

ROYAL HASKONING

3 BASIS FOR DEVELOPMENT OF THE PLAN

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3 BASIS FOR DEVELOPMENT OF THE PLAN

3.1 Historical and Current Perspective

3.1.1 Physical Structure of the Coast

The south-west peninsula of England, including Cornwall and the Isles of Scilly has effectively formed as a drowned landscape, following isostatic downward movement of southern Britain after the retreat of the ice-cap at the end of the last ice age, some 14,000 years ago. Although the ice-cap did not reach beyond the north coast of Cornwall, glacial melt-water streams and the onshore transport of eroded glacial material from the degrading ice-cap in the Celtic Sea, supplied huge amounts of sediment to the coasts. Rising and falling sea levels, which have accompanied all the periods of glaciation through the Holocene, have also played a huge role in shaping the present day coast.

A detailed discussion of the geology and coastal processes is presented in Appendix C. A summary of these controlling factors is provided below.

Geology

The geology of the entire coastline of the SMP area, from Rame Head to Hartland Point and including the Isles of Scilly, consists almost exclusively of ancient, resistant rock. Importantly, although direct glacial deposits are entirely absent, the coastline of Cornwall does retain a series of intermittent exposures of raised beaches and head deposits (Futurecoast, 2002). These are important because they represent a potential source of sediment to the coastline in the future.

The geomorphology and general shape of the SMP coastline is characterised by hard, craggy cliffs, resistant headlands, small and medium sized bays containing wide sandy beaches, rocky coves containing smaller pocket beaches formed from sand, gravel and cobbles, large areas of both relic and mobile dunes (locally often referred to as 'towans') and several examples of drowned river valleys. Many of the smaller bays and coves around the coastline coincide with minor faults in the bedrock geology.

The shape of the coastline has a direct impact on how changes and processes at one location influences change at another location. In general terms this particular SMP coastline does not demonstrate such linkages along the coast because of the resistant headlands and long stretches of hard rock between the beaches. Linkages are therefore confined to within each bay or estuary and so each act independently from each other.

Influence of Manmade Defences

Much of the high value attributed to the open coast within the SMP area relates to a naturally evolving coastline. Human intervention across the SMP coast has however been influential in modifying these processes at individual locations. This is generally through hard engineered, coast-protection structures and sea defences where a decision in the past has been to 'hold' the frontage in a modified and 'stable' form. Defences therefore form a very important aspect of control on the physical coastline at individual locations within the SMP area.

A variety of coast-protection structures and sea defences exist at these locations, with the design and construction of these structures a reaction to control specific physical

processes occurring at that location. Detailed discussion about the influence of defences at each location is presented in Chapter 4.

In summary, the SMP coastline is mostly a natural coastline. This natural coastline is interspersed with locations where the coastline is managed in order to control natural change. Management of the coastline corresponds with human settlement at the coastline, with the defences allowing the settlements to function and interact with the coast. Decisions about how coastal change at these locations will be managed are therefore of fundamental importance to the way in which these settlements will function into the future. Increasing our resilience to flooding and adaptation to localised erosion will be challenges to address.

Physical Interaction

Hydrodynamics

This section describes the wider hydrodynamic conditions experienced across the SMP frontage, encompassing tides, water levels and wave climate.

Tides

Mean tidal ranges for the SMP coast do not vary greatly around the coast. Storm surges can temporarily raise the sea surface and enhance tide levels, due to low atmospheric pressure and strong winds, most notable when they coincide with high spring tides. It is generally thought that tides and tidal currents are less important than wave energy in driving erosion and transport of sediments along both the south and north coasts of Cornwall.

Wave Climate

The coast of Cornwall and the Isles of Scilly both experience one of the highest energy wave climates in the UK, due to an extreme westerly mainland and (offshore) location and predominantly south-west, west and north-westerly facing shorelines. The wave climate has been extremely influential in shaping a rugged coastline from the resistant geology.

Sediment Sources

Sediment is (or has been historically) provided to the shoreline of Cornwall and the Isles of Scilly in a number of ways:

- cliff erosion and weathering
- dune erosion
- onshore transport of relic glacial material (mainly north coast)
- onshore transport of contemporary calcium-carbonate (shell) sources
- erosion of the seabed bedrock
- fluvial inputs
- industrial activity (china clay, tin and copper mining).

Sediment Supply

Much of Cornwall and the Isles of Scilly demonstrate swash-aligned shorelines, indicating that the onshore-offshore transport of sediment is dominant. There is generally a lack of research into sediment transport around the SMP coast (with the exception of areas such as St Ives Bay and Carrick Roads) and so detailed assessment remains difficult.

Coastal Change

The coastal zone is a dynamic environment, reliant on natural process to form the boundary between land and the sea. There are a number of key areas and locations which are at risk of coastal erosion and flooding around the coast of Cornwall and the Isles of Scilly.

Table 3.1 Known erosion and flood risk areas

Erosion risk:	Flood Risk:
Portwrinkle	Looe
Charlestown (St Austell Bay)	Fowey
Pendennis	Par & St Blazey
Praa Sands & Perranuthnoe	Mevagissey
Marazion & St Michaels Mount	Flushing
Penzance	Loe Bar & Loe Pool
Hugh Town, St Mary's (the Garrison)	Pentewan
Popplestone Bay, Bryher	Seaton
Hayle Towans	Penzance & Newlyn
Godrevy cliffs	Hayle
Fistral Dunes	Perranporth
Newquay Bay	Padstow
Treyarnon to Constantine	Wadebridge
Tintagel	Bude
Downderry.	Truro
	Penryn
	Golant
	Lerryn
	Portmellon
	Hugh Town (St Mary's)

Confidence and Uncertainty

The study of coastal behaviour and processes is far from being an exact science. Sea level rise is a key component of our assessments of change at the coast, about which there is uncertainty, however the use of government adopted allowances mean we have consistency in approach across all SMP2s. Sea level rise is the general term for the upward trend in mean sea level resulting from a combination of local or regional geological movements and global climate change. Within the SMP2 we have used the recommended contingency allowances for net sea level rise as adopted for use by the government in 2006 (FCDPAG3 Economic Appraisal Supplementary Note to Operating Authorities – Climate change impacts, October 2006). This approach results in the following contingency allowances for sea level rise for the three SMP2 epochs; 0.06m to the year 2025; 0.34m to 2055; and 1.0m to the year 2105.

Records and data can be assessed to determine particular trends to gain an understanding of how the coastline is changing. However, due to the highly sensitive and responsive nature of coastal processes, there are uncertainties when predicting erosion rates and sediment movement. Coastal monitoring within the study area at specific locations as and when required has been ongoing for some time. More recently a Regional South West Coastal Monitoring programme has been established to undertake coastal monitoring on a more consistent and wide-ranging basis. Over time

this will build up a valuable picture of change along the coast, however at this stage the data are too limited to draw long-term trends and conclusions to inform this SMP.

Coastal monitoring data for the SMP2 area along with the rest of the South West Region is freely available from the Channel Coastal Observatory website at www.channelcoast.org

The erosion zones presented with the SMP2 are to be treated as indicative lines, as they are predictions based on present-day scenarios. This information should therefore be regarded as supporting data for policy development and not as absolute predictions of coastal erosion. For the purpose of planning 100 years in advance, a large number of uncertainties remain.

However, such uncertainty is far more related to timing of events such as erosion rates and far less in the understanding that erosion and change will occur. One such obvious uncertainty is in the rate of sea level rise, which strongly influences erosion rates.

At a more local scale there is uncertainty as to the response of the estuaries to sea level rise. Sediment availability and increased fluvial flows (resulting from increased rainfall linked to climate change) will also be influential in shaping the estuaries in the future.

Conclusions

Considering the importance of the coastline, from both a natural and human perspective, shows that there is a clear need for management only at specific locations in order to sustain our coastline environment for future generations. It is important that we take sound and considered decisions about the future management of the coast at these specific locations.

The SMP is the mechanism for creating a plan of intent, so that future strategies and schemes can consider the broader scale of the coastal zone. This is important because management decisions made now will influence these longer term trends and then influence the long-term sustainability of management. The Cornwall and Isles of Scilly Plan has strived to achieve a balance between human aspirations and natural processes in such a way as to create the opportunity for sustainable management of the coast for future generations.

Although there are uncertainties about the timing and exact nature of future change, the SMP can, with a reasonable confidence, project forward the behaviour of the coast in the short term and in many areas through to the medium term. The SMP can also predict with a degree of confidence the longer-term general behaviour of the coast, identifying where there is evident long-term change and pressure.

The SMP puts forward a plan for managing change in a sustainable way taking account of the overall physical structure of the coast and man's influence on this structure and behaviour.

3.1.2 The Purpose of the SMP in Relation to the Physical Structure and Processes

The aim of the SMP is to ensure that a proper account is taken of the impact or interaction between areas, such that management in one area does not have a detrimental impact elsewhere. At the same time the SMP has to provide flood and erosion risk policy guidance to a level that may feed practically into local planning and management of specific defence lengths. In developing this, therefore, the SMP has to maintain a perspective at a broad level while still addressing local interactions.

3.1.3 Future flooding and shoreline change

Two key technical elements of the SMP process are projections of future shoreline position (essentially coastal erosion) and flood extents and boundaries. It is prescribed that these be assessed in three epochs representing, nominally, 2025, 2055 and 2105. Two possible approaches to coastal management must also be accounted for, termed 'No Active Intervention' (NAI) and 'With Present Management' (WPM). These represent situations under which managers do not seek to further influence the natural course of events (NAI) or decide to maintain the current standard of defence (WPM). The 'No Active Intervention' and 'With Present Management' scenarios are projected forward to 2105 and mapped as part of the technical work underpinning the SMP review. They therefore provide the physical basis for the initial consideration of policy options.

The descriptions below relate to the coast within the SMP area and also to those estuaries that were deemed to have relatively low dynamics. The more responsive estuaries (the Fal, Camel, and Fowey), were studied by ABPmer, and are described in Appendix C.

Future flood outlines

Future flood outlines were required to inform assessment of future flood risk and habitat change. The flood risk assessment was based on estimation of the extent of future floods at the 1:200 year level, whilst habitats assessment utilised mapping of two tidal stages, mean low water spring (MLWS) and mean high water spring (MHWS), and also the 1:1 year extreme water level.

These tidal height data were provided for primary locations throughout the region by Posford Haskoning (2003). Other locations were obtained through simple linear interpolation, based on coastline distance between the primary locations. It was not necessary to map flooding under the WPM scenario, due to its underlying assumption that current flood defence standards would be maintained, i.e. that protection would be provided against 1:200 year floods.

Before estimating future flood and erosion hazards it was first necessary to predict sea level rise. Defra (2006) describes how this should be done, and their method provides the following results:

- 2025 - 0.06 m
- 2055 - 0.30 m
- 2105 - 0.93 m

Flood outlines were obtained at each of the three epochs using the following procedure:

- water levels obtained from Posford Haskoning (2003) were increased by the expected sea level rise associated with each epoch;
- resulting levels were projected onto the coastal boundary of a three-dimensional model of the land surface, which was provided by the EA, and created through LiDAR surveys;
- the resulting contour lines were captured as digital GIS files for subsequent mapping;
- these maps were later used to determine where assets would become vulnerable to future flooding, and how intertidal habitats areas might develop.

Future coastline change

The process of projecting the future position of the coast and the less responsive estuaries (the Looe, Helford River, Hayle and Gannel) began by mapping a current shore reference line. This line was defined so that it tracked the geomorphic feature of most relevance to the management of that location. For example, the cliff top was chosen if one was present, along beaches and within estuaries the MHWS line was normally tracked, whilst defences were usually followed where they existed.

Different types of coast behave, by definition, differently, and so the reference line was divided wherever the geology or geomorphology changed, or at the end of a coastal structure. This provided 835 individual coastal segments. The shore reference line was also used to generate transects along the coast, to allow subsequent mapping of the predicted changes. These were placed every 25 metres, resulting in a total of more than 28,000 transects.

Each of the coastal segments was then examined to identify its type, e.g. beach, dune, cliff, rocky shore and whether it was artificially defended. Certain characteristics of each segment were then recorded, and these depended on its type. Historic recession rates were estimated for all the segments using a number of sources. The level of certainty behind this key information was quite variable, and so these estimates were expressed as uncertain bands, between upper and lower limits.

If a structure was present then coastal ‘catch up’ was also estimated, based on its size, age and setting. This represents recession that would rapidly follow structure failure as the shore profile adapts towards a more natural equilibrium form. Such estimation is naturally uncertain, and this uncertainty was represented by estimating upper and lower limits of the catch-up distance.

Simple models were then applied to each segment to account for the acceleration of historic recession due to sea level rise. The simplest model dealt with rocky shores not subject to wave activity. Here shore recession was treated as a simple function of shore slope and the increase in sea level. The sensitivity of beach shores depended on the slope and availability of sediment, which determined the roll-back response to the sea level rise. A simple function was drawn from Walkden and Dickson (2008) to emulate the response of cliff/ platform shores to elevated sea levels.

Under the WPM scenario, structures were assumed to be maintained throughout the SMP period. However the NAI scenario required estimation of structure residual life. Data on residual life was drawn from the National Flood and Coastal Defence Database (NFCDD) and reviewed. These data were applied to fit the three epoch approach, i.e. failure was assumed to happen at the end/ start of an epoch, rather than during it. This meant that most of the structures were deemed to have failed at the end of epoch 1 (i.e. in the year 2025), since it would have been unsafe to assume that, without maintenance, they would have been sound until 2055. Once the strong bias towards failure at the end of epoch 1 was established, this was applied to all the remaining structures, except substantial harbour structures.

The results of this process were around 5000 estimates of future recession under each of the two management scenarios. These included upper and lower estimates for each of the three epochs, for each coastal segment. The most important of these results, those that revealed a significant hazard, can be found in both the maps and tables of Potential Baseline Erosion Rates in Chapter 4. In addition the entire set of results can be viewed by the operating authorities in the GIS Viewer that accompanies this SMP.

3.1.4

Natural and Cultural Heritage

The SMP shoreline is highly diverse in terms of its natural and cultural heritage; those aspects of the coastline give an essential and important quality, and are a backdrop to the current use and appreciation of the area.

Appendix D (Thematic Review) provides a detailed definition of the natural heritage, landscape, historic environment and land use within the SMP area. The following paragraphs draw this together in a general appreciation of the values of the area.

Geology

62 locations throughout the SMP coastline have been identified as having a national importance in terms of their earth heritage or rock features. These sites have SSSI status which has been designated for their geological interest, and are also classified as Regionally Important Geological Sites (RIGS).

Heritage

As significant as the geological history, is the long-term occupation and human activity around our coastline. The historic landscape of the coast, shore and intertidal zone and its component features demonstrate the extent to which human communities have occupied and used the coast, sea and shore over thousands of years. Visible and submerged landscapes and deposits hold vital and irreplaceable evidence of the development of the landscape and seascapes and the strong influence of past communities in shaping and exploiting the shoreline. The management of this heritage is therefore critical in sustaining the social and historical values of the coast.

Heritage contributes vitally to local character not only underpinning community identity, but also acting as a major attraction for visitors and a key element of the economic benefits of tourism. The coast boasts many buildings, sites and monuments of national or regional interest.

The Cornwall and West Devon Mining Landscape has World Heritage Site (WHS) designation, and is of huge importance within the study area. The sites included consist of the most authentic and historically significant surviving components of the Cornish mining heritage from the period 1700 to 1914. This designation demonstrates how sites such as the Port of Hayle have an 'outstanding universal value', which is so exceptional that it transcends national boundaries and is of the highest importance to the international community as a whole (Operational Guidelines for the Implementation of the World Heritage Convention 2005).

Understanding the coastal heritage is important in understanding the area and its development, and the way in which man's use and values have adapted to or been altered by the changing coastline. In addition to the important cultural and educational context, the varied assemblage of heritage interest supports an extremely significant tourism industry.

In some areas, sites or monuments are at risk from erosion or flooding. As an overall approach within SMPs, the objective is not to defend every site or monument, but to identify those which are most at risk, so that prior survey and recording can be undertaken before the sea encroaches and destroys them. Each area does have to be considered on its own merit however. There are areas where the heritage value is embedded within present day values of our existing settlements and there are features

where their context within the coastal zone is essential to understanding their value and where they contribute importantly to the overall historic landscape character of the coast. While an underlying principle (in line with that of the SMP as a whole), is to minimise reliance on defence, the SMP also has to consider the opportunity to sustain the historic environmental values in an appropriate manner.

Natural Environment

The Cornwall and Isles of Scilly coastline supports a wide variety of habitat and species, conservation designations, some being of international importance, others of national importance.

Ramsar sites, Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) are all designated as being of international or European importance under the Ramsar Convention on Wetlands, the Habitats Directive and Birds Directive. The Isles of Scilly is the only designated Ramsar site within the SMP2 boundary, with a further nine SACs and two SPAs identified as occurring within the area. Table 3.2 presents the internationally designated sites in the study area.

Table 3.2 International Designated Sites of the Cornwall and Isles of Scilly SMP2

International Designation	Site Name
Ramsar	ISLES OF SCILLY
SPA	MARAZION MARSH
	ISLES OF SCILLY
SAC	POLRUAN TO POLPERRO
	PENHALE DUNES
	THE LIZARD
	GODREVY HEAD TO ST AGNES
	TINTAGEL-MARSLAND-CLOVELLY COAST
	FAL & HELFORD
	ISLES OF SCILLY COMPLEX

Not all of the UK's priority species and habitats are found in designated areas, and while management of special sites and the wider countryside are pre-requisites of securing future biodiversity, experience shows that targeted action can deliver sustained improvements to the status of species and habitats. The UK Biodiversity Action Plan partnership is committed to achieving this by identifying priorities and assessing progress at a UK level, setting targets and identifying action at a country level, and implementing action at country, regional or local level as appropriate. Of particular relevance to the Cornwall and Isles of Scilly SMP are coastal and floodplain grazing marsh, saltmarsh, sand dunes, intertidal mudflats and saline lagoons.

The variety of habitats fringing the coastline has presented paradoxes for shoreline management; some areas of freshwater habitat today, such as Loe Pool and Marazion Marsh were of a coastal nature prior to change. As such, the development of SMP policy for these areas has attempted to provide for the most sustainable future management of these areas, with the effects of policy having been assessed through both the SEA and HRA processes.

Landscape

All the above interests contribute to the exceptional landscape value of the coastline.

In general terms Cornish coastline conjures images of wild and rugged scenery on the north coast and a more sheltered and tranquil, softer environment on the south coast. The Isles of Scilly represent a unique land and seascape of remote beauty with picturesque white sand beaches. These characteristics are reflected in the designation of much of the coast throughout the SMP area as the Cornwall Area of Outstanding Natural Beauty (AONB) and Isles of Scilly AONB. This designation promotes the conservation and enhancement of the natural beauty of an area. This includes protecting its flora, fauna, geological and landscape features.

In addition to the natural landscape and coastal vistas are the human coastal settlements, which contribute much to the broader landscape value and include many areas or features which are both of great heritage value and visually iconic, particularly when considering how features such as St Michael's Mount, Tintagel and the myriad relic engine houses seem to fit seamlessly with the natural landscape which surrounds them.

The quality of this landscape draws together the many aspects and activities associated with the coastline, and in turn, provides a valuable asset both to local residents and to the regional economy through tourism.

3.1.5 Human (Socio-Economic) Environment and Activity

Cornwall is a rural and maritime county and remains essentially rural in character. Farming remains the predominant land use, in spatial terms, both inland and along the coast, although it is no longer the main element of the economy, especially within the coastal zone. The majority of coastal settlements are dependant on a range of industries which whilst still including farming and other traditional occupations such as fishing, is focussed primarily now on a large number of service sectors associated with tourism and recreation. There are other light industry types within the region. Employment opportunities are limited, especially where the traditional industries are in decline. Tourism is a major source of revenue across the entire SMP area and continues to be a growing industry of regional importance.

Throughout the area, there is a wide range of scattered rural settlements. The great number of small towns and villages throughout the SMP area reflects an economy that was historically built around largely self-sufficient farming, fishing and mining communities. The dispersed settlement pattern means that the SMP area has a low population density when compared to the rest of the country. Most of the major communities within Cornwall are in close proximity to the coast due to their historical development around harbours. Hugh Town which is located on St Mary's within the Scilly archipelago is an important centre for the islands. Of the 140 islands that make up the Isles of Scilly, only five are inhabited. These are St Mary's, Tresco, Bryher, St Martin's, and St Agnes.

Population growth in Cornwall today is primarily through inward migration, as the area is considered a desirable location to live, particularly for families and older people, who often move to the coast. Economic conditions in the county mean that many younger people emigrate to more active economically diverse areas. The population of the Scilly

Isles remains fairly constant, although it is comprised of a disproportionately large number of older people.

During the summer months particularly, the numbers of people in Cornwall and Isles of Scilly increases very significantly due to the influx of tourists, particularly to the coastal areas. This can increase pressure on the services, infrastructure and environment of the area.

Access to the shoreline throughout the study area is excellent and indeed a requirement of much of everyday life throughout Cornwall and the Isles of Scilly. The South West Coast Path is a massive asset to the area and makes much of the direct shoreline frontage accessible to all. Areas of private frontage do exist however and these are mostly associated with the Ministry of Defence and landholders such as the National Trust, Crown Estate and the Duchy of Cornwall. Some industry (e.g. quarry companies), private dwellings, farms, hotels and golf clubs also own sections of frontage where access may be denied. However in many cases access routes across private land holdings are provided in order that beaches and intertidal areas (which are generally not privately owned) can be reached by the public. For some, this also presents revenue opportunities in the form of car parking.

The SMP process has to consider all such aspects balancing the possible difficulty of maintaining the socio-economic structure against the change along the frontage. An important role of the SMP is to examine how the various communities can be sustained in the context of the coast eroding locally, and increased flood risk in the future.

Equally important, however, is to reflect what it is about each community that is important, so that in maintaining defence to an area, or in considering the need for change in defence policy, the values of the coastal frontages are equally maintained. This requires a long-term view to be taken, considering how management of defences may be best adapted to longer-term changes and the threat of sea level rise and climate change.

3.2 Sustainable Policy

SMPs have to identify how the coast can be managed in a sustainable way in terms of managing and adapting to flood and coastal erosion risk in the light of future climate change and sea level rise. In addition to this, it also aims to deliver wider environmental and social benefits as part of the SMP policies.

As an overall principle it is adequate to take the definition provided by the original 1987 statement of sustainable development:

'development which meets the needs of the present without compromising the ability of future generations to meet their own needs' subsequently amended and adopted in the Defra SMP guidance, in relation to defence management policy as avoiding: *'tying future generations into inflexible and expensive options for defence.'*

While this provided an initial intent for the long-term view being taken by the first review of the SMP, such a definition lacks (quite correctly, given its context) specific guidance as to the day to day, area by area management of individual sections of the coast or of risk. It is essential therefore, to interpret this in relation to the actual situations that exist and the future that is envisaged.

There are two aspects to sustainability:

- the effort needed to deliver an outcome – such as pressure resulting from changing the coastal form, such as resisting erosion;
- the harm or benefit resulting from the outcome - the vision of what is wanted of the coast.

These have to take account of the issues in a particular area, for example: natural processes, ecology, homes, businesses, navigation or recreation.

The issues along the Cornwall and Isles of Scilly coast have been identified from the following sources of information:

- earlier studies, such as the first SMP, strategies and scheme studies;
- stakeholder meetings and discussions with the EMF, Key Stakeholders Group (KSG) and CSG;
- locally based public workshops;
- a review of policy documents, structure and local plans.

The most sustainable approach is to not intervene on the coast and to let it respond in a dynamic way to natural processes. There is an increasing need to manage flood and erosion risk through alternative methods, such as community based flood warnings and improving the resilience of individual properties, in an attempt to adapt to climate change and sea level rise on a basis that fully utilises understanding of the situation at a local level.

This also fits with the intentions of the European Water Framework Directive, which aims to restore water bodies (including coastal areas) to their natural state, unless there is a good reason not to. This can be done where there are no issues that need managing. However, the coast and hinterland are home to a wide variety of activities, features and issues often with complex interactions.

There are parts of the coast that people would not wish to change as the impact would have a detrimental effect on the sustainability of other issues or features elsewhere on the coast. These may be natural, man-made or social features that the present generation wants to pass on to future generations.

The right balance needs to be achieved between these two extremes, while making sure inflexible and expensive management plans are not passed on to future generations. Even where the coast is currently managed, future intervention may not be the right choice if it is likely that on-going management will have a detrimental effect on natural processes or long-term impact on other parts of the coast. It is likely that management in these places will increase in the future as the coast evolves or because of climate change. Careful consideration would therefore be needed to decide whether it would be sustainable to continue existing management practices rather than letting the coastline behave more naturally.

3.2.1 Natural Processes

We are now entering a period of accelerating sea level rise that will impose greater pressure on the coast to erode and could in some localised areas result in significant change. Sea level rise will also increase risks of flooding. We have to plan for this change. In general terms we have to expect greater energy against the coast and

against defences coupled with a potential reduction of sediment along sections of the shoreline. If we choose to continue to defend our shorelines in the same locations that we do at present, then the size of the defences may need to increase. Increasing the size of defences has a number of implications including cost, land-take, visual and amenity impact, and access to the shoreline. We therefore need to create width where this is possible in order to absorb the sea's energy. Shoreline width can be created through setting back defences or through modifying the approach we take. Equally we need to recognise the importance of the geomorphological control that exists along the coastline at the headlands. We need to work with change to sustain the shape of the coast and the features about it that we value.

As discussed earlier, there are no areas of significant transfer of sediment along the shoreline. Generally this is a coast where action in one area will not have a major impact outside of the immediate area. However, in considering the sustainability of managing areas of the coast we have to understand the significance of the impacts of expectation and consistency to how we approach management in discrete locations. A sustainable coastal system is one that is allowed to behave as naturally as possible, without significant further intervention.

3.2.2 Economic Sustainability

One of the difficulties facing us, as a nation, is the cost of continuing to protect shorelines to the extent that we do at present. Most of the coastal and flood defences that exist have been funded by public money, both for their construction and their ongoing maintenance requirements. In addition, many of the defences that exist today have been the result of reactive management with often limited understanding (or perhaps knowledge) of the long-term consequences, including financial commitment.

Studies over the past few years have established that the cost of maintaining all existing defences is already likely to be significantly more than present expenditure levels. In simple terms, this means that more public money needs to be invested in coastal defence, defence expenditure has to be prioritised, or funding has to come from other sources based on the benefit they bring. Whilst the first option would clearly be the preference of those living on or owning land along the coast, this has to be put into context of how the general UK taxpayer wishes to see their money used. Given that the cost to provide defences that are both effective and stable currently averages between £2million and £5million per kilometre, the number of privately owned properties that can be protected for this investment has to be weighed up against how else that money can be used, for example education, health and other social benefits.

Furthermore, because of the climate changes being predicted, which will accelerate the natural changes already taking place, the equivalent cost of providing a defence will increase during the next century, possibly in some areas to between 2 and 4 times the present cost. Consequently those areas where the UK taxpayer is prepared to continue to fund defence may well become even more selective and the threshold at which an area is economically defendable could well shift. Whilst it is not known how attitudes might change, it is not unreasonable to assume that future policy-makers will be more inclined to resist investing considerable sums in protecting property in high risk areas, such as the coast, if there are substantially cheaper options, such as constructing new properties further inland.

It is extremely important that the long-term policies in the SMP recognise these future issues and reflect likely future constraints. Failure to do so within this Plan would not

ensure future protection; rather it would give a false impression of a future shoreline management scenario which could not be justified and would fail to be implemented once funding was sought. The implications of these national financial constraints are that protection is most likely to be focussed upon larger conurbations and towns, where the highest level of benefit is achieved for the investment made, i.e. more properties can be protected per million pound of investment. The consequence is that rural communities are more likely to be affected by changing financial constraints, but from a national funding perspective, i.e. best use of the taxpayer's money, this makes economic sense.

However, sustainability cannot only be judged on the effort necessary to defend areas. There has also to be consideration of what values and heritage may be passed on to future generations. This is not just in the bricks and mortar that is being defended but is the character and vitality of the coastal communities. There has, therefore, to be a sensible balance achieved between those areas where the increasing pressure from the changing shoreline will make defence unacceptable in reality and those where defences can be maintained but at increased cost. The SMP has to consider this in terms of the following aspects:

- what is the value that is being defended, whether this is in terms of a viable community or merely from the economic perspective of a hard asset;
- whether defences themselves are causing a further deterioration in conditions which makes their maintenance increasingly difficult;
- how management practice will itself evolve. For example following one course of action; will providing defence now mean further resource being put into defence later?

In this latter case the SMP attempts to identify where there is a need to possibly take earlier action to support existing natural structures or to take advantage of existing width, so as to provide a more sustainable defence system in the future.

In many respects sustainability and the balance which we are attempting to achieve may be considered in terms of how the consequence of our action now will be considered in the future. Either in terms of these consequences or in deciding to defend or not defend, a simple test of sustainability is the degree of regret that might be felt in the future of the decision which is being made now. Will we wish that we had taken a different course of action?

3.2.3 Natural Environment

The forces of nature have created a variety of land forms and habitats along the Cornwall and Isles of Scilly coastline. The special quality of the natural habitats and geological/ geomorphological features on this coast is recognised in a number of national and international designations, protected under statutory international and national legislation, as well as regional and local planning policies. There is a legal requirement to consider the implications of any 'plan' or 'project' that may impact on a Special Protection Area (SPA) or Special Area of Conservation (SAC), through the European Union Habitats Directive (Council Directive 92/43/EEC) and Birds Directive (Council Directive 79/409/EEC). The Defra High Level Target for Flood and Coastal Defence (Target 9 – Biodiversity) also requires all local councils and other operating authorities to:

- avoid damage to environmental interest;

- ensure no net loss to habitats covered by Biodiversity Action Plans;
- seek opportunities for environmental enhancement.

A key requirement for the SMP is to promote the maintenance of biodiversity or enhancement, through identifying biodiversity opportunities. Coastal management can have a significant impact on habitats and land forms, both directly and indirectly. In places, coastal defences may be detrimental to nature conservation interests, e.g. producing coastal squeeze, but in other locations defences may protect the interest of a site, e.g. freshwater sites. Coastal habitats may also form the coastal defence, e.g. Loe Bar which protects freshwater habitat and prevents tidal water reaching Helston.

Coastal management decisions therefore need to be made through consideration of both nature conservation and risk management. Although the conservation of ecological features in a changing environment remains important, in terms of environmental sustainability, future management of the coast needs to allow habitats and features to respond and adjust to change, such as accelerated sea level rise. It is recognised that true coastal habitats cannot always be protected *in situ* because a large element of their ecological interest derives from their dynamic nature and this is important to ensure the continued functionality of any habitat. Similarly in terms of many of the geological designations, many of these rely on fresh exposure of the cliffs. This poses a particular challenge for nature conservation and shifts the emphasis from site ‘preservation’ to ‘conservation’.

Accommodating future change requires flexibility in the assessment of nature conservation issues, possibly looking beyond the designation boundaries to consider wider-scale or longer-term benefits. The SMP also needs to consider opportunities for enhancing biodiversity throughout the SMP area, not just at designated sites.

The natural environment of the SMP coastline, quite apart from its intrinsic value, is acknowledged to be of exceptional importance in tourism and to the very way of life of people living in the area. In looking to sustain this environment the SMP has to consider how both the *natural* and *built* environment co-exist on this dynamic coastline.

3.3 The Scale of SMP2 Review

It is evident from Section 3.1 above and Appendix D that there is a high degree of diversity over the SMP2 coastline. This is in terms of the physical processes, natural and cultural heritage and socio-economic drivers; and in considering sustainability (Section 3.2) that there is significant interaction within each theme and between the different themes or individual sectors of interest. Depending on the scale at which the coast is considered there are different interactions within this diversity.

The aim of the SMP is to provide an assessment of flood and erosion risk at the national level and, associated with this, an indication of the overall level of commitment to defence in these areas. Equally the SMP aims to provide a general assessment of appropriate policy for risk management at a level that will assist direct management of defences in a way that will support other management objectives for the areas. To address both levels there needs to be a layered approach to the SMP analysis. To achieve this, despite maintaining a clear awareness of the broader levels of interactions between areas, it is necessary, to allow focus on all issues, to consider sections of the coast in detail and within which individual policy units can then be derived. In taking such an approach, consideration has also to be given to the higher level issues, such that the interaction between these is not lost.

The consultation undertaken at the start of the SMP allowed issues to be identified for individual features within the area, providing an insight to what the public regard as the key values of their coastline. This was used to develop an overall characterisation of the coast, which in turn assisted in agreeing specific objectives for management. Consideration of this overall characterisation allows the coast to be divided into sections, through which more detailed consideration could be given to the development of policy. This process is discussed in Section 3.4.

The figure below illustrates the approach and understanding of the development of policy for SMP2, incorporating all the aspects of work detailed in the previous sections.

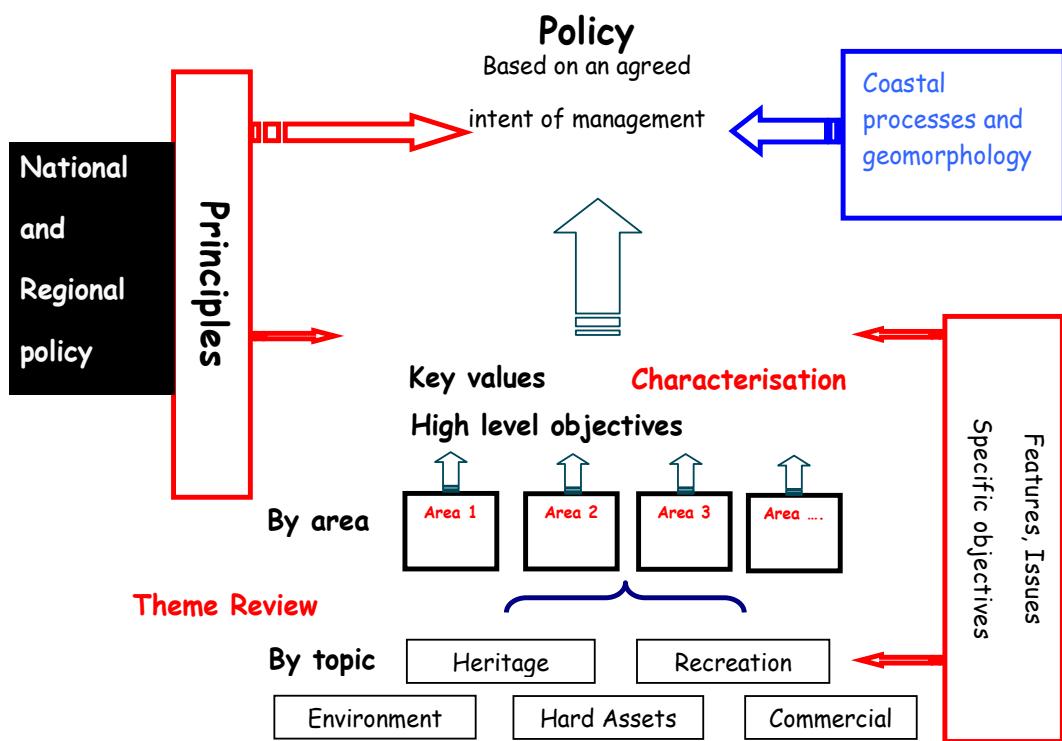


Figure 3.1 Schematic of SMP2 Policy Development

3.4 Links to other plans

3.4.1 The spatial planning system

The Government's national policy for managing development on coastal areas affected by coastal change is set out in Planning Policy Statement 25 Supplement; Development and Coastal Change (March 2010). The aim is that coastal communities should continue to prosper and adapt to coastal change. This means that planning should:

- ensure that policies and decisions in coastal areas are based on an understanding of coastal change over time;
- prevent new development from being put at risk from coastal change;
- ensure that the risk to development which is, exceptionally, necessary in coastal change areas because it requires a coastal location and provides substantial

- economic and social benefits to communities, is managed over its planned lifetime;
- ensure that plans are in place to secure the long-term sustainability of coastal areas.

In order to achieve the above it is essential that planners are informed about the current shoreline and future physical changes to it through erosion, coastal landslip, permanent inundation and coastal accretion. The SMP is therefore a key source of evidence base that planners should consult when determining the material planning considerations set out above (Policy DCC1 from PPS25 Supplement).

The SMP2 assists planners by identifying Coastal Change Management Areas (CCMAs). These are areas likely to be affected by physical changes at the coast, for which the planning authority should set out the type of development appropriate for that location, the circumstances in which certain types of development may be permissible and allocations for land for appropriate development (Adapted from PPS25 Supplement March 2010)

Throughout the development of the Cornwall and Isles of Scilly SMP2, the Client Steering Group has consulted with the Forward Planning team at Cornwall Council about CCMAs within the study area and the SMP2 Preferred Plan for these locations. This work has fed directly into the Core Strategy Issues and Options documents prepared for the Local Development Framework.

3.4.2 Coastal Strategies

The SMP provides a large-scale assessment of the risks associated with coastal evolution and presents a policy framework to address these risks in a sustainable manner. In doing so, a SMP is a high-level document that forms an important part of the Defra strategy for flood and coastal defence which provides both a broad-scale assessment of these risks but also quite specific advice to operating authorities in their management of defences.

Following the adoption of the SMP, the Action Plan should therefore be used by the operating authorities to direct investment at the coast. Often this requires further study at a Management Area or Policy Unit level to determine the next steps in implementing the intent of management. Strategy studies, as set out in the Flood and Coastal Defence Project Appraisal Guidance (FCDPAG) are undertaken to identify and evaluate options for the best approach to implement the intent of management to make the best use of public money and achieve transparent, balanced and good decision making taking account of a wide range of factors. This is the next layer of decision making following the SMP, and because of the more detailed level of study undertaken can find that the SMP policy options are not technically, environmentally, or economically feasible and suggest alternatives. Strategies should then be used in turn to inform future SMP revisions.

3.5 Development of Policy

3.5.1 Derivation of Policy Development Zones

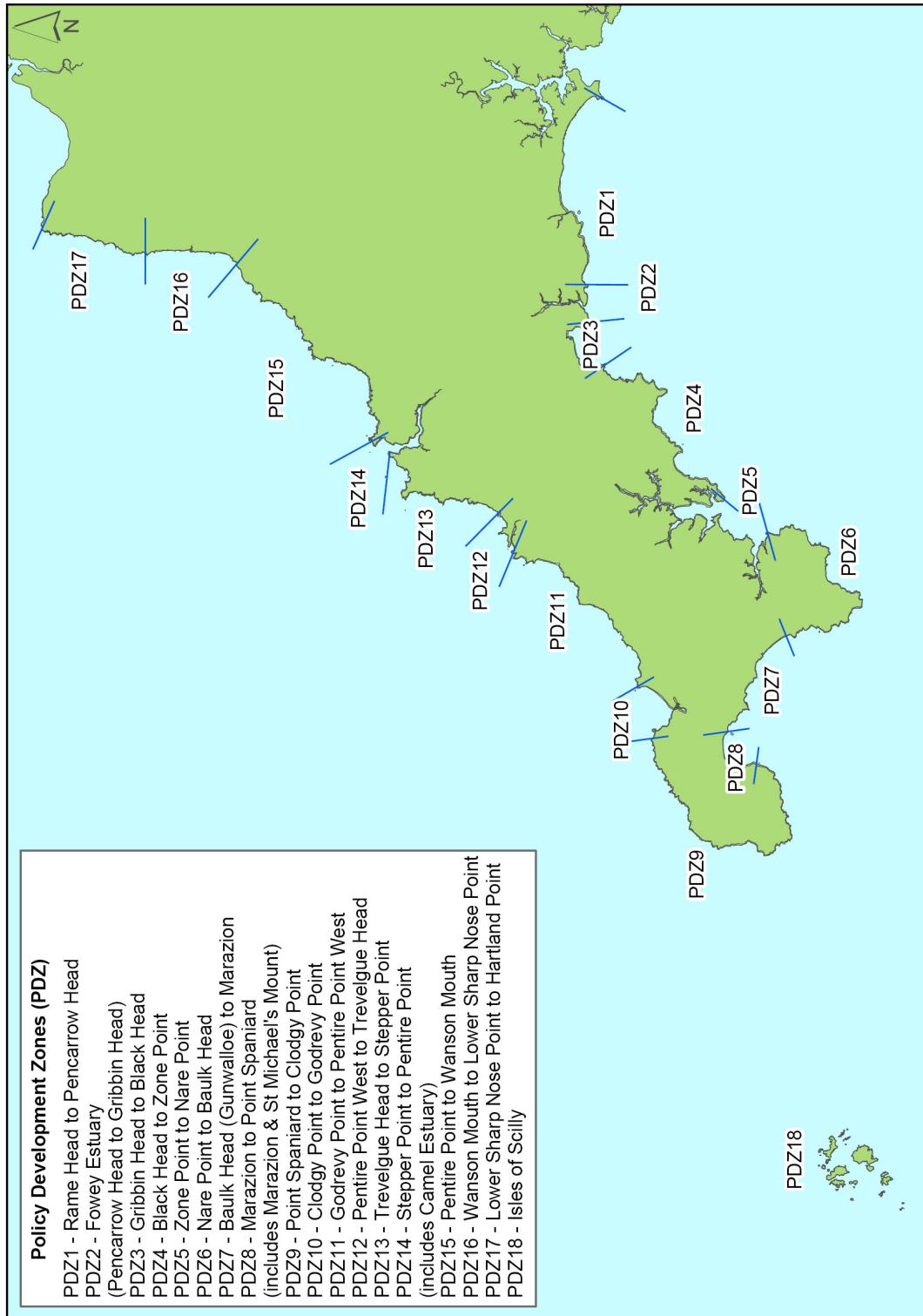
There is no single issue which dominates the development of policy on the coast. From whichever perspective the coast is viewed, there are always overlapping issues and interests between sections. Purely from the manageability of developing policy in

sufficient detail, however, the coast has to be divided. This has been done to minimise the residual linkages between one section of the coast and the adjacent section, but also to ensure that in developing and discussing policy, all major interactions across all themes are able to be considered. It is within these sections or zones that individual policy units may be developed. The high level division is shown in Figure 3.2.

This division is not intended to define hard barriers to thinking about the coast as a whole but solely a practical means of examining the coast in detail. So as not to be confused with the final policy units, the sections are called, merely as a matter of labelling and convenience, Policy Development Zones (PDZ).

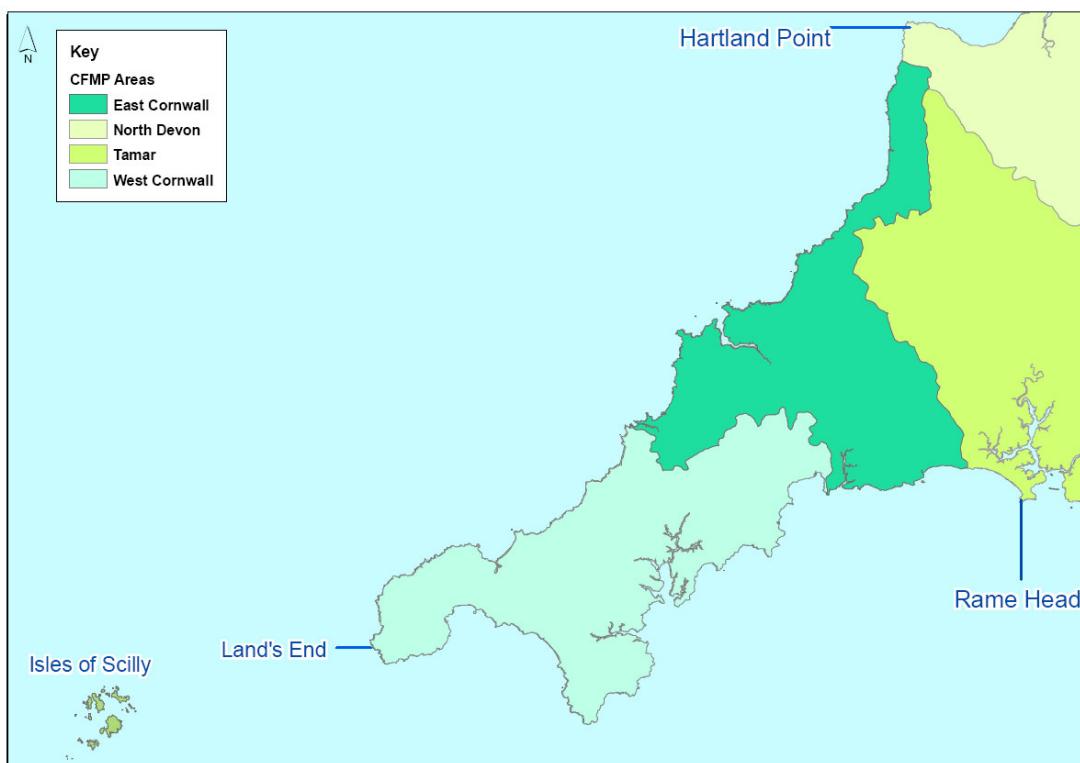
Figure 3.2

Cornwall and Isles of Scilly SMP2 Policy Development Zones (PDZ)



Catchment Flood Management Plans (CFMPs) are in place for the whole of the SMP2 area (excluding the Isles of Scilly) and consider fluvial, pluvial and still water tidal flood risk now and in the future in order to set policies for managing the risk on a catchment basis. The CFMPs that cover the SMP2 study area are West Cornwall CFMP, East Cornwall CFMP, Tamar CFMP and North Devon CFMP, the boundaries of which are shown on Figure 3.3 below. The CFMPs were adopted by the Environment Agency in 2008.

Figure 3.3 CFMP boundaries with the SMP2 study area



The CFMP policy unit boundaries and the SMP Guidance Appendix F Estuaries Assessment have been considered to some extent in determining the PDZ boundaries in relation to the upstream extent on estuaries.

The Estuaries Assessment is presented in Appendix C. This was undertaken for the Fal, Fowey and Camel estuaries to determine the upstream extent of each estuary for SMP2 consideration in accordance with the Defra Appendix F assessment guidelines.

The approach to determining the upstream extent of the PDZs has been driven however by the Client Steering Group who requested that each estuary was considered to its normal tidal limit, including the Fowey, Fal and Camel estuaries. This was in order to ensure the SMP2 was able to provide guidance on pressures and management of the Special Areas of Conservation (SAC) present on the Fal and upper reaches of the Camel estuary. Extending the boundary on the Fowey was in order that the SMP2 could consider flood risk at communities in the upper estuary.

This is beyond the upper boundary determined by the Appendix F assessment and SMP1 coverage in some locations. This means that there are now no areas within the study area which are not covered either by SMP2 or CFMP policy to ensure no gaps exist.

Within the study area there is an overlap with SMP2 and CFMP coverage at key communities, because tidal flood risks have been given some consideration within the CFMP. As such there could be conflicts in the intent of management and preferred plan between the two documents. Within the SMP2, while CFMP policy is acknowledged and considered, the general approach has been to use the analysis and assessment undertaken in the SMP2 to inform the Preferred Plan. This is because the CFMPs primary consideration was fluvial and pluvial flood risk, with only a limited consideration of the impacts of tidal flooding at certain locations. It was not within the scope of the CFMPs to cover the range of estuary and coastal assessments required of the SMP2.

Chapter 5 presents a comparison between the SMP2 Preferred Plan and the CFMP policy where a specific action to implement the CFMP Policy option is published in the CFMPs for Tamar Catchment, East and West Cornwall and North Devon.

3.5.2 Identification of Policy Units

Within each PDZ different scenarios are considered; always starting with the policy for NAI for all locations within the PDZ. This provides the baseline for considering the need or the sense in actively managing the coast. The second scenario is based on the policy developed from SMP1, taking into account further detail or modification which may have been developed during strategy studies undertaken since SMP1. These are termed WPM (i.e. that policy which the SMP2 is reviewing¹) and provides the starting point for considering future management. This WPM scenario sets out a series of policies for individual lengths of coast within each PDZ. Within any PDZ these individual policies may be different for specific lengths along the shoreline, such that one length may be to HTL, in a different length the policy may be for MR.

The two initial scenarios are compared and the way in which they allow the coast to develop and the manner in which they meet or fail to meet objectives defined within the SMP2 is considered. For some sections of coast the scenarios may be the same. In other areas one scenario may address certain issues but fail to address others. In this comparison, therefore, there may be the opportunity to introduce adaptation which will move forward to a more sensible approach to long-term management. In such cases new scenarios are then considered, looking how best to deliver the objectives of the SMP.

From this approach either the WPM policies are confirmed or new policies developed for individual sections of the shore. A preferred defence policy is then defined for a specific section of the coast. This section of coast is the policy unit. This defines how that section of coast should be managed over the lifetime of the SMP.

There is appreciation that there may be a need for transition from present management through to the long-term policy. This may be a result of a new policy being

¹ It is recognised that the purpose of the SMP is to review this present management, making recommendations where necessary for these policies to be updated. As such the SMP2, on completion and approval, will define present management for the future.

recommended or it may be in recognition of the way in which the coast is likely to evolve. To allow adaptation there is scope within the SMP for changes in policy over time. Policy for each unit is therefore defined over time; short term (0-20 years), medium term (20-50 years) and long term (50-100 years).

The aim of developing policy for individual units of the coast within the framework of the PDZ is to ensure that the broader implications of managing one policy unit with respect to another unit is considered; hence the scenario approach. These implications are discussed in the process of developing policy within Chapter 4. Inevitably, therefore, there are dependencies between policy units, the intent being to manage groups of policy units to best deliver objectives for management of areas of the coast. This is discussed below.

3.5.3 Management Areas

PDZs, as described above, are merely a convenient mechanism for ensuring that policy is developed over appropriate lengths of the coast to ensure interactions are taken into account. Policy units are then sections of the coast for which specific policy options (NAI, HTL and MR) are defined. However, as discussed above there may be dependencies between Policy Units (for example to justify a policy of retreat in one area may be on the assumption that an adjacent section of coast is held). Having defined these policies, therefore, it is equally important to group policy units where there is this dependency. Such groups of policy units are defined as Management Areas (MA). It is within these management areas that the overall intent of management of the coast can best be described.

The definition of the Management Area is only at the end of the policy development process. A statement can then be produced providing the understanding of why a specific area of the coast is to be managed in this way and how individual policies work to deliver that intent:

Within each 'PDZ' the coast has been further sub-divided into a series of 'Management Areas' and within each of these, management policies have been selected for a series of 'Policy Units', as schematised below:

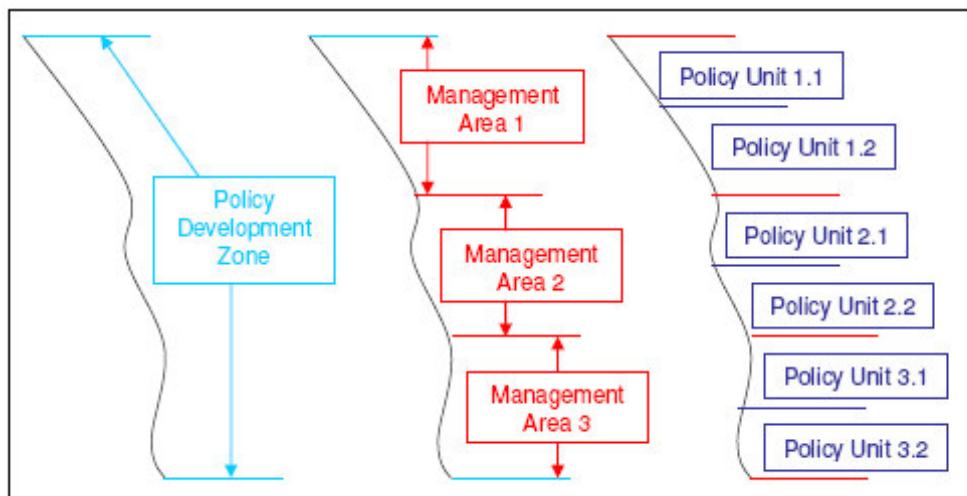


Figure3.3 Schematic of SMP2 links between PDZ, MA and PU.

3.6

Policy Development Zone (PDZ) Analysis

The analysis and discussion for each zone aims to provide an understanding of the issues and nature of the area in a manner which is logical and rigorous and which may be referred to and understood by both coastal managers and people who use or live on the coast. Each PDZ is presented as a series of reports in Chapter 4. Each zone is presented in a standard approach, in line with the SMP guidance. Within each report information has been set out in three sections:

- Description
- Physical Characteristics
- Management.

These are explained below:

DESCRIPTION

The initial section provides a brief overview of issues relating to the coast. Within this first section is a list of the high level objectives agreed for the SMP. These objectives and principles attempt to summarise the overall aim derived from the more detailed list of objectives in Appendix E.

This section merely describes where things are and what they are, in terms of: the underlying physical nature of the coast, together with the use being made of specific areas. This section aims to set the scene, starting to pull together the overall picture. More detail on the physical processes is provided in Appendix C.

PHYSICAL PROCESSES

Basic Parameters

These provide direct information on wave climate and water level within each zone, together with a synopsis of rates of erosion for different sections of the coast within the zone.

MANAGEMENT

Present Management

Current management is summarised in terms of the policies developed during SMP1 and with respect to subsequent strategy studies.

Discussion and Detailed Development of Policies

This sub-section uses the two baseline scenarios to consider specific issues in more detail, looking at both the long-term implications of the current policies and stepping back from the more local strategy development areas to consider any impacts on the coast as a whole. The discussion also considers any detailed proposals put forward in strategies and comments on these from the broader perspective. Where the current policy is felt not to fully address some of the issues being identified, further scenarios are developed. Typically this has been found to be a variation within one of the baseline scenarios, rather than a scenario with such wide reaching impacts that the influence of management affects areas outside the development zone being considered. From this discussion and from the analysis of different approaches and their consequences, recommendations are made for the SMP policy. This principally starts with where management would take the coast in the long term, working back to how policy should therefore be adapted over the short and medium term periods.

Management Areas

Policy units are grouped as management areas, providing coherent intent as to the management and dependencies over the area.

3.7 Management Area Policy Statements

The policy units and management areas are developed in the analysis described above. A summary or statement is presented for each management area across Chapters 4, 5 and 6. This is set out in the following manner.

SUMMARY OF POLICY

The format for this summary is based on the PU summary suggested by the procedural guidance and is contained within Chapter 4. The policy summaries have been grouped by management area. A brief overview of the preferred plan recommendation is presented together with an overview of implementation for the short and medium term, followed by the long-term intent. Finally the specific policies are identified. These summaries should be read together with the more detailed information given in the main body of the PDZ report (Chapter 4).

CHANGES FROM PRESENT MANAGEMENT

The essential changes from current management are highlighted within Chapter 5.

IMPLICATIONS

For each management area a summary of findings of the SEA and HRA is provided, as well as implications with respect to the built environment (economics summary).

A further summary of the implications of the preferred plan is provided in Chapter 5 where the potential impacts these policies will have in terms of the various specific themes and in terms of residual risk and risk reduction is presented. .

MANAGEMENT AREA ACTION PLAN

The management area action plan draws together actions for the whole of the SMP2 coastline and is presented in Chapter 6 on a Management Area basis.