

**A DECADE OF STRATEGIC COASTAL DEFENSE PLANNING IN THE UK:  
APPROACHES, LESSONS LEARNED AND THE WAY FORWARD  
Kevin Burgess, Halcrow<sup>1</sup> & Reg Purnell, Defra<sup>2</sup>**

**Abstract**

The past decade has seen the development and active pursuit, on a national basis, of a strategic approach to coastal engineering in the UK, driven by national government through the Department for Environment, Food and Rural Affairs (Defra) and the Welsh Assembly Government (WAG). The management of our coastlines within a strategic framework has encouraged practices that are least-damaging to our developed and natural environments and which are both technically and economically sustainable in the long term, by concentrating upon:

- Taking a long-term view;
- Having foresight in identifying problems;
- Innovation in seeking and developing solutions;
- A comprehensive regard to impacts and a move away from parochial attitudes;
- Assessment and reduction of risks; and
- Balanced decision making when selecting the outcome.

**Introduction**

The coastline of England is some 3000km in length. Of this total some 1000 km fronts 2200 sq km of land which is below the level of the highest tide and hence at risk of flooding; about 10% of this land is classified as urban. Of the remaining coastline about 1000 kms is at risk of loss by erosion, of which 90% of the frontage is currently protected by human intervention. Studies have assessed that without human intervention, then the potential annual average damage in these coastal areas at risk of flooding or erosion would exceed \$2.5 billion . Fortunately, investment over many years has reduced this to a more acceptable level.

Against this background, it is not surprising that successive UK governments have long recognised the potential impact of flooding and coastal erosion on the economic wealth of the nation and the health and wellbeing of the population and as a result have invested significant sums of tax payer's money to reduce and mitigate that risk.

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<sup>1</sup> *Kevin Burgess, Halcrow Maritime Group Director, Halcrow, Swindon, Wiltshire, SN40QD, United Kingdom.*

*E-mail: [burgesska@halcrow.com](mailto:burgesska@halcrow.com) Telephone +44 1793 816309*

<sup>2</sup> *Reg Purnell, Chief Engineer Flood Management Division, Department for Environment, Food and Rural Affairs, Room 306, Ergon House, Horseferry Road, London, SW1P 2AL, United Kingdom.*

*E-mail: [reg.purnell-official@defra.gsi.gov.uk](mailto:reg.purnell-official@defra.gsi.gov.uk) Telephone +44 20 7238 6178*

## Background

The problems associated with coastal erosion and flooding are not new to England. Our historical records are littered with accounts of flooding and disappearing villages and towns and the human tragedy associated with such events. Dunwich, originally the capital of Anglo Saxon East Anglia, is now but a single street, erosion having gradually eaten away most of the town since the great storm of 1347. In Aldeburgh, in Suffolk, the old town hall has a fine sea view. However, when it was built there were some six roads between it and the sea. In addition, numerous small villages along the soft and erodable east coast, from Yorkshire down through to Essex, have long ceased to exist although remains of some can still be found at low tide. Records from our low lying coastal towns are littered with the details of numerous past flood events, some of which must have caused absolute devastation to the area concerned. The most recent example is the great East Coast flood of 1953 when over 300 lives were lost, 32,000 inhabitants were evacuated from their homes and the damage to the UK economy, recovering after years of conflict, incalculable.

In these affluent and technically advanced times it is sometimes easy to forget the benefits gained by our forefathers with development of coastal lands. Trade and communication links and the ability to derive a living from the sea. To protect these assets our predecessors did sometimes construct coastal defenses, although not always successful as shown by Aldeburgh and Dunwich but more often they were able to adopt a more pragmatic approach which recognised the power of the sea. It was the industrial revolution, and the subsequent explosion in the size of the urban population, when options for flexibility at the coastline were somewhat reduced and society was forced to spend more and more money building substantial sea walls and promenades to protect its valuable investment and to increase the leisure activities. A legacy we have now inherited.

In recent years as our understanding of coastal processes has improved, we have recognised the limitations in continuing to build substantial sea walls and promenades and as a consequence the design of our coastal defenses has become more scientifically based. Attention has turned to adapting and supplementing natural coastal processes with the aim of adopting a coastal policy which is both more environmentally acceptable and sustainable in engineering terms. However, it was soon recognised that if this policy objective was to be met then we would need to ensure that improved or new coastal defense measures should not be considered in isolation and that a strategic approach was required.

The commitment to a coastal policy based on a strategic approach was first stated by the Ministry of Agriculture, Fisheries and Food (forerunner to Department for Environment Food and Rural Affairs) and the Welsh Office (forerunner to the National Assembly of Wales) in their strategy for flood and coastal defenses in England and Wales, published in September 1993. This stated: *“new development or the construction of new or improved defense measures should not be considered in isolation. A new flood*

*wall can cause erosion or problems elsewhere; a new development can change flood patterns or create the need for new defense measures. It is therefore important to look at the processes within a related area and the appropriate responses for that area. It is also necessary to consider the affect that any proposed actions, or decisions not to act, will have on the effectiveness of defense measures in adjoining or related areas and the impact these may have on the proposed action.”*

## **Constraints**

It is one thing for a government department to decide to embark on a policy programme of strategic development at the coastline. It is yet another story delivering on that approach. Whilst it was recognised that the concept of strategic planning had a sound scientific base, there were significant constraints. Chief among them was that history had left us with a legacy of over 90 different operating authorities with responsibility for flood and coastal defenses at the coast line. Whilst the Environment Agency, the Governments largest flood defense operating authority, had responsibility for most areas of coastal flooding, some of these coastal authorities were relatively small, infrequently undertook coastal work and hence lacked many of the skills necessary to participate in a strategic approach. More interestingly, there was no history of these operating authorities working together. Up to the publication of the Government Strategy for Flood and Coastal Defense, their chief responsibility was their own City Council’s frontage. Research has shown that previously some had a somewhat insular approach adopting solutions which whilst tackling their own problem failed to appreciate the long term impact on others.

A change in governance to facilitate a strategic approach was considered and discarded since resolution would have required time and primary legislation. It was felt that persuasion would reap quicker benefits. A one-off research project demonstrated that the coastline of England and Wales could be split in some eleven major cells with, in general terms, sediment not passing those cell boundaries. It was then necessary to encourage the coastal authorities to set up coastal groups based on those coastal cells. These groups would allow authorities on adjoining lengths of coastline to meet and discuss similar problems, solutions, joint gathering of data etc. It would also be necessary for government to provide technical advice on the development of a strategic approach within these cells. The concept of Shoreline Management Plans (SMP) based on coastal cells was born, which subsequently evolved into a tiered strategic framework for coastal defense planning at all levels.

Another flood and coastal constraint was and still is the amount of funds available to us to provide defense. At the local operating authority level, the stance of local politicians is often to defend any areas once they become threatened. However there are insufficient funds available in any year to undertake all coastal defense works required. Since 1999 MAFF, and subsequently Defra, have commissioned national level studies to establish the total expenditure necessary to provide flood and coastal defense. These studies have concluded that simply to replace those defenses that we already have when they reach the end of their effective life will require a rolling programme of expenditure

every year of approximately double that presently being spent . Add to that the impacts of climate change, and in the future we will need to be spending up to four times the present level of annual expenditure to maintain defenses (Burgess, 2004). Clearly without a vast increase in funding, most probably at the expense of other national needs, there are some hard decisions to be faced. This has been a factor, amongst others including land use and environmental implications, in setting mechanisms for prioritising future coastal defense works, and increasing recognition that those funds that are available must be put to best possible use.

## The UK Strategic Framework

The objective of UK national government with respect to flood and coastal defense has been stated as *“to reduce risks to people and the developed and natural environment from flooding and coastal erosion by encouraging the provision of technically, environmentally and economically sound and sustainable defense measures”*. In this context sustainable schemes are defined as those which *“take account of the interrelationships with other defenses, developments and processes ..... and which avoid as far as possible tying future generations into inflexible and expensive options for defense”*.

This definition of sustainability is important to note as it means that our approach cannot be ‘defend at all costs’. Even if a scheme is economically justified at the moment, we must question the viability of continuing this practice into the future and consider alternative options before proceeding. These options may be alternative engineering or management solutions, or might be more radical, for example allowing a previously defended shoreline to erode.

The need for a strategic framework was seen as essential to the achievement of these objectives. Over the years this has resulted in the development of a number of instruments with strategic planning at different levels, as summarised in Table 1 and illustrated below.



**Table 1 - Stages in the strategy development/appraisal process**

<b>STAGE</b>	<b>Shoreline Management Plans (SMPs)</b>	<b>Strategy / Implementation Plans</b>	<b>Schemes</b>
<b>AIM</b>	To identify general policy(ies) and management approaches	To identify appropriate scheme types to implement policy	To define the nature of works to implement preferred scheme
<b>DELIVERS</b>	Constraints, data, knowledge, areas of uncertainty, preferred approach	Details of approach (i.e. scheme type) including economic and environmental actions	Design of engineering options for preferred scheme type
<b>OUTPUT</b>	Generic strategic option (e.g. hold, retreat, advance) and approach (e.g. hard or soft defence measures)	Details of scheme (e.g. beach recharge, seawall, setback embankment)	Type of works (e.g. revetment, wall, recycling)

The shorelines of England and Wales are divided into approximately 50 Shoreline Management Plans, each covering wide process-based sediment regimes (generally many tens of kilometres). These provide a baseline understanding of the issues affecting a section of coast, identifying needs and constraints imposed by the physical environment, human activities and nature conservation.

The requirements for SMPs are to identify the best sustainable approaches to reducing risks over the next 100 years. These are produced as ‘living documents’, which will be reviewed and updated on a regular basis as new or more detailed information and better understanding became available. One of the main benefits of the SMPs was that they have managed to deliver a more co-ordinated approach, with the formation of coastal groups, sharing knowledge and problems specific to a particular length of shoreline, and gaining economy of scale in the work carried out to develop these long-term plans.

The development of Strategy Plans has followed on a needs basis, i.e. depending upon the policies in the SMP. These are generally focused upon more localised sediment cells where clear inter-dependencies have been identified (usually spanning several kilometres) and are intended to determine actual defence requirements and actions to implement the SMP policy.

From these strategies individual schemes and design/construction work is identified to address specific erosion/flooding problems.

Through working within this framework we are able to gain a better understanding of our national defence needs and promote sustainable approaches with due regard to neighbouring shorelines and a range of different social and environmental demands.

The available funding issue has been addressed in a practical fashion by Defra and WAG, and a prioritisation mechanism developed. A priority score is derived for all potential schemes by assessing urgency, level of development, economics and over-riding environmental concerns, against a consistent set of guiding criteria (Defra 2002). On an annual basis, authorities with powers to implement coastal defence works identify forthcoming schemes (which must be in accordance with a SMP) and their score. National government annually set a threshold score, based upon available funds, above which schemes can be implemented.

This approach helps those developing SMPs and Strategy Plans to have a clearer understanding of the potential for schemes to be implemented and advise accordingly. Further, in situations where local council politicians wish to pursue schemes that are economically viable, although not meeting the necessary priority score, this system allows a distinction to be made between the interests at a local level and the best value decisions that need to be at a national level.

## **Lessons Learnt**

In the mid- to late-1990's the speed with which the concept of strategic planning for coastal defenses and the consequential production of SMPs initially exceeded expectations. A response perhaps accelerated by the knowledge that government financial assistance was more likely if the authority had proceeded along a path of long-term strategic planning. Within a few years SMPs had been produced for each coastal cell along the whole coastline of England and Wales thereby providing the coastal authorities with the objective means to plan coastal defenses over a much longer period. The SMPs gave greater opportunity for implementing more sustainable and environmentally friendly options including the adoption of so-called managed coastal retreat. In point of fact, this was not a new policy option. The coastline of eastern England had been retreating naturally for hundreds of years as a response to rising sea levels and the normal seasonal storm forces. The exception was that now the operating authorities could recognise where that retreat was most likely to occur and manage it to their own objectives. That might mean building defenses, enhancing natural defenses or in some instances accepting that to stop erosion or flooding was not economically worthwhile or sustainable in the long term. In those instances it might be preferable to allow the coastline to naturally retreat and in the process seek environmental gain.

However, just as the ostrich buries its head in the sand when it sees danger, mankind has that same capability. Despite the recognised power of nature and the need to find solutions to coastal flooding and erosion that are sustainable in the long term, many found, and still find, the concept of managed retreat unacceptable. That is despite the fact that it had been occurring quite naturally since the land bridge between the UK

and mainland Europe was breached at the end of the last ice age. Opposition was partly driven by the losses that land owners could suffer if the coastline was allowed to retreat for compensation for loss is not available. On the other hand government funds are available if defense measures are shown to be in the communities' best economic interest and are sustainable in the long term. The result was that we saw instances where the scientific approach to coastal defenses was not politically acceptable and hence the most effective SMP was not instigated. The end result largely remained the same, since clearly if the strategy plan adopted was not likely to lead to a decrease in damage, then government funds were not available.

Some might argue that it is a logical step forward to provide compensation for the loss of land due to erosion or flooding where no action to prevent loss is seen as in the communities best interest and without doubt this approach would ease the production of meaningful long-term plans. Possibly, but current government policy is that compensation for natural events is not available. To do so would divert funds from the greater need of protecting areas of population. It is a matter for purchasers of coastal land to ascertain the risk before purchase.

These matters have been tackled through two particular initiatives. First, the undertaking of a nation-wide study called Futurecoast, and second through the development of more comprehensive guidance for SMPs and its application on 3 pilot projects.

#### *Futurecoast*

A key objective of the Futurecoast study was to allow coastal evolutionary processes and present and future management decisions to be placed within a longer-term and wider-scale framework, which would provide a scientific basis for considering the direction for sustainable strategic management response. This information would feed into the second round of SMPs.

Futurecoast considered fresh approaches to assessing shoreline evolution, which were used to provide an analysis of future evolution for the entire shorelines of England and Wales over the next 100 years. Although the study was a scientific one the output was primarily aimed at the coastal managers and organisations developing and implementing the SMPs. Futurecoast provides a raised awareness of key coastal process issues that are relevant beyond the time horizon of existing plans and the design life of present coastal defense management approaches, and scientific knowledge which enables the consequences of particular management options for any specific location to be recognised.

One of the main benefits of commissioning such a study was that it addressed an issue common to many SMPs throughout the country and therefore it ensured that there was a consistency and reliability in detail and understanding for all areas of the coastline. It also removed any potential excuses from the developers of SMPs not fully accounting for long-term shoreline evolution!

## *Second-generation Shoreline Management Plans*

Futurecoast provided a major step forward in getting better science into shoreline management planning. But this in itself would not be enough. It was clear from the previous SMPs that inputs into the analysis and development of policies were of variable quality and needed to be improved upon in many cases. In 2002 a complete review of the requirements for SMPs was undertaken and comprehensive guidance produced on the principles of SMPs and how to conduct the various studies and assessments required to produce these plans. This included measures to improve the link between engineering science and planning, approaches for meaningful engagement with stakeholders, and procedures to develop robust policies which could withstand the challenges that would undoubtedly arise.

Included within this was a decision to make assessments which looked forward 100 years in an attempt to have operating authorities act wisely now and not leave a legacy of unmanageable defences for our descendents. Many of the problems we have today are a legacy of ill-informed planning in the past.

There is also the issue of accelerated climate change. If current predictions of rising sea levels are correct, where we continue to hold the shoreline in its present position we will experience even greater pressure in the future. Over the next century this is expected to include the complete loss of beaches due to intertidal squeeze and the need for substantially larger defences to maintain the current standards of protection. With these changes we should not expect that today's approach to defense at any one location will necessarily remain achievable in the future.

It is however recognised that due to present-day needs, wholesale changes to existing management practices may not be appropriate in the immediate-term. The SMPs therefore provide a 'route map' for decision makers to move from the present situation towards the future, whilst looking to remain flexible enough to adapt to changes in legislation, politics and social attitudes. Essentially we are looking at the long-term not to determine what policies our descendents must adopt, but to make sure that the practices that we implement today and tomorrow will not be inappropriate.

The new guidelines for SMPs have since been tested and developed further on three 'pilot' second-generation plans. This has generally been very successful but not been without its difficulties, in particular the reaction of local politicians to the long-term retreat of some populated areas that have been defended for several decades. This is not unexpected but it is notable now that the rationale behind some of these requirements is now better understood by these groups at the local level. Indeed there is less debate now regarding the basis for the policies, in fact there is some agreement with the logic of these decisions, but attention is now focusing upon the issue of compensation for those affected. This we expect to continue to be a matter of debate for some time to come.

## **The Future**

It is interesting that adoption of the strategic approach has probably helped to increase the level of investment in coastal defenses. Whilst in the past our investment in coastal defenses normally responded to natural coastal catastrophes, in more recent times, we have learned that it is far better to try and assess where the risk of coastal erosion or flooding is greatest and instigate investment to reduce that risk, hopefully before the inevitable event occurs. Strategic planning and in particular the improved understanding of coastal processes which flowed from the production of SMPs demonstrated that perhaps our level of investment was less than optimum. Subsequent assessments of the national risk of flooding and coastal erosion led to a significant increase in investment. Even so investment levels still fell short of that required to undertake all schemes that could be demonstrated to be in the nation's economic interest. .

A recently completed study undertaken for Government by our Office of Science and Technology under its "Foresight" programme has examined the likely changes in flood and coastal risk in the long term. It clearly demonstrates that under the influence of climate change and demographic and economic change the probability and impact of flooding and coastal erosion will increase over the next 100 years. It points out that *"the future is very uncertain and cannot be predicted. It is therefore important to develop policies that can cope with a range of different outcomes-and which can adapt flexibly as the situation evolves. The greater the uncertainty, the greater the need for flexibility."* In addition it notes that *"decisions taken today will have a profound impact on the size of flooding (and erosion) risk that future generations will need to manage. They will strongly influence the options available for managing those risks."*

Through the latest developments with the SMPs we are at last getting a realistic understanding of the future needs. The concept of sustainable long-term policies is clearly unpopular at some levels and will indeed need to be carefully managed and controlled if we are to realise this vision. However this is a necessary approach if we are to comply with environmental legislation and have manageable shorelines rather than ones which are encased in concrete with ever spiralling costs to maintain these defenses.

The governments original Strategy for Flood and Coastal Defense was originally published in 1993 and in many respects its guidance has been overtaken by events. In response Defra is now reviewing its strategy and has published its consultation report "Making space for water" prior to finalising its revised strategy later this year. This is likely to reiterate the need for long term strategic planning if we are to adopt sustainable policies at the coastline.

## **Conclusions**

Many of the issues and problems associated with the coast have traditionally been dealt with in a reactive and piecemeal fashion. Rather than resolving the difficulties, in many cases coastal defense works in the past have compounded them, storing up problems for future generations such as today's coastal engineers to deal with. We need

to learn from these mistakes and look to not repeat them. Our approach to coastal engineering both now and in the future must also be less parochial in terms of the issues that we are dealing with and we must be seeking to make best use of the limited funds that are available to us.

We are still actively providing flood and coastal defense to our shorelines, but in the UK we are making sure that this is in accordance with our strategic planning. By regularly standing back from the local needs and evaluating them in the context of the bigger picture we are able to confirm, or otherwise, the wisdom of our actions. For example will a scheme have detrimental implications elsewhere, is it economically justified in the long-term, if not would be better spending our money elsewhere? Even at the site specific level we regularly re-evaluate our approach, for example should we continue to recharge an open beach, should we add control structures, could we engineer a better management solution?

If defense practices are not compatible with a wider and longer-term sustainable strategy then we may have to alter our present approach and deal with the consequences of that change. Taking a long-term view presents major challenges in how to assess management policies and requires a major shift in thinking on the part of coastal engineers and planners, and this should not be underestimated. Despite this, a major benefit of the strategic approach has been to narrow the gap between the scientific and engineering community, and the officials in local and national government who make the decisions on coastal defense policy and practices. The latter are beginning to realise that they must first have knowledge of coastal processes, future shoreline evolution and thus risks before taking decisions.

Perhaps most importantly from an economic point of view is that through adopting a strategic framework for national level decision-making, we are able to ensure that we optimise our return on finite funds. With a structure that focuses upon quantified risks we are able to measure the benefits of our actions and make investment decisions with the advantages of transparency and auditability. In other words we are able to decide where and how to best spend our capital to best achieve the reduction in risk to people and the environment, which is Defra's primary objective in respect of flood and coastal defence.

We have come a long way in little over a decade. Taking decisions for coastal defense in the UK has been vastly improved through adopting a strategic framework. There can be no doubt that in taking this approach we are now seeing coastal defense management policies that are in the overall best interests of the nation as a whole.

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