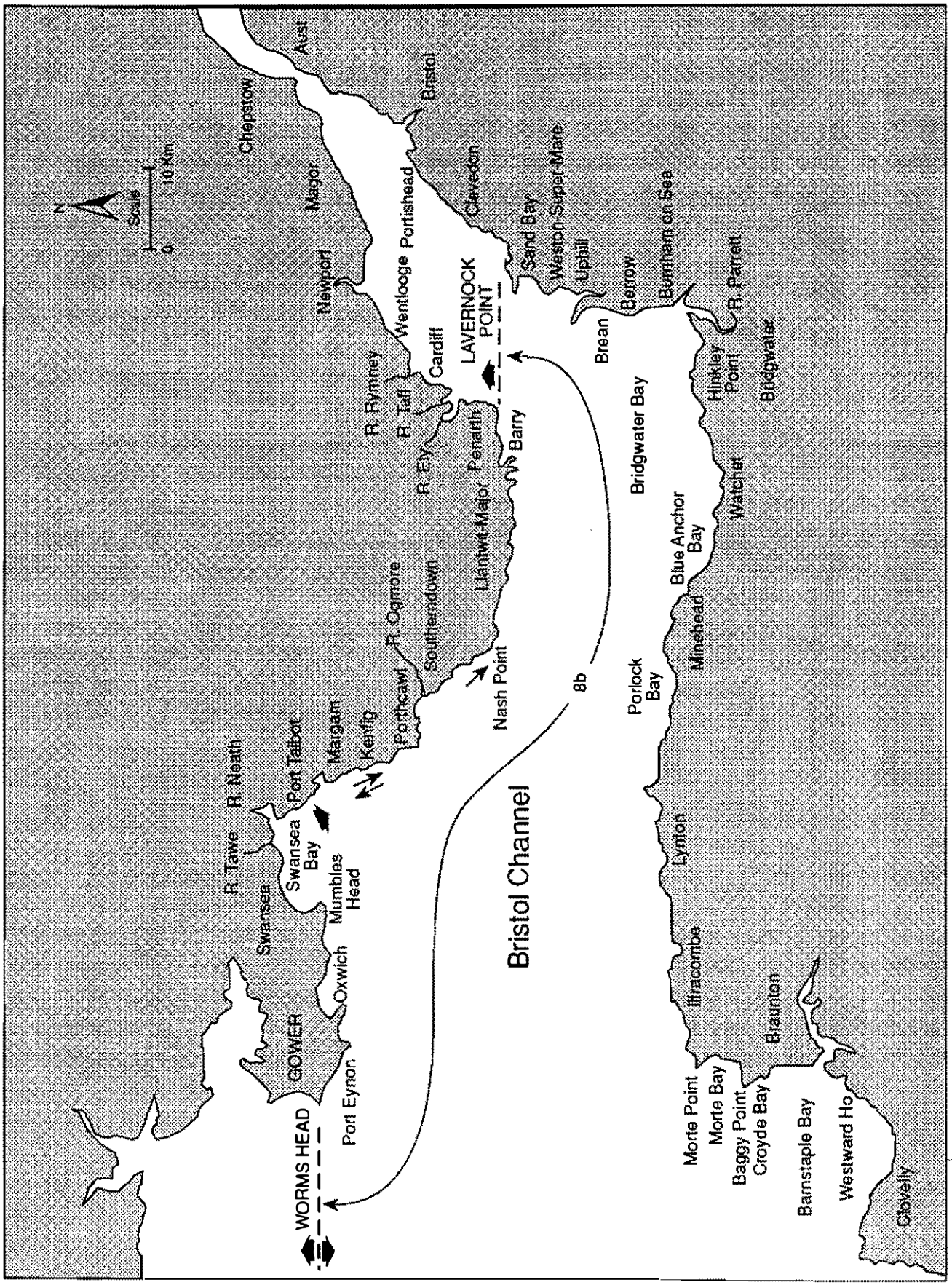
CELL 7	Land's End to The Severn
SUB-CELL 7e	Sand Bay to Sharpness
COASTAL AUTHORITIES	
District Councils:	Woodspring, Bristol, Northavon, Stroud
County Councils:	Avon, Gloucester
NRA Regions:	Wessex, Severn Trent
GENERAL	Most of the coastline lies below the high water of spring tides and is thus very vulnerable to flooding.
BEACHES	Mainly mudflats and saltmarshes.
BACKSHORE	Alluvial coastline with higher ground of easily erodible sandstones and limestones between Clevedon and Portishead and again at Aust (Severn Bridge).
EROSION	Serious erosion tends to occur when high tidal levels coincide with storm activity. Locally generated waves can cause considerable damage to flood banks.
ACCRETION	No known areas of significant accretion.
AREAS OF FLOOD RISK	Most of the coastline is potentially at risk.
LITTORAL PROCESSES	No appreciable drift. Wave heights are relatively modest, being generated within the estuary and having very little penetration of Atlantic swell. High tide levels combined with surges lead to flooding. Tidal currents dominate movements in the estuary but other than affecting approaches to harbours, appear to have little coastal impact.

Sub-cell 8a Wellhouse to Lavernock Point



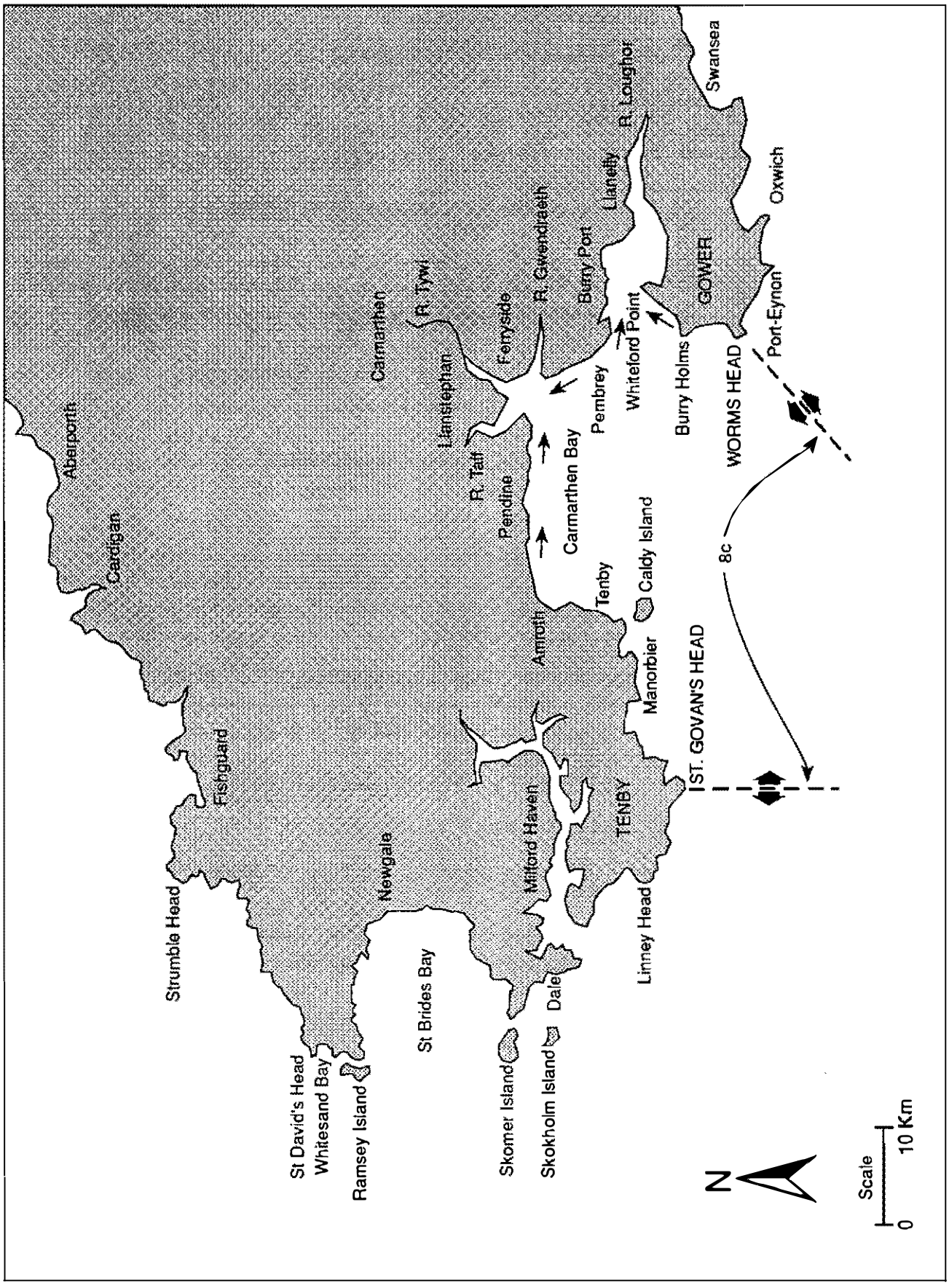
CELL 8	The Severn to St. David's Head
SUB-CELL 8a	Wellhouse to Lavernock Point
COASTAL AUTHORITIES	
District Councils:	Forest of Dean, Monmouth, Newport, Cardiff, Vale of Glamorgan
County Councils:	Gloucester, Gwent, South Glamorgan
NRA Regions:	Severn Trent, Wales
GENERAL	The low lying shoreline from Wellhouse opposite Sharpness, to the river Rhymney is well sheltered from wave activity but is nevertheless very vulnerable to flooding.
BEACHES	Predominantly mudflats and saltmarsh. A boulder strewn foreshore from Penarth to Lavernock Point.
BACKSHORE	Alluvial land upstream of Penarth forms low lying agricultural land. Limestone and marl cliffs extend between Penarth and Lavernock Point. These weather rapidly.
EROSION	No serious coast erosion problems. Short stretches of low eroding clay cliff in the vicinity of Magor. Some beach lowering at Penarth.
ACCRETION	No appreciable accretion.
AREAS OF FLOOD RISK	Much of the reclaimed land between Chepstow and Cardiff is protected by flood banks and is at risk during very high tides. Some vulnerable development on Wentlooge levels. Coastal development between Ely and Rhymney rivers.
LITTORAL PROCESSES	A weak drift of pebbles northwards from Lavernock Point to Penarth. No noticeable drift elsewhere. Tidal currents control the development of sand banks within the estuary and in turn these banks determine the size of waves which can be generated. High tides and surges coupled with locally generated waves make the shoreline prone to flooding.

Sub-cell 8b Lavernock Point to Worms Head



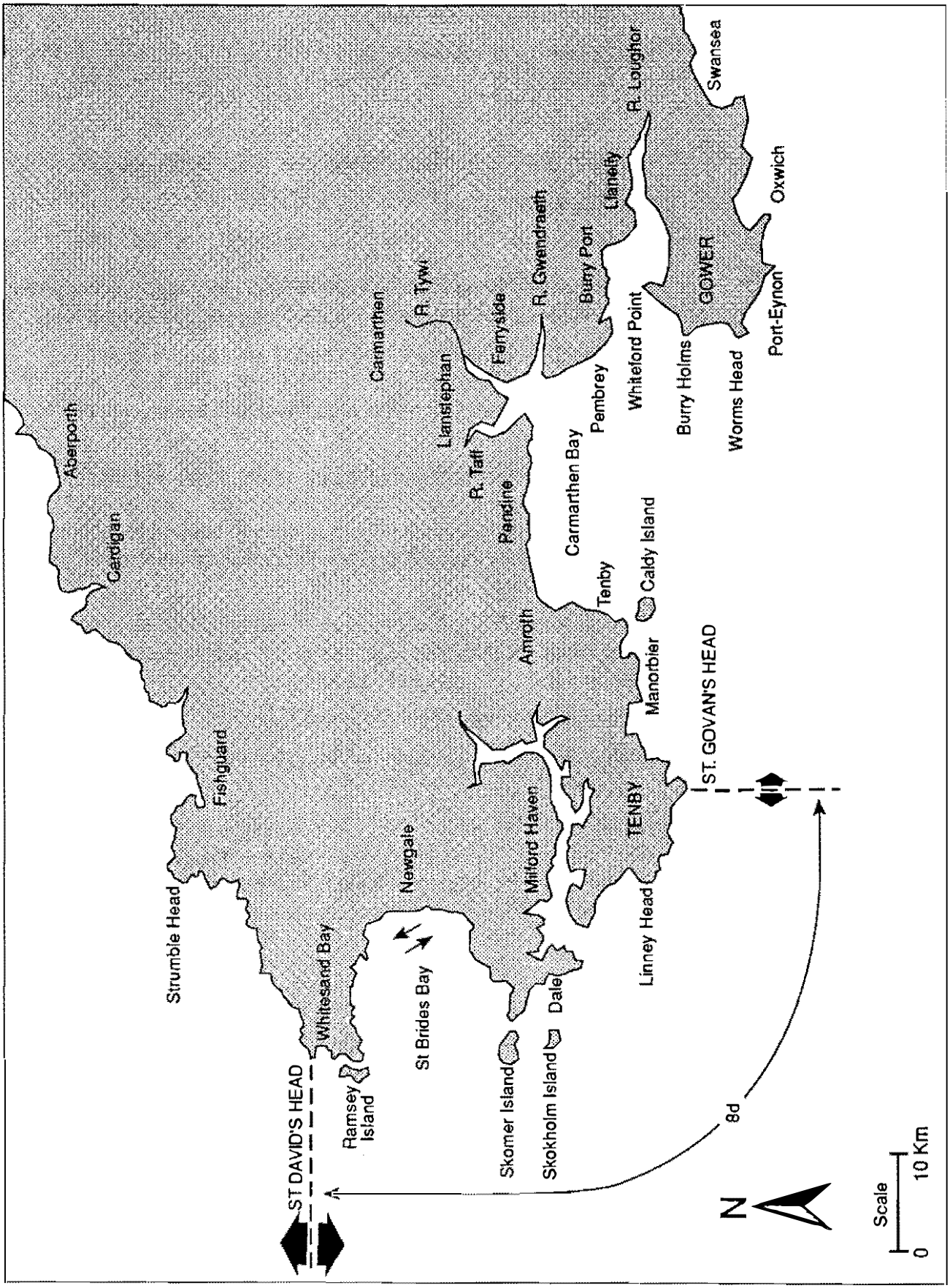
CELL 8	The Severn to St. David's Head
SUB-CELL 8b	Lavernock Point to Worms Head
COASTAL AUTHORITIES	
District Councils:	Vale of Glamorgan, Ogwr, Port Talbot, Neath, Swansea
County Councils:	South Glamorgan, Mid Glamorgan, West Glamorgan
NRA Regions:	Wales
GENERAL	The low lying coastline of Swansea Bay, with the Gower to the west and the cliffs of Nash Point to Lavernock to the east, forms an obvious coastal cell.
BEACHES	Rocky foreshore with sands and shingle storm beaches between Lavernock Point and Nash Point. Wider sand beaches on the coast from Nash to Ogmore. Extensive sand beaches in the eastern half of Swansea Bay with sandy/silty intertidal flats to the west. Pocket shingle beaches in the eastern part of the Gower form a contrast with major sand beaches in the western part.
BACKSHORE	Limestone or marl cliffs extend west from Lavernock round Nash and then north to Ogmore. Extensive dune systems between Ogmore and Swansea, interspersed in the Porthcawl area with low rocky cliffs. Limestones and shales form the cliffs of the Gower peninsula.
EROSION	Cliff erosion from Barry to Southerndown. Beach erosion in many of the small bays in the Porthcawl area. Dune recession at Kenfig. Beach erosion at Margam and Port Talbot. Large scale navigational dredging at the approaches to Port Talbot and backshore despoliation at Margam may have exacerbated erosion processes in Swansea Bay.
ACCRETION	Shingle accretion west of Barry. Accretion in river Neath estuary.
AREAS OF FLOOD RISK	Newton (south of Porthcawl). Low lying land between Neath and Swansea.
LITTORAL PROCESSES	Littoral drift is low to moderate but very variable in direction within embayments but predominantly eastwards on "open" stretches of coast. Major interruptions to drift from the dredging of Port Talbot Harbour and the rivers Neath and Tawe navigation channels. Beach erosion occurs at undefended south westerly coasts under severe wave action at high tide levels. Tidal circulation may result in an interchange of sediment between the beaches and the nearshore sea bed. However there is little evidence that this mechanism is significant in controlling beach regimes.

Sub-cell 8c Worms Head to St Govan's Head



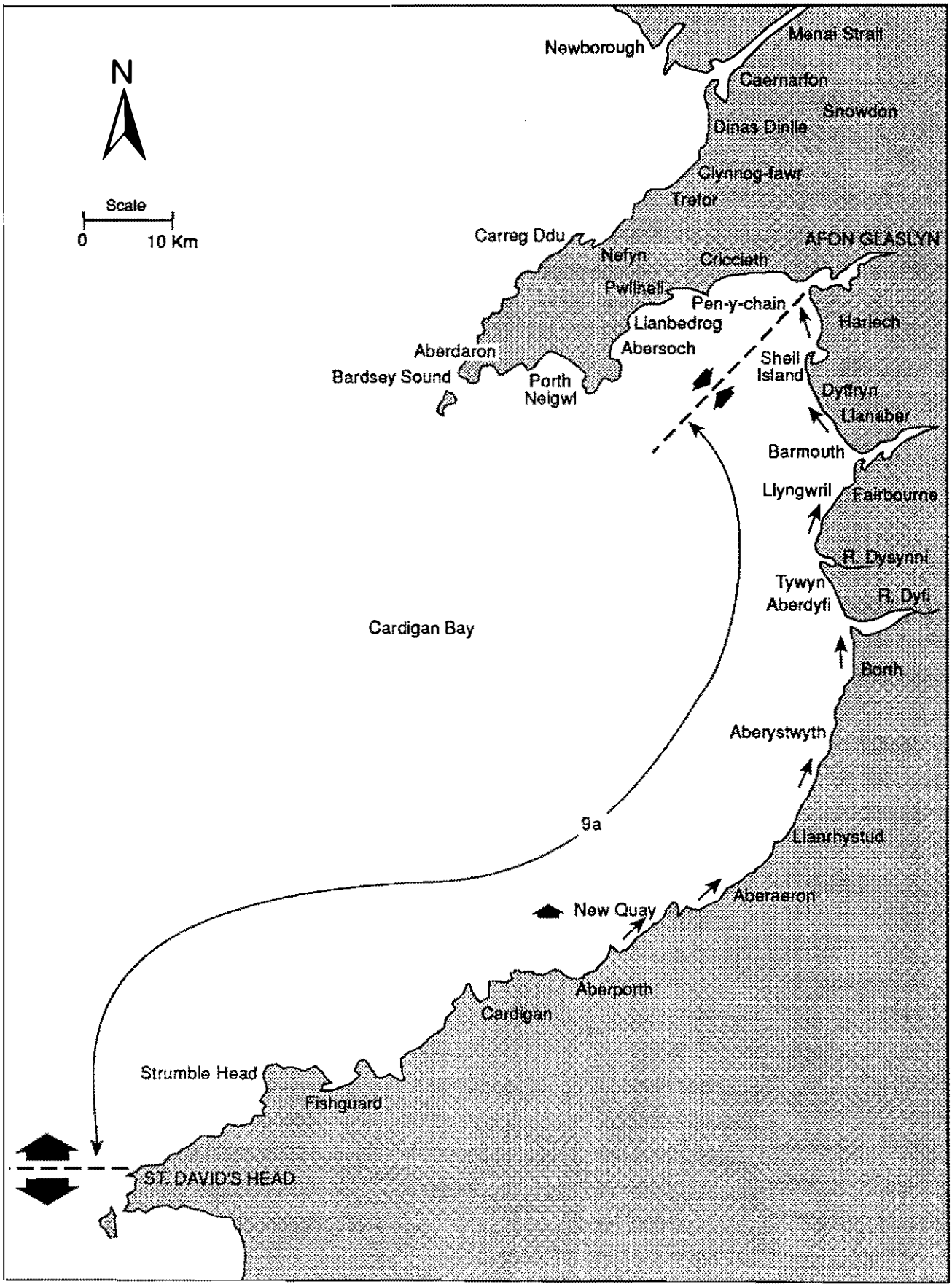
CELL 8	The Severn to St. David's Head
SUB-CELL 8c	Worms Head to St. Govan's Head.
COASTAL AUTHORITIES	
District Councils:	Swansea, Lliw Valley, Llanelli, Carmarthen, South Pembrokeshire
County Councils:	West Glamorgan, Dyfed
NRA Regions:	Wales
GENERAL	Carmarthen Bay forms a readily identifiable coastal cell, being fringed by the Gower peninsula to the east and the Tenby peninsula to the west.
BEACHES	Extensive sand beaches and dune systems are widespread with saltmarshes bordering the estuaries. Sand and pebble beaches are found at base of cliffs and across valley mouths in the western part of Carmarthen Bay.
BACKSHORE	Limestone cliffs on the Gower peninsula. Sand dunes and salt marshes dominate the low lying shoreline in Carmarthen Bay. Sandstones, shales and limestones extend from Amroth to St Govan's Head. Resistant limestones form high cliffs and stacks on the south part of the Tenby peninsula.
EROSION	Dune erosion at Pendine and Pembrey. Local erosion at Broughton, (north of Burry Holms), Ferryside, and Ginst Point (at the east end of Pendine Sands). Beach erosion at Amroth.
ACCRETION	Local accretion at Burry Port and at Llanstephan.
AREAS OF FLOOD RISK	Low lying land bordering the Loughor and the Taf/Tywi/Gwendraeth estuaries.
LITTORAL PROCESSES	Littoral drift is very variable, with low, generally eastward, drift along cliffed stretches of coast and strong circulation of sediments in the Loughor and the Taf/Tywi/Gwendraeth river estuaries. Erosion on open coasts is due to combination of strong wave exposure and high tides.

Sub-cell 8d St Govan's Head to St. David's Head



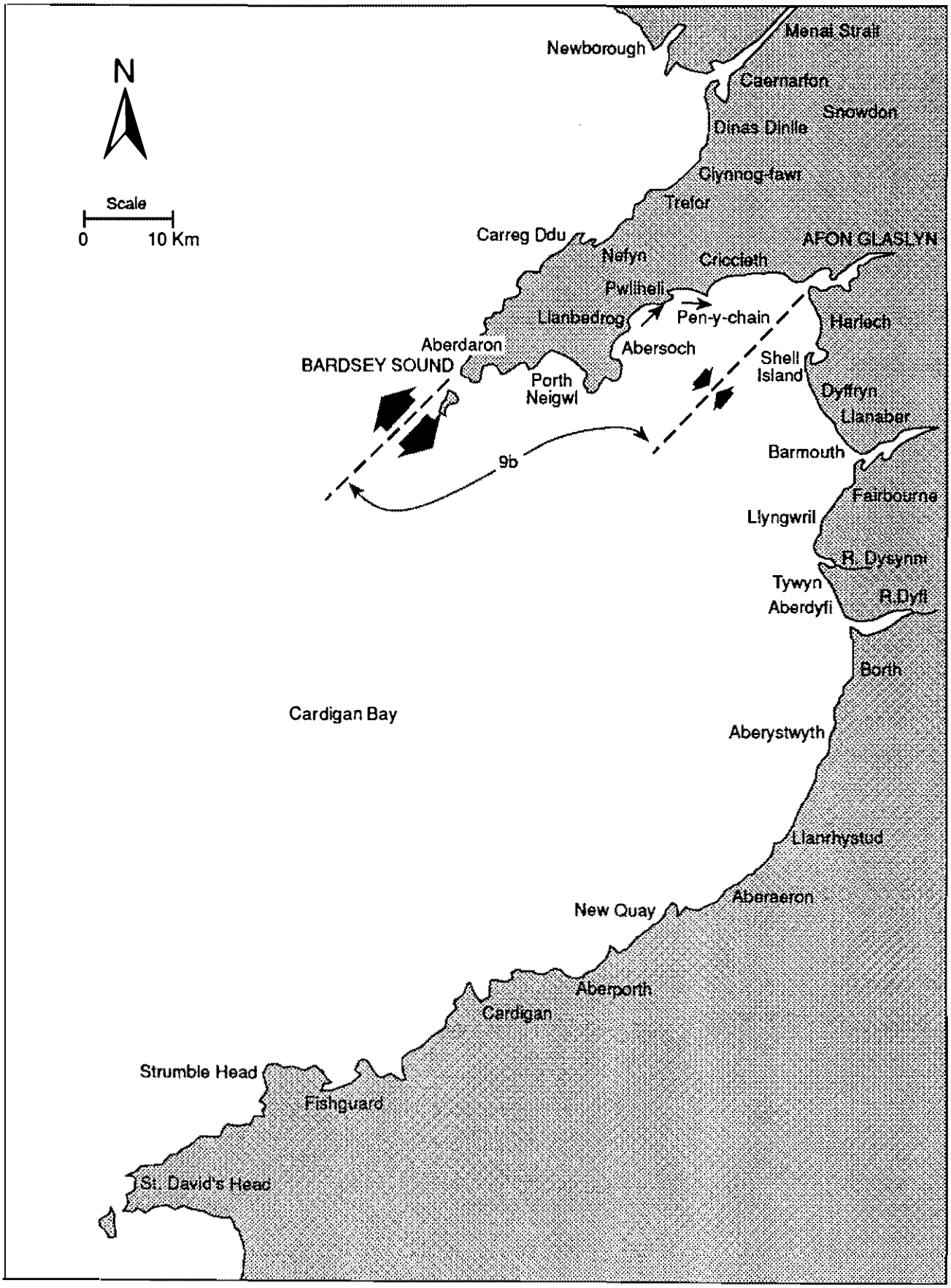
CELL 8	The Severn to St. David's Head
SUB-CELL 8d	St. Govan's Head to St. David's Head
COASTAL AUTHORITIES	
District Councils:	South Pembrokeshire, Preseli Pembrokeshire
County Councils:	Dyfed
NRA Regions:	Wales
GENERAL	This headland and bay coast is dissected by the vast natural harbour of Milford Haven. Division into smaller littoral cells is possible. The coast is generally unpopulated and lacking in coastal defences.
BEACHES	Wide sand beaches in bays and in coves. There are also long stretches of rocky shoreline with pebble beaches derived from erosion of cliffs and of glacial deposits.
BACKSHORE	The geology is very complicated but the cliffs are predominantly limestones and sandstones from St. Govan's Head to St. Brides Bay. St. Brides Bay is cut in relatively soft shales and sandstones. The rugged cliffs from St. Brides Bay to St. David's Head contain intrusions of igneous rock.
EROSION	Localised and on a small scale (e.g. cliff erosion at Broadhaven at the south end of St Brides Bay, and in Whitesand Bay.
ACCRETION	No known areas of present day accretion.
AREAS OF FLOOD RISK	Valley behind Newgale beach.
LITTORAL PROCESSES	Littoral drift is insignificant. Wave action produces strong onshore/offshore movements, which are strong enough to sometimes reveal fossilised trees at low tide in St Brides Bay. Tidal currents do not play an important role on this very strongly indented coastline. There is also very little interdependence between beaches, with the exception of the long frontage in St. Brides Bay in which littoral movement can take place freely.

Sub-cell 9a St. David's Head to Afon Glaslyn



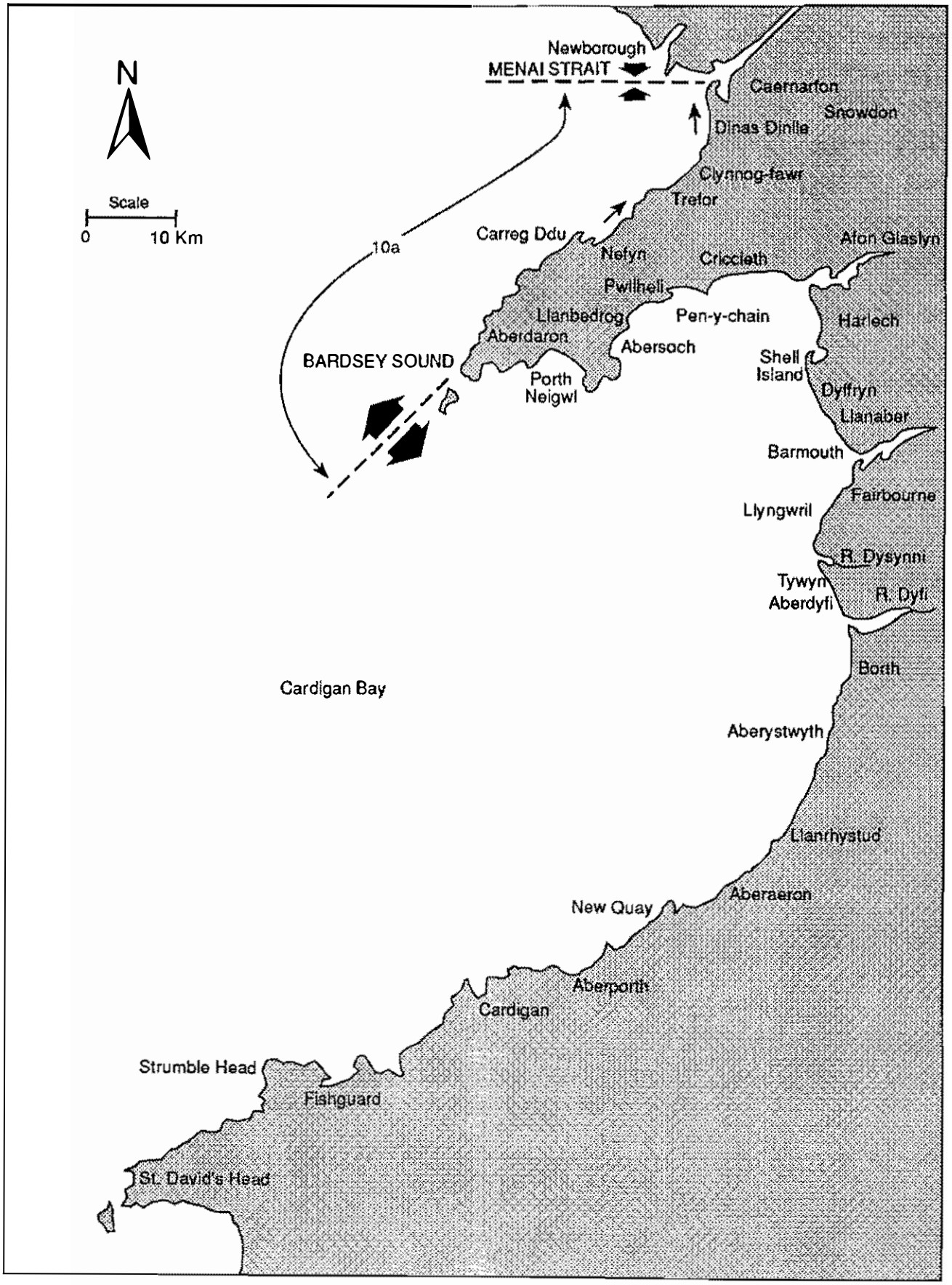
CELL 9	St. David's Head to Bardsey Sound
SUB-CELL 9a	St. David's Head to Afon Glaslyn
COASTAL AUTHORITIES	
District Councils:	Preseli Pembrokeshire, Ceredigion, Meirionnydd
County Councils:	Dyfed, Gwynedd
NRA Regions:	Wales
GENERAL	The whole of the long sparsely populated coastline of Cardigan Bay should ideally be treated as one unit. Erosion of cliffs of glacial drift in the south feeds beaches in the north part of Cardigan Bay.
BEACHES	Sandy coves on the rugged coast from St. David's Head to New Quay. More extensive sand and pebble beaches from New Quay to Borth. Northern end of Cardigan has predominantly sandy beaches, often surmounted by shingle ridges.
BACKSHORE	Predominantly cliffed coast. (Cliffs of glacial drift at locations between New Quay and Barmouth.) Sand/shingle spits, dunes and saltmarshes at estuary mouths.
EROSION	Erosion of beaches and clay cliffs is widespread. Cliff slippage north of New Quay. Erosion between Aberaeron and Llanrhystud. Beach erosion at Aberystwyth, and at Clarach Bay (just to the north). Local erosion at Borth. Dune erosion between Aberdyfi and Tywyn. Beach erosion from Tywyn to River Dysynni. Erosion of clay cliffs at Llyngwril. Beach erosion from Barmouth to Llanaber.
ACCRETION	Sand accretion at Aberdyfi, Barmouth and Morfa Halech.
AREAS OF FLOOD RISK	Potential flood risk due to spit recession south of Aberystwyth. Aberdyfi to Tywyn. Llanaber to Dyffryn Ardudwy.
LITTORAL PROCESSES	There is a moderate northward drift on open stretches of coast. Some drift reversal at estuary mouths. Wave action does not cause serious problems on the rugged coast south of New Quay. However the softer coastline to the north is vulnerable to wave induced erosion and has broadly common downdrift erosion problems. Coastal defences are few but have strong knock-on effects downdrift. Tidal currents run parallel to the coast and do not independently affect coastal processes (they transport material put in suspension by waves).

Sub-cell 9b Afon Glaslyn to Bardsey Sound

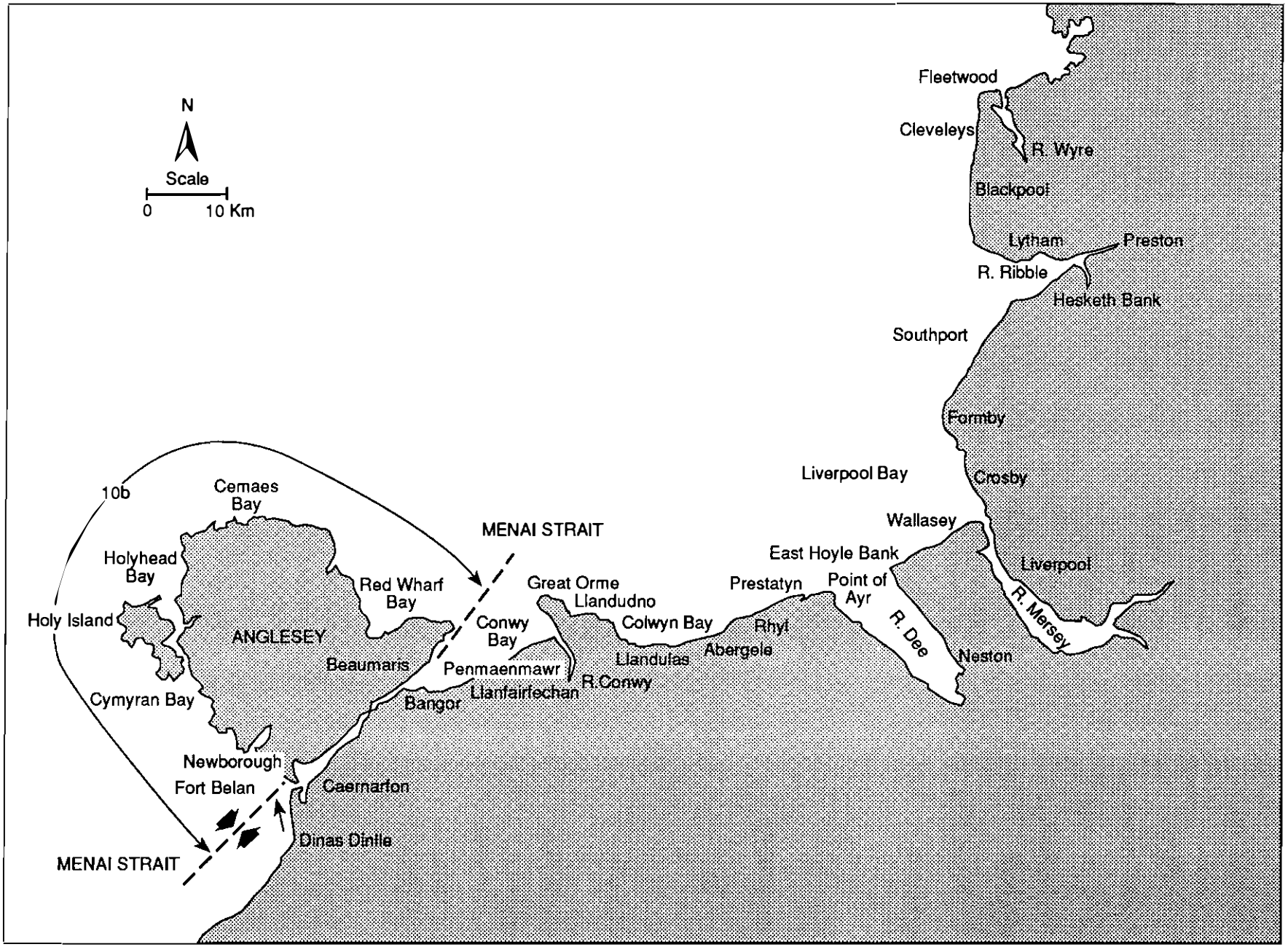


CELL 9	St David's Head to Bardsey Sound
SUB-CELL 9b	Afon Glaslyn to Bardsey Sound
COASTAL AUTHORITIES	
District Councils:	Dwyfor
County Councils:	Gwynedd
NRA Regions:	Wales
GENERAL	The frontage is on the south face of Lleyn peninsula and comprises hard igneous outcrops linked by glacial drift cliffs and sand dune systems. Area is lightly developed and best treated as a single unit due to common nature of problems.
BEACHES	Predominantly sandy. Shingle beaches between Criccieth and river Dwyfor to the west. Shingle spits at Pwllheli harbour entrance.
BACKSHORE	Dune systems at Morfa Bychan east of Criccieth, Abererch east of Pwllheli, also west of Pwllheli and at Abersoch. Glacial drift cliffs in Criccieth area, Llanbedrog area and bays between St Tudwals to the south of Abersoch, and Bardsey.
EROSION	Widespread clay cliff and sand dune erosion. Clay cliff slippage at Criccieth. Sand/clay cliff erosion from east of Criccieth Castle to Pen-y-chain. Sand dune erosion west to Pwllheli harbour, and at various points from west of Pwllheli to south of Abersoch. Clay cliff erosion between Llanbedrog and Aberdaron.
ACCRETION	Sand accretion on the Pwllheli promenade and shingle spit accretion on both sides of the harbour mouth. Sand accretion in Marchros area at south end of Abersoch Bay.
AREAS OF FLOOD RISK	Various stretches of low lying land from Glanllynau, west of Criccietch, to east of Llanbedrog. Breach just west of Pwllheli would threaten part of town.
LITTORAL PROCESSES	There is negligible or very low eastward drift from Aberdaron to Llanbedrog. Moderate eastward drift from Llanbedrog to the river Glaslyn. The southern shoreline of the Lleyn peninsula is very susceptible to erosion by wave action and dune blowouts are accelerated by severe winds. Erosion exacerbated by holidaymakers trampling dunes. Tidal currents do not have a significant impact other than removing fines from cliff erosion and also producing siltation in Pwllheli harbour. Coastal defences east of Llanbedrog are likely to have strong 'knock-on' effect due to one directional drift.

Sub-cell 10a Bardsey Sound to Menai Strait



CELL 10	Bardsey Sound to Great Orme
SUB-CELL 10a	Bardsey Sound to Menai Strait
COASTAL AUTHORITIES	
District Councils:	Dwyfor, Arfon
County Councils:	Gwynedd
NRA Regions:	Wales
GENERAL	The north face of Lleyn peninsula is almost entirely rural and has a rugged grandeur. The natural break between the mainland and Anglesey forms an appropriate sub-cell boundary.
BEACHES	Generally narrow sand and shingle foreshore but with substantial sand beaches in major embayments (e.g. Porth Dinllaen and Porth Nefyn, both near Nefyn). Foreshore width increases near the entrance to Menai Strait and there is a large sand and shingle spit protecting saltmarsh at Morfa Dinlle (north of Dinas Dinlle).
BACKSHORE	The southern part of the peninsula formed of hard igneous rock with high cliffs of glacial drift lining embayments. North of Trefor a lower glacial drift backshore gives way to a shingle ridge protecting low lying land at Dinas Dinlle. At Dinas Dinlle there is a short length of higher glacial drift cliff again.
EROSION	Cliff erosion problems at Nefyn, Trefor and Clynnog-fawr. Erosion of glacial drift and shingle banks at Dinas Dinlle.
ACCRETION	Sand dunes at north end of Dinas Dinlle.
AREAS OF FLOOD RISK	Low lying land north and south of Dinas Dinlle.
LITTORAL PROCESSES	Low northeastward drift. The sand bays between the tip of the peninsula and Caregg Ddu experience seasonal onshore/offshore movement. Here there is little interdependence between adjacent bays. To the northeast of Carreg Ddu the coastline is less segmented and cliff erosion provides some feed of beach material to be transported towards Menai Strait. However, much of the material eroded from the cliffs consists of fines and is lost offshore. Thus despite this feed, the spit at Dinas Dinlle is suffering from a deficiency in supply of fresh material.

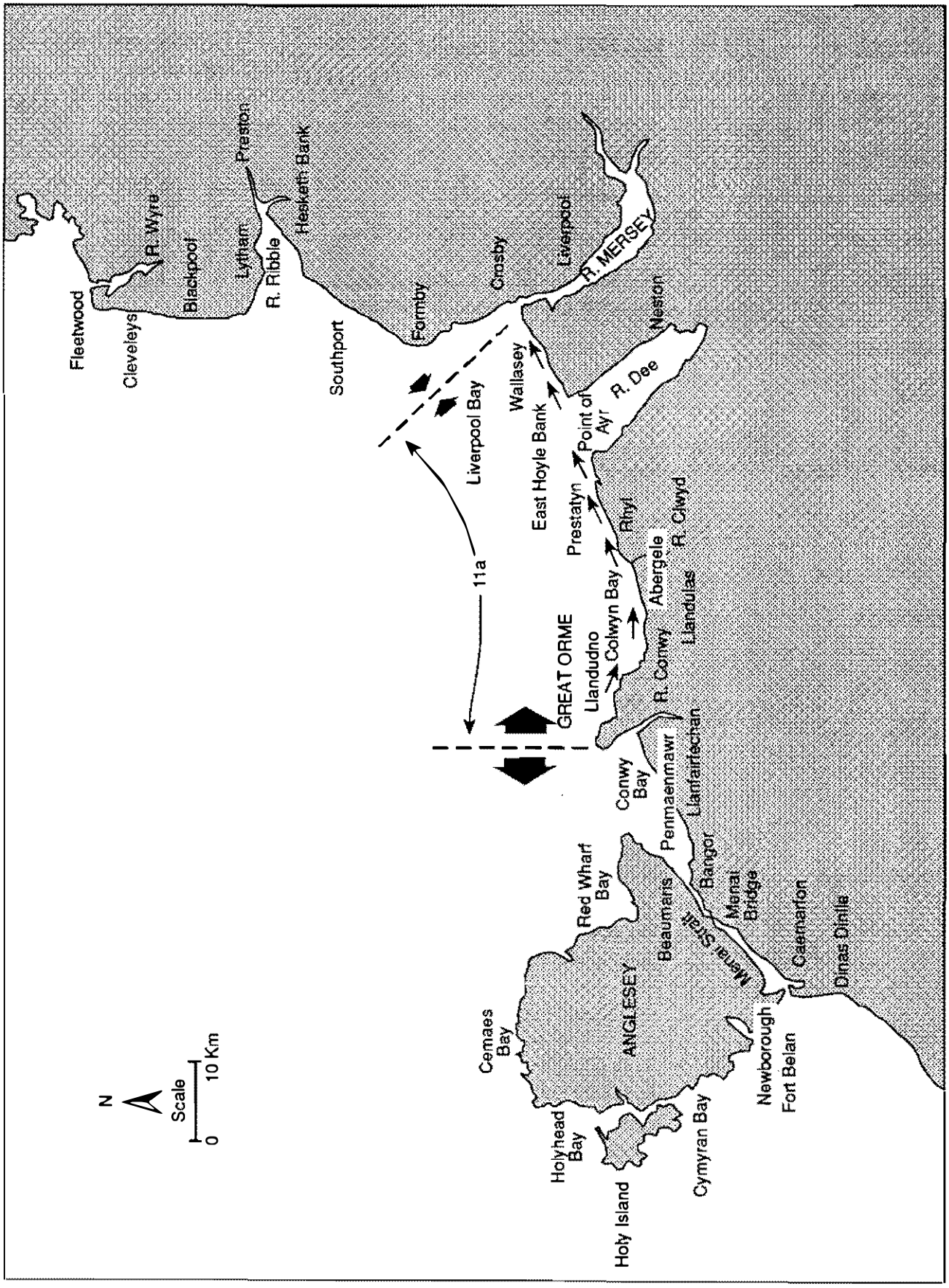

N
Scale
0
10 Km
Fleetwood
Cleveleys
R. Wyre
Blackpool
Lytham
Preston
R. Ribble
Hesketh Bank
Southport
Formby
Liverpool Bay
Crosby
Wallasey
East Hoyle Bank
Liverpool
R. Mersey
Point of Ayr
Prestatyn
R. Dee
Neston
Rhyl
Abergele
Colwyn Bay
Great Orme
Llandudno
Llandulas
Conwy Bay
R.Conwy
Penmaenmawr
Llanfairfechan
Bangor
Beaumaris
Red Wharf Bay
Holyhead Bay
Cemaes Bay
10b
MENAI STRAIT
ANGLESEY
Holy Island
Cymyran Bay
Newborough
Fort Belan
Caernarfon
Dinas Dinlle
MENAI STRAIT

CELL 10	Bardsey Sound to Great Orme.
SUB-CELL 10b	Isle of Anglesey.
COASTAL AUTHORITIES	
District Councils:	Ynys Môn (Isle of Anglesey)
County Councils:	Gwynedd
NRA Regions:	Wales
GENERAL	Rocky coastline of Anglesey has little interaction with the mainland coast with the possible exception of sand banks at the west and east ends of Menai Strait.
BEACHES	Predominantly sandy.
BACKSHORE	Hard pre-Cambrian rocks form an indented coastline which is resistant to erosion. The southern part of Anglesey is Carboniferous, limestones mostly where exposed on the coast. Where there is a cover of glacial boulder clay it is rapidly eroded. In many areas small dune systems back the bays.
EROSION	Local coast protection works in areas of clay cliff erosion. There do not appear to be any extensive areas of erosion. Erosion tends to occur more on the west coast than the north or east. Erosion in Cymyran Bay, for example, is probably related to the exposure to predominant south westerly storms. The shoreline of Menai Strait is generally stable with the exception of low boulder clay cliffs near Beaumaris.
ACCRETION	Newborough Warren, in the southwest corner of the Island.
AREAS OF FLOOD RISK	Low lying areas in the south west corner of the Island (eg. at Malltreath Marsh and in the Menai Strait, near Newborough Warren).
LITTORAL PROCESSES	Littoral drift is very low and variable in direction. Most beaches within embayments or between headlands can probably be treated individually as far as coastal defence works are concerned. Little is known about coastal processes. However, because of the indented nature of the coast, tidal currents probably play a minor role (possibly with the exception of helping siltation take place between Holy Island and "mainland" Anglesey.) Wave action at high tides causes beach lowering and attack on dunes at heads of indentations, and of low glacial cliffs, particularly on west facing coasts.

Sub-cell 10c Fort Belan to Great Orme

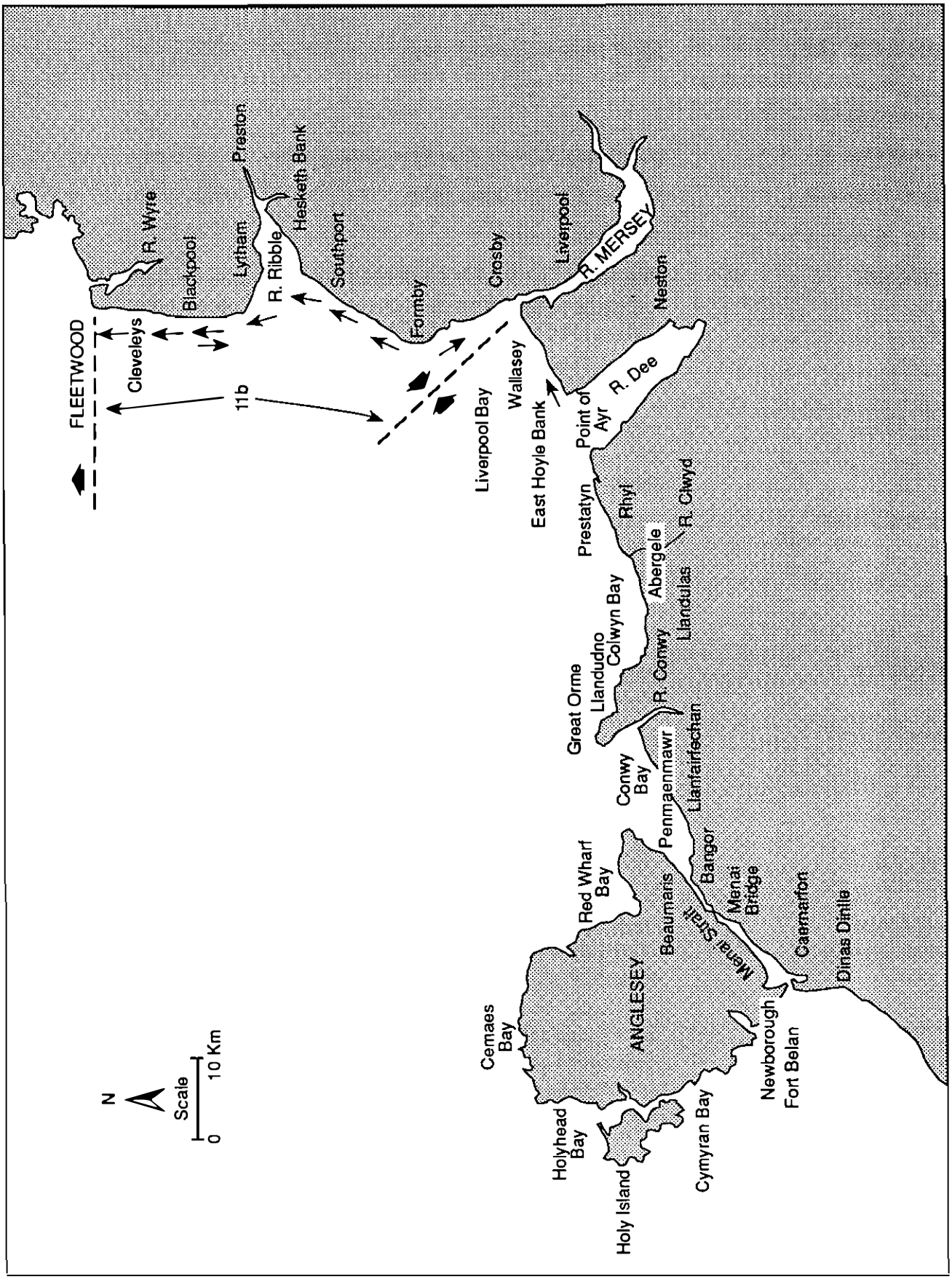
CELL 10	Bardsey Sound to Great Orme.
SUB-CELL 10c	Fort Belan to Great Orme.
COASTAL AUTHORITIES	
District Councils:	Arfon, Aberconwy
County Councils:	Gwynedd
NRA Regions:	Wales
GENERAL	The mainland coast has little interaction between it and Anglesey due to the rapid currents through the Menai Strait.
BEACHES	Sand beaches backed by salt marsh at the west end of Menai Strait. Sands and muds east of Bangor form the intertidal flats of Lavan Sands and Conwy Sands (in Conwy Bay). Some shingle beaches fringe Lavan Sands.
BACKSHORE	Low lying land from Fort Belan to Caernarfon. Higher ground from Caernarfon to Bangor. Low lying land bordering Lavan Sands and Conwy Sands, but with rocky headlands to east of Llanfairfechan and clay cliffs east of Penmaenmawr. (Part of the foreshore at Penmaenmawr is now reclaimed for the A55 trunk road.)
EROSION	Minor erosion/flooding west of Caernarfon (on the margins of Foryd Bay). Minor erosion/flooding east of Bangor. Beach erosion at Llanfairfechan. Sand dune erosion at Conwy Morfa (on the west shore of the Conwy estuary).
ACCRETION	Accretion probably taking place on Lavan Sands and Conwy Sands.
AREAS OF FLOOD RISK	Low lying land west of Caernarfon and east of Bangor.
LITTORAL PROCESSES	Littoral drift is low and variable in direction. Waves from the north cause some bank erosion despite the width of the intertidal flats at Lavan Sands and Conwy Sands. The effects of tidal currents within Conwy Bay are poorly understood. It is possible that sand may be transported in suspension from west to east around the Great Orme. The mainland coast from Fort Belan to the Great Orme can be treated as a single unit for the purpose of management. However there appears to be little interaction between the coast west of Caernarfon and that bordering Lavan Sands and Conwy Bay.

Sub-cell 11a Great Orme to River Mersey



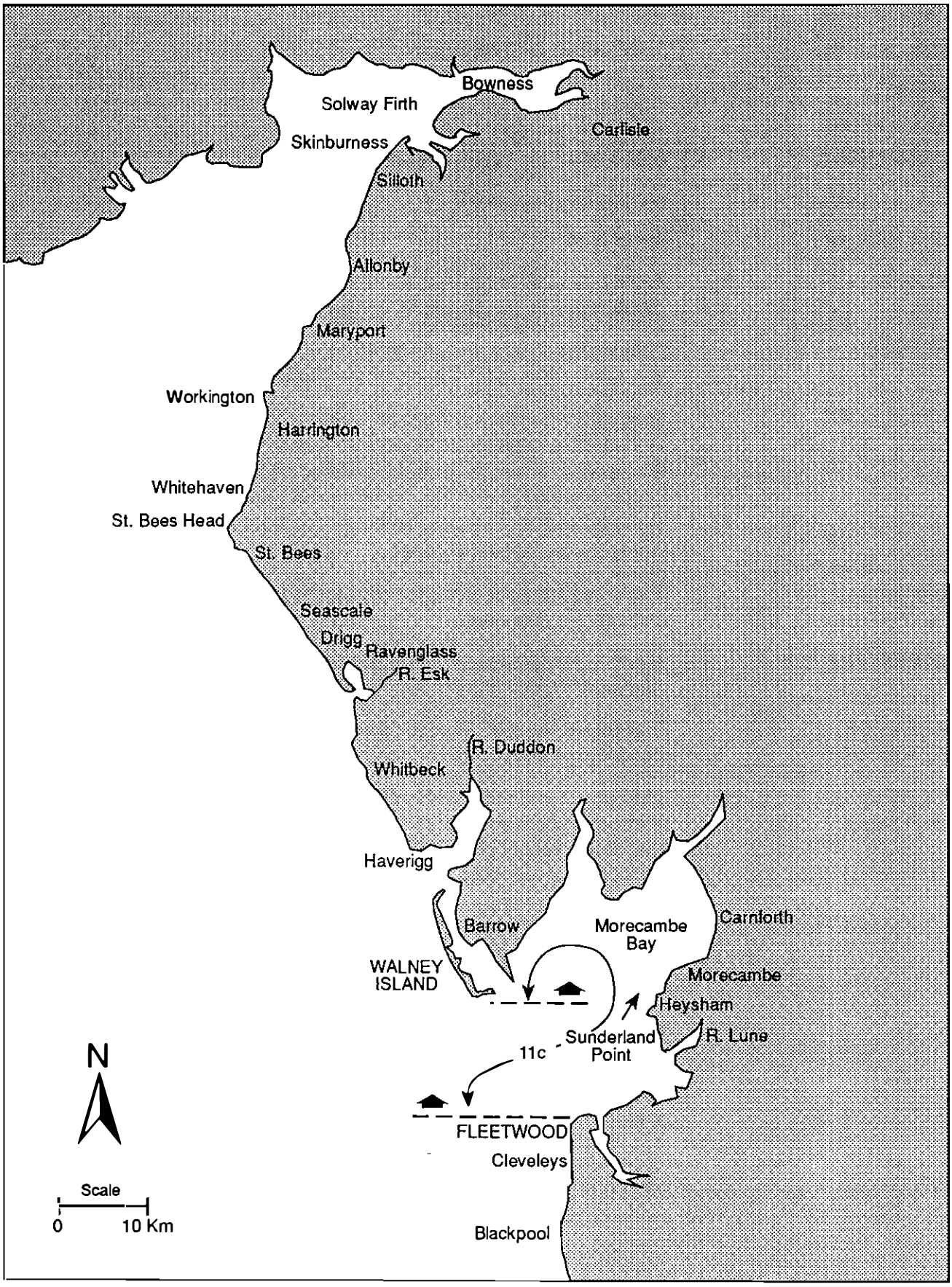
CELL 11	Great Orme to Solway Firth
SUB-CELL 11a	Great Orme to River Mersey
COASTAL AUTHORITIES	
District Councils:	Aberconwy, Colwyn, Rhuddlan, Delyn, Wirral
County Councils:	Gwynedd, Clwyd, Merseyside
NRA Regions:	Wales, North West
GENERAL	With the exception of the promontory of Little Orme (east of Great Orme) and of the mouth of the river Clywd, the coast has few natural barriers to the nett eastward drift. Downdrift problems occur widely and hence this long frontage (most of which is protected) should be treated as a strongly dependent unit.
BEACHES	Predominantly sand. There are also shingle beaches in Llandudno Bay and locally east of Little Orme. There are extensive shingle beaches between Llandulas and Towyn (east of Abergele).
BACKSHORE	Limestone promontories at Great Orme and Little Orme and at Pen-tan-maen to the east. High ground to east of Little Orme consists mainly of clay cliffs which give way to low alluvial plain east of Llandulas (low land extends to the Dee). Stretches of low lying, former marshland can also be found over the frontage from the Dee to the Mersey.
EROSION	Beach erosion is widespread as most of the coast is a "soft" one. Little erosion of the backshore due to extensive protection works.
ACCRETION	Siltation at the entrance to the Clwyd. Siltation in the Dee and sand accretion at the Point of Ayr and on East Hoyle Bank. Redistribution of sediments in outer Mersey causing areas of accretion adjacent to navigation training walls.
AREAS OF FLOOD RISK	Llandudno and Penryhn Bay to the east. Abergele to river Clwyd. Rhyl to Point of Ayr. Dee estuary.
LITTORAL PROCESSES	Moderate to high eastward rate of sand transport. Low eastward rate of shingle transport. Wave driven eastward drift is not very effectively controlled by groyning because of the very large foreshore width. Residual currents in Liverpool Bay provide a mechanism for transporting sand towards the Dee and Mersey. Little evidence of such onshore movement west of the Dee. The open coast of the Wirral benefits from this offshore supply in very sheltered areas (e.g. landward of East Hoyle Bank). The cross-shore distribution of sand transport is complex and any major coastal works necessitate complex studies to optimise design and to minimise downcoast erosion problems.

Sub-cell 11b River Mersey to Fleetwood



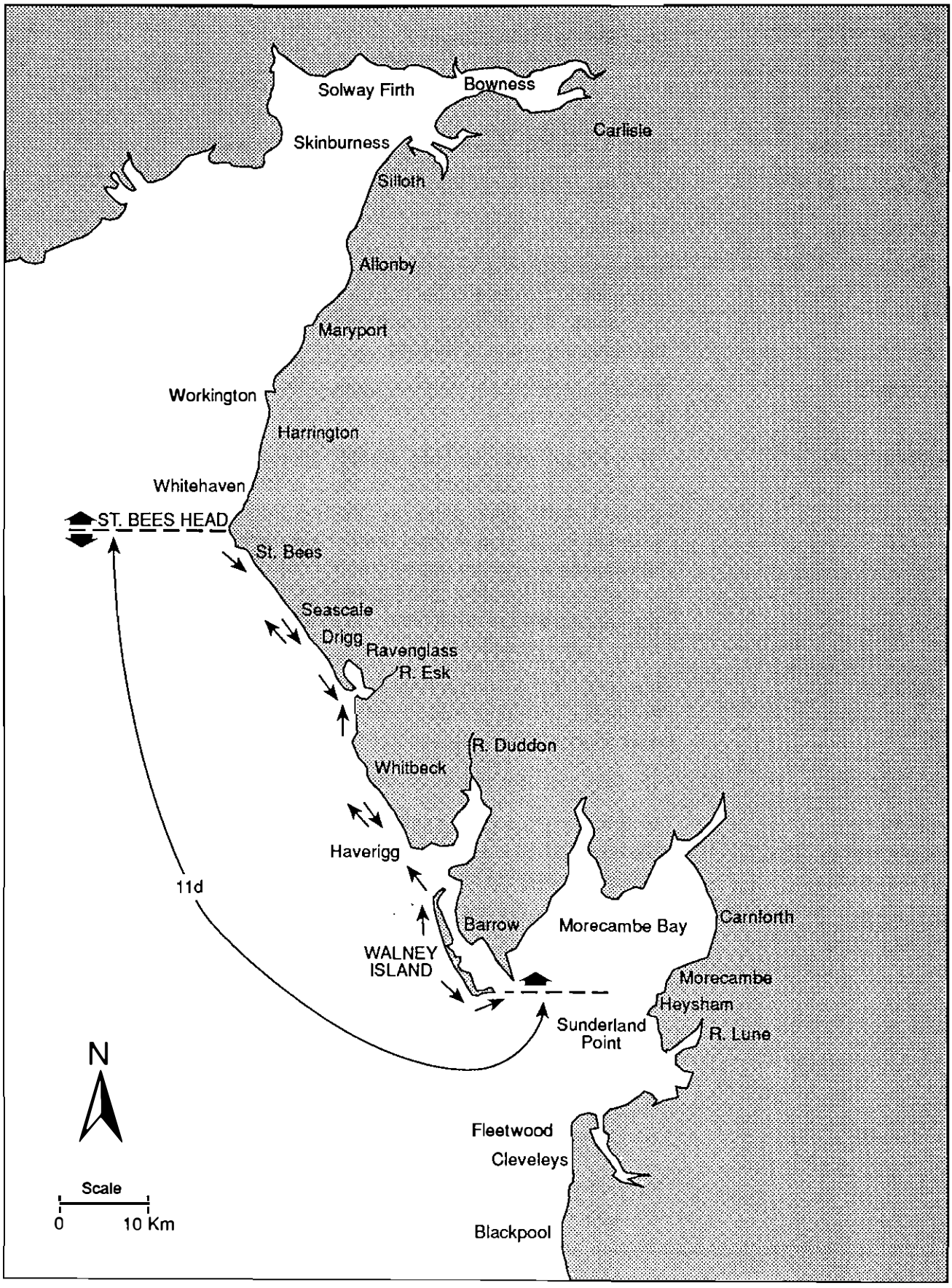
CELL 11	Great Orme to Solway Firth
SUB-CELL 11b	River Mersey to Fleetwood
COASTAL AUTHORITIES	
District Councils:	Sefton, West Lancashire, Fylde, Blackpool, Wyre
County Councils:	Merseyside, Lancashire
NRA Regions:	North West
GENERAL	A predominantly low lying eroding "soft" coast which, despite its considerable length, should be treated as a single coastal unit.
BEACHES	Wide sand beaches on open stretches of coast. Sand banks, mud flats and saltmarshes in the estuary of the Ribble.
BACKSHORE	Extensive sand dune systems from Crosby to Southport. Salt marshes in the Ribble estuary. Small sand dune area between Lytham and Blackpool (much of the backshore has urban development). Higher areas of ground (e.g. at Blackpool) consist of clay cliffs but generally highly defended. Low lying land from Cleveleys to Fleetwood all of which has also been defended.
EROSION	Beach/dune erosion of the Formby peninsula and beach erosion from Blackpool to Cleveleys.
ACCRETION	Mouth of the Ribble has extensive sand banks and salt marsh development also occurs on the estuary margins.
AREAS OF FLOOD RISK	Entrance to the river Alt to the south of Formby, Southport to Hesketh, Cleveleys to Fleetwood.
LITTORAL PROCESSES	High rate of northerly sand transport between the Mersey and the Ribble with somewhat lower rate of northward transport between the Ribble and the Wyre. Wave induced northward drift on open coasts. Onshore movement of fine sand and silts due to residual currents is particularly important in estuary mouths. Developed frontages cannot retreat and are subject to widespread beach erosion. (Blackpool in particular). Liverpool Bay has experienced major changes due to redistribution of sediments following canalization of outer Mersey. These changes are very complex and any large scale works require major studies to assess impacts.

Sub-cell 11c Fleetwood to Walney Island



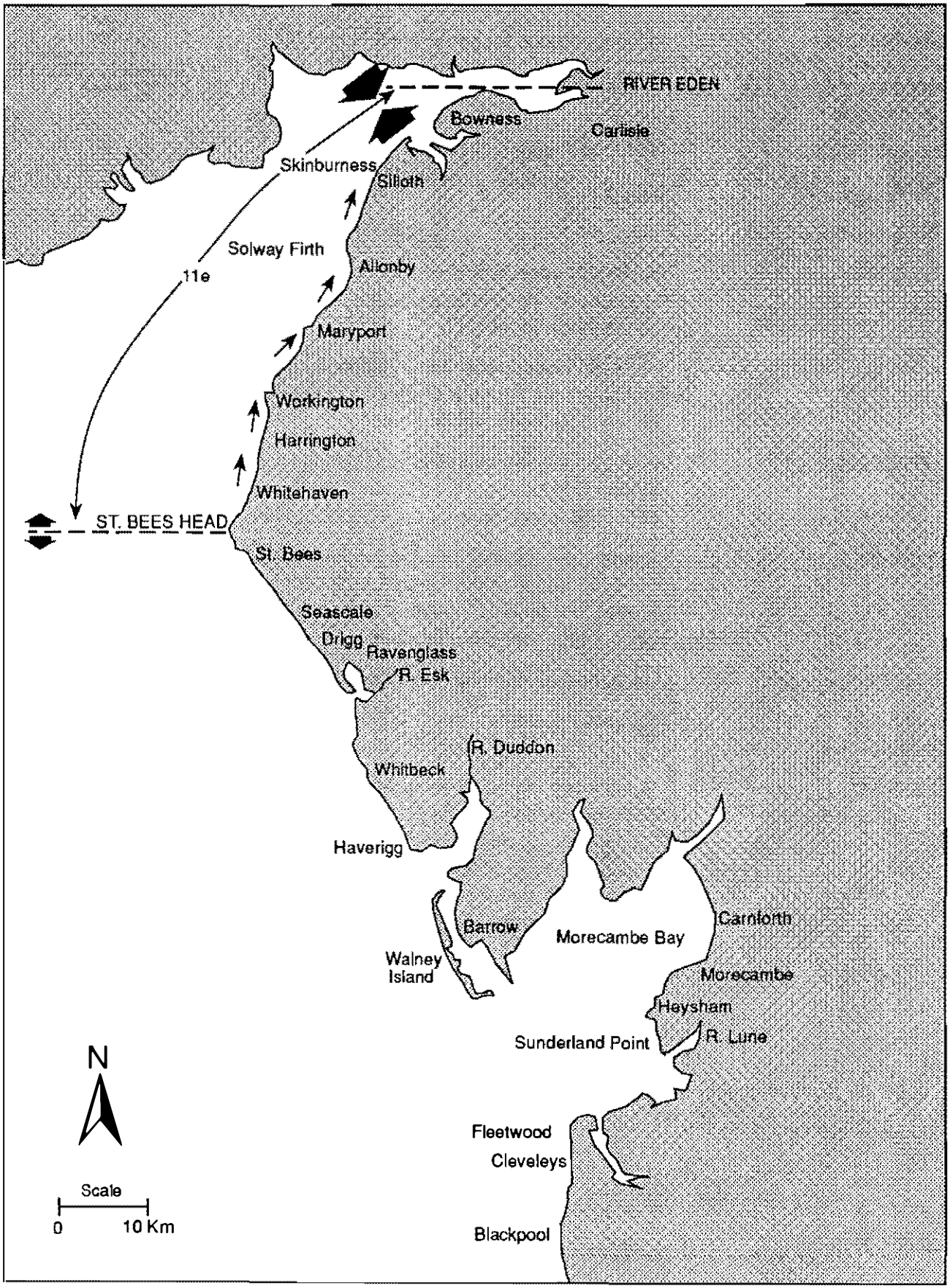
CELL 11	Great Orme to Solway Firth
SUB-CELL 11c	Fleetwood to Walney Island
COASTAL AUTHORITIES	
District Councils:	Wyre, Lancaster, South Lakeland, Barrow in Furness
County Councils:	Lancashire, Cumbria
NRA Regions:	North West
GENERAL	Morecambe Bay has vast expanses of intertidal sand flats, with areas of saltmarsh at the head of the Bay and in the Lune estuary to the southward. It is generally a sediment sink but the low lying land bordering it is prone to flooding.
BEACHES	Extensive mud flats in the Lune estuary. Wide intertidal sand flats within Morecambe Bay.
BACKSHORE	Saltmarshes border the Lune estuary. Limestone promontories occur in parts of Morecambe Bay (e.g. Heysham to Morecambe). There are also areas of glacial drift forming low cliffs (e.g. Sunderland Point at the entrance to the Lune, Walney Island). Saltmarshes extend from north of Morecambe around the central margin of the Bay. The western margin of the Bay has low clay cliffs separated by stretches of low lying land. Erosion of glacial material there, forms mounds of pebbles, called scars, on the upper foreshore.
EROSION	Some clay cliff erosion in local areas of higher ground (e.g. Sunderland Point in Lune estuary and on west shore of Morecambe Bay. Also on west face of Walney Island).
ACCRETION	The Bay acts as a sink for sands and silts.
AREAS OF FLOOD RISK	Most of the shore of the Lune estuary is at risk. Much of the frontage in Morecambe Bay is also at flood risk. (Morecambe urban frontage prone to flooding under extreme events.)
LITTORAL PROCESSES	Moderate northerly littoral drift between Sunderland Point and Heysham. Elsewhere the drift is low and generally insignificant. Movement on upper foreshores is generally weak due to low level of wave activity. Movement on intertidal banks is dominated by tidal currents although waves do have some effect, penetrating via a deep water channel called Lune Deep into Morecambe Bay. Lune Deep may focus waves onto the Heysham to Morecambe frontage. Surges significantly increase the flood risk. These are generally associated with very strong westerly or south westerly winds. Coastal defences generally appear to have little knock-on effect and damage normally occurs due to wave action during high tides.

Sub-cell 11d Walney Island to St. Bees Head



CELL 11	Great Orme to Solway Firth
SUB-CELL 11d	Walney Island to St. Bees Head
COASTAL AUTHORITIES	
District Councils:	Barrow in Furness, Copeland
County Councils:	Cumbria
NRA Regions:	North West
GENERAL	A relatively open stretch of "soft" coastline with a number of rivers and estuaries whose mouths are infilled with sand and which therefore do little to inhibit littoral drift.
BEACHES	Wide sand beaches backed in places by pebble storm ridges (e.g. Walney Island, between Whitbeck and Ravenglass and intermittently between Seascale and St. Bees).
BACKSHORE	Coastline with low clay cliffs, and areas of windblown sand around estuary mouths (e.g. Haverigg Point, at Ravenglass/Drigg). Sandstone cliffs at St. Bees Head.
EROSION	Erosion predominates along the cliffed stretches of coast (which are mainly of glacial origin). In particular there is erosion of the west face of Walney Head. Cliffs protecting railway line between Seascale and St. Bees are also prone to erosion.
ACCRETION	Sand dune accretion at Haverigg Point, Ravenglass Estuary, Drigg Point.
AREAS OF FLOOD RISK	No known areas of serious flood risk.
LITTORAL PROCESSES	Weak littoral drift which is variable in direction. Some river mouths are deflected northwards and some southwards indicating little nett transport. The soft glacial cliffs and the more recent deposits of sand and shingle are subject to long term erosion by wave action. Wind action is also important, controlling the development of dune systems. Tidal currents also help to transport material into estuary mouths and the process of infilling is particularly well illustrated at Ravenglass, at the confluence of the rivers Irt, Mite and Esk.

Sub-cell 11e St. Bees Head to River Eden



CELL 11	Great Orme to Solway Firth
SUB-CELL 11e	St. Bees Head to River Eden
COASTAL AUTHORITIES	
District Councils:	Copeland, Allerdale, Carlisle
County Councils:	Cumbria
NRA Regions:	North West
GENERAL	St. Bees Head forms a natural drift boundary, with the shorelines to north and south having significantly different wave aspects. Drift north of St. Bees is predominantly northwards, dying out at the mouth of the Solway Firth.
BEACHES	Predominantly sand foreshores with pebble storm beaches. Sand banks and mud flats are often veneered with coal dust north of Allonby.
BACKSHORE	Sandstone cliffs extend from St. Bees Head to just north of Maryport. Sand dunes extend from Maryport north to Silloth, giving way to salt marshes in the Solway Firth.
EROSION	Widespread. Slag and shale from collieries and steelworks has previously been dumped on the shore, forming cliffs and reclaimed beaches at Whitehaven, Workington and Maryport. These are now eroding following industrial decline in this area. Downdrift erosion is also taking place due to strongly unidirectional drift, giving rise to problems to the north of the harbours of Harrington, Workington, Maryport and Silloth.
ACCRETION	Large scale sediment movement due to tidal current action gives rise to changes in the patterns of siltation/erosion in the Firth. The area is a sink for sediments and has also trapped substantial quantities of coal particles from the polluted beaches in the south.
AREAS OF FLOOD RISK	Industrial and urban frontage at Siddick (to the north of Workington). Maryport Harbour. Much of the coastline north of Maryport Harbour to the Solway Firth is low lying but is relatively lightly developed, hence not seriously affected by flooding.
LITTORAL PROCESSES	The predominant southwesterly fetch results in a strongly unidirectional, moderate northward wave induced littoral transport with consequent downdrift effects which are most apparent at harbour mouths. This drift reduces rapidly in strength north of Silloth. Downdrift erosion processes are widespread and can have serious consequences. Updrift frontages are also subject to erosion particularly where harbours have been constructed on reclaimed land (e.g. Maryport).

4 Acknowledgements

We would like to thank the following individuals and organisations for their comments on draft versions of this report.

Mr J R V Ash, MAFF Regional Engineer, Cambridge

Mr D J Ayers, MAFF Regional Engineer, Taunton

Mr A B Hughes, MAFF Regional Engineer, Tunbridge Wells

Mr D Knight, MAFF Regional Engineer, York

Mr J G Sexton, MAFF Regional Engineer, Lincoln

Mr H R Payne, Water and Environmental Protection Division, Welsh Office

Mr A C Polson, Flood Defence Division, MAFF

Mr R Leafe, English Nature, Peterborough

5 Reference

Galvin C, (1990). "Importance of longshore transport", Shore and Beach, 58, No 1.

Table

Table 1 Description of cell boundaries

Cell	Sub-cell	Location	Boundary
1		St Abb's Head	Drift Divide headland
	1a		
		The Tyne	One way drift harbour
	1b		
		Seaham Harbour	One way drift harbour
	1c		
		Saltburn	One way drift headland
	1d		
1		Flamborough Head	One way drift headland
2		Flamborough Head	One way drift headland
	2a		
		Sunk Island	Sediment sink
		Immingham	Sediment sink
	2b		
		Donna Nook	Drift divide and onshore feed
	2c		
		Gibraltar Point	Sediment sink
	2d		
		Snettisham	Sediment sink
2		The Wash	Sediment sink
3		The Wash	Sediment sink
		Snettisham	Sediment sink
	3a		
		Sheringham	Drift divide
	3b		
		Lowestoft	One way drift harbour
	3c		
		Harwich	One way drift harbour
	3d		
		Canvey Island	Sediment sink
3		The Thames	Sediment sink

Table 1 Continued

4		The Thames	Sediment sink
		Isle of Grain	Sediment sink
	4a		
		North Foreland	Drift divide
	4b		
		Dover Harbour	One way drift harbour
	4c		
		Beachy Head	One way drift headland
	4d		
4		Selsey Bill	Drift divide
5		Selsey Bill	Drift divide
	5a		
		Portsmouth Harbour	Sediment sink
	5b		
		Southampton (Totton)	Sediment sink
	5c		
		Hurst Spit	One way drift spit
		The Needles	Drift divide
	5d		
		Foreland	One way drift headland
	5e		
		The Needles	Drift divide
		Hurst Spit	One way drift spit
	5f		
		Durlston Head	One way drift headland
	5g		
5		Portland Bill	Drift divide

Table 1 Continued

6		Portland Bill	Drift divide
	6a		
		Dawlish Warren	Sediment sink
	6b		
		Start Point	Drift divide
	6c		
		Rame Head	One way drift headland
	6d		
		Lizard Point	Drift divide
	6e		
6		Land's End	Drift divide
7		Land's End	Drift divide
	7a		
		Trevose Head	One way drift headland
	7b		
		Hartland Point	One way drift headland
	7c		
		Morte Point	Drift divide
	7d		
		Sand Bay	Drift divide
	7e		
		Sharpness	Sediment sink
7		The Severn	Sediment sink
8		The Severn	Sediment sink
		Wellhouse	Sediment sink
	8a		
		Lavernock Point	One way drift headland
	8b		
		Worms Head	Drift divide
	8c		
		St. Govan's Head	Drift divide
	8d		
8		St. David's Head	Drift divide

Table 1 Continued

9		St. David's Head	Drift divide
	9a		
		Afon Glaslyn	Sediment sink
	9b		
9		Bardsey Sound	Drift divide
10		Bardsey Sound	Drift divide
	10a		
		Menai Strait	Sediment sink
	10b	Isle of Anglesey	Separate coastal unit
		Fort Belan	Sediment sink
	10c		
10		Great Orme	Drift divide
11		Great Orme	Drift divide
	11a		
		River Mersey	Sediment sink
	11b		
		Fleetwood	One way drift spit
	11c		
		Walney Island	One way drift spit
	11d		
		St Bees Head	Drift divide
	11e		
		River Eden	Sediment sink
11		Solway Firth	Sediment sink