

The Planning, Implementation and Monitoring of Coastal Defences

CoPraNet Seminar and Study Tour

6th-10th September 2005
North West England



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Graham Lymbery

**Project Leader for Coastal Defence, Sefton Council
Chairman of Coastal Cell 11 Working Party
www.nwcoastline.org.uk**

It is important to start by saying thank you to everyone who made this workshop possible. This includes those working behind the scenes, those doing talks, those guiding walks and all the people who attended and participated in lively discussions. If the only measure of success was the amount of chatting that got done and the smiles on people's faces then I could confidently say that we had a successful workshop. However, given that we had so many people speaking to us at the workshop or sending us emails afterwards congratulating us on a relevant, informative and accessible event, then it is safe to say that we succeeded in communicating a topical aspect of Integrated Coastal Zone Management.

What was it that we sought to communicate? We wanted to illustrate through practical examples the link between science and decision-making. The context was broadly coastal defence linking into the theme of coastal erosion within the CoPraNet project. By examining some of the issues around the collection, management and analysis of data relevant to our understanding of coastal processes, we hoped to highlight the importance of this area and some of the problems associated with it.

By then looking at how this understanding of coastal processes feeds into the policy development and decision-making process we hoped to make it very obvious how fundamental this link is. The aim was for delegates to leave the workshop with a better understanding of these issues and an idea of how they might choose to apply some of the knowledge learnt to their own locations.

This document seeks to support those who attended the workshop by acting as a reference of the talks they saw presented and also to reach out to a broader audience. I hope you find it useful and I trust that we can continue to share knowledge between coastal practitioners (both coastal managers and academics) in such a productive manner in the future.

Background

This study forms part of a series of international workshops taking place as part of the CoPraNet project; an Interreg IIC West-funded project running from January 2004 to December 2006. CoPraNet stands for 'Coastal Practice Network' and is based on integrated coastal zone management, in particular focusing on the themes of coastal erosion, sustainable tourism at the coast and beach management.

The Planning, Implementation and Monitoring of Coastal Defences is the second workshop to be held by Sefton as part of the CoPraNet project and follows a successful workshop 'The Role of Regional Parks in Sustainable Tourism', which took place in October 2004.

Coastal erosion management is a key issue for the North West of England. The coast here extends for 1,000 km from Chester in the south to Carlisle in the north. It is a mainly lowland and sedimentary coast, with several major estuaries (Dee, Mersey, Ribble and Solway) and Morecambe Bay, which covers 31,000 ha and is an extremely complex and dynamic coastal environment.

There are extensive sand dune systems and salt marshes forming natural coastal defences, together with hard coastal defence works protecting the many coastal settlements, ranging from a large, mainly urban, conurbation (Liverpool) through to major resorts such as Blackpool and Southport, smaller resorts such as Lytham and working coastal towns such as Barrow.

In the Liverpool Bay Area Proudman Oceanographic Laboratories, a government-funded research organisation, is operating a real-time Liverpool Bay Coastal Observatory (see cobs.pol.ac.uk) to monitor a coastal sea's response both to natural forcing and to the consequences of human activity and to test coastal process models by assessing real data against modelled predictions.

In Morecambe Bay the local authorities have come together to develop a Morecambe Bay Coastal Observatory. This includes satellite imaging to track sediment movements across the bay.

At a regional level there is a proposal for regional monitoring to collect data for coastal defence work (sediment movements, wave heights, wind and tide, etc.) and there is an example from another part of the UK (the Channel Coast Observatory), where such a regime is already in place and operating successfully.

There is thus a wealth of monitoring work to discuss, both existing and proposed, together with practical examples of different areas of the coast that exhibit a wide range of management problems and solutions.

The Event

The Planning, Implementation and Monitoring of Coastal Defences took place from 5th to 10th of September 2005 and was based in Southport, with study visits up and down the North West coast.

The aims of the event were to:

- Examine key issues for the sustainable management of coastal erosion and flood defence, using examples from the North West of England as a basis for discussion
- Review the national, regional, sub-regional and local approaches to monitoring for coastal erosion within the wider context of ICZM
- Demonstrate differing approaches to coastal defence and their implications for sustainable use and management of the coast
- Consider the type of research that needs to be undertaken in order to better inform coastal management

Participants were formally welcomed by Jeff Lang, Chairman of the North West Coastal Forum and by The Worshipful The Mayor of the Metropolitan Borough of Sefton, Councillor John F Walker at the conference dinner on the first evening.

The seminar started with a context-setting session to brief non-experts on ICZM, coastal defence in the UK and what the CoPraNet project is all about in order for those delegates to better understand the presentations and field trips on the following days.

The following sessions, more technical in nature, looked at coastal erosion monitoring in practice using regional, sub-regional and local examples and considered allied issues such as requirements for good data management.

Climate change and the implications for coastal defence and for human uses of the coast were also discussed. This session demonstrated the links to the sustainable tourism aspect of the CoPraNet project and the previous Sefton workshop by looking at how climate change might impact on the visitor economy and by exploring how managed realignment can provide new sustainable tourism opportunities at, for example the proposed Ribble Estuary Regional Park.

There were many opportunities for questions and discussion throughout each day and the opportunity to hear about how similar issues are being tackled in other areas with presentations from CoPraNet partners and other EU projects looking at coastal change, for example the Corepoint project.

The study visits, which formed an integral part of the workshop, comprised visits to a mix of soft coastal defences (the dune systems of Sefton) and hard coastal defences around resort towns (Southport, Blackpool and Morecambe) and how they are managed.

The sites visited illustrated the need for understanding the implications of management actions and of future coastal evolution to inform future management actions.

The study visits to the hard coastal defences also explored how major coastal engineering projects can be linked into resort regeneration initiatives by inclusion of major art works, including an innovative art project based around eco-tourism, which can help to improve the town's image and attract tourism.

Jeff Lang

Chairman, North West Coastal Forum

Chief Operating Officer, Wastewater Treatment, United Utilities

As chairman of the North West Coastal Forum it's my pleasure to welcome you all to Southport. The recent disaster on the Gulf Coast of the US is a timely reminder of the importance of coastal defence.

I am the Chairman of the North West Coastal Forum and I am also Chief Operating Officer Wastewater for United Utilities PLC, the North West's water supply and treatment company. United Utilities has a big interface and involvement with coastal issues through concerns about bathing water, etc.

CoPraNet

As you probably know, CoPraNet stands for Coastal Practitioners Network and is a European part-funded project aimed at establishing a Coastal Practitioners Network to bridge the gap between planners, managers and the research community throughout Europe.

The CoPraNet partner countries include: Denmark, France, Germany, Greece, Ireland, the Netherlands, Poland, Portugal, Spain, Sweden and the UK and the overall budget is €1.6 million (€1 million from ERDF), with the North West's budget being €75,000 (€18,750 match). The project timeframe is from 2004 to 2006.

CoPraNet aims to support the interregional exchange of best practice information on sustainable tourism, coastal erosion and beach management through an integrated approach.

All these things are close to the heart of the North West Coastal Forum and that's why the Forum was delighted to be asked by Sefton Council, the local UK CoPraNet Partner, to help them deliver the project, as the Coastal Forum is able to bring a truly regional approach to CoPraNet.

The North West Coastal Forum

The North West Coastal Forum is a partnership organisation with, currently, the following organisations represented on its Management Board:

- Action Ribble Estuary
- Associated British Ports Holdings plc
- British Resorts Association
- Cheshire County Council
- Coastal Cell 11 Working Party
- Countryside Agency
- Cumbria County Council
- ENCAMS
- English Heritage
- English Nature
- Environment Agency
- Government Office for the North West
- Lancashire County Council
- Liverpool Bay Coastal Group
- Mersey Docks and Harbour Company Ltd
- National Trust
- North West Coastal Group
- North Western & North Wales Sea Fisheries Committee
- North West Regional Assembly
- NW Business Leadership team
- NW Regional Development Agency
- PISCES (The Partnership of Irish Sea Coast and Estuary Strategies)
- RSPB
- Sefton Council
- Sustainability North West
- UK Beach Management Forum
- United Utilities

The primary aim of the North West Coastal Forum is:

'To promote and deliver integrated coastal zone management in the North West to secure the long term sustainability of the Region's coast.'

We felt that a more snappy strap line was required for general consumption and so we decide on the very simple:

'Making the most of the North West Coast'

Looking to the future we have just completed a review of the Coastal Forum's key goals and objectives, which underpin the overall aim. We have decided on these:

- Facilitating best practice in delivering ICZM for the North West
- Influencing key opinion formers on coastal issues
- Improving water quality
- A cleaner, safer coastal environment
- Safeguarding, enhancing and restoring natural and historic heritage
- Improving recreational opportunities and visitor experience
- Optimising the economic value of the NW coast in ways that do not damage the environment

To make sure we don't lose sight of these objectives they are to be at the heart of the Coastal Forums Business Plan to help us keep a clear focus on what we are trying to achieve. This event aligns with almost all the above goals.

Achievements to Date

The Coastal Forum's achievements to date include:

- Developing a dedicated Forum website (www.nwcoastalforum.co.uk) as a gateway to coastal management in North West England.
- Raising the profile of the North West coast through presentations and networking at a national and regional level.
- Holding seminars and conferences, for example this event and a recent seminar on offshore renewable energy
- Responding to the EU ICZM Strategy consultations and co-ordinating responses to other consultations.
- Co-ordinating the work of existing groups, recognising links, creating strong communications networks and providing a forum for the discussion and consultation of coastal issues
- Researching issues, for example the North West Fisheries Regeneration Study

Looking to the Future

In our progress towards Integrated Coastal Zone Management we are to carry out a 'stock take' to identify any areas or gaps that we need to address. We then want to measure how well we are progressing towards achieving ICZM and so we want to investigate the use of ICZM indicators.

We are on the verge of acquiring funding to pay for a North West Coastal Trail Officer to take forward work on the proposed North West Coastal Trail.

We are looking forward to working with PISCES (www.northwestcoast.org.uk/pisc.es.htm) to help co-ordinate work under the Natural Economy heading of the Regional Economic Strategy. Under this project many small-scale projects by members of PISCES will collectively add up to make a difference.

Finally our next biennial North West Coastal Conference is due next year. This is an opportunity for all Coastal Forum partners and members to get together to celebrate success and look to the future.

That completes my overview of the Coastal Forum and it only remains for me to say that we are delighted to be involved in this conference and hope you find the next few days rewarding.

For further information on the work of the North West Coastal Forum see www.nwcoastalforum.co.uk or contact **Caroline Salthouse**, North West Coastal Forum Secretariat, on Tel: **01942 776941** Email: caroline.salthouse@nwra.gov.uk

Caroline Salthouse

**North West Coastal Forum Secretariat
Regional Coastal Project Officer, North West Regional Assembly**

The Project

CoPraNet is an Interreg IIIc Networking project, involving 21 Partners in 11 EU countries: Denmark, France, Germany, Greece, Ireland, the Netherlands, Poland, Portugal, Spain, Sweden and the UK. The lead partner is EUCC – The Coastal Union, Netherlands, and the local partner here in the North West is Sefton Council, which is subcontracting work to the North West Coastal Forum to enable a truly regional approach. The project is running from January 2004 to December 2006.

The project objectives are:

- To establish a Coastal Practitioners Network and bridge the gap between planners, managers and the research community throughout Europe
- To support interregional exchange of best practice information on sustainable tourism, coastal erosion and beach management through an integrated approach

Outputs

Networking events: over the lifetime of the project there will be a total of 11 thematic international workshops, of which this event is one, with associated study visits. There have also been two conferences, Littoral 2004 and ICCCM '05, and all workshops and conferences will produce reports.

Web-based knowledge transfer: a key part of the project is the development of a multilingual website (www.coastalpractice.net), which is continually being added to and will ultimately contain:

- An information system on best practice experience
- A multilingual guide for beach management and coastal erosion
- An ICZM project database
- An international quality label for tourism destinations
- An active electronic helpdesk
- Downloadable copies of the project newsletters, currently available in eight EU languages

The North West's Contribution to CoPraNet

The North West Coastal Forum, acting on Sefton Council's behalf, is leading on the erosion and beach management work that make up Component 2 of the project. We are joint leaders of Component 2 with Down District Council, who are leading on the sustainable tourism work.

We are also actively contributing to the sustainable tourism knowledge gathering and outputs of the project, including the development of the tourism quality label and the beach management guide. We are also contributing best practice case studies to the sustainable tourism and erosion databases, which will be available on the website.

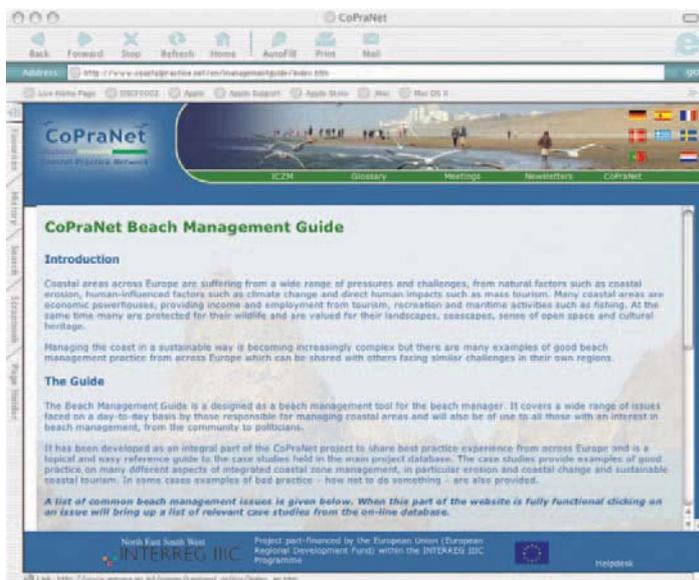
The project is also providing assistance for North West coastal practitioners to attend the annual conferences and the international workshops and study visits and hosting two thematic workshops, one on a sustainable tourism theme and one on an erosion theme.

First North West Workshop: The Role of Regional Parks in Sustainable Tourism

The aim of this workshop was to identify key issues for the promotion and management of sustainable tourism in a regional context.

The three-day workshop and study tour took place in October 2004 and considered the existing and proposed coastal Regional Parks of Mersey Waterfront, Ribble Estuary and Morecambe Bay.

Attended overall by 38 delegates including four CoPraNet partners, the workshop and study tour took in coastal locations from Merseyside to South Lakeland and involved a wide variety of people and organisations involved with visitor management, tourism, regeneration, resorts and natural areas.



Strong networks are being forged, not only between CoPraNet partners but also between people within the North West as a direct result of meeting whilst attending CoPraNet events.

It has also been possible to undertake training as a result of involvement with CoPraNet. For example a one-day course on ICZM Indicators was held immediately following ICCCM '05 in Portugal, so it was possible for a NW participant to take part and bring this knowledge back to inform future work to be undertaken by the North West Coastal Forum.

The CoPraNet Network Expansion

CoPraNet, the Coastal Practice Network, is an INTERREG IIC project, which was set up with the aim of establishing a European network of coastal stakeholders to share knowledge and best practice on coastal management.

The challenges of the network are to establish an 'open source' ICZM-platform and to integrate ICZM-projects, national and international networks so they can stimulate rather than compete, to make coastal practitioners the main drivers of ICZM community and to promote the exchange of experiences in many EU languages.

The 21 partners involved in CoPraNet at present have successfully established a working network with beneficial knowledge transfer between partners. In order successfully to achieve what CoPraNet was set up to do, however, it needs to continue beyond the December 2006 Interreg funding end date and needs to bring many more EU partners on board. This will then help to realise the EU aim to have a European coastal practitioners network that can be fully self-supporting by the end of the CoPraNet project.

Second North West Workshop: The Planning, Implementation and Monitoring of Coastal Defences – Autumn 2005

This seminar and associated study visits is a five-day event aimed at coastal engineers, coastal managers, planners, coastal partnership officers, land and site managers, researchers, academics and others from across the EU and over 80 people have registered to attend. Workshop reports from both events will be produced later in 2005.

Additional Work

In addition to the work outlined above, the North West Coastal Forum has set up an e-distribution for UK contacts to receive news and newsletters. To join this, contact caroline.salthouse@nwra.gov.uk (Tel: **01942 776941**).

Benefits

There has been a wide exchange of knowledge, both to and from the North West as 16 NW coastal practitioner visits have been supported to four out of the five International Seminars and the two Annual Conferences, and many more North West coastal practitioners have been or will be involved in the two North West workshops.

To this end organisations can now join CoPraNet as Associate Partners. Although Associate Partners cannot benefit from the current project funding directly, they will be able to:

- Directly plug into a network of like-minded partners with similar aims
- Draw on European expertise by exchanging and applying best practices in coastal planning
- Participate in a European benchmarking programme for sustainable coastal tourism (see www.coastalpractice.net/en/qualitylabel/index.htm)
- Liaise with the new European Network for Coastal Research, a Coordination Action under the EU's 6th Framework Programme (ENCORA), intended to start early 2006
- Access European best practice information through the CoPraNet newsletter, website and Helpdesk
- Participate in testing the European ICZM (Integrated Coastal Zone Management) Progress Indicator
- Participate in the CoPraNet workshop 2005-2006, on a cost basis throughout Europe (UK, Ireland, Denmark, the Netherlands, Poland, Greece, France, Spain and more)
- Find partners for new projects and partnerships
- Be involved in the introduction of better coastal management practices and the improvement of information flow
- Be at the forefront of the implementation of integrated coastal zone management throughout Europe

To join the Coastal Practice Network as an Associate Partner see: www.coastalpractice.net/en/network_expansion/index.htm

Expansion in the UK

Since the inception of CoPraNet there has been discussion over whether or not there is a need to set up subsidiary networks, perhaps on a national or regional basis. Examples include the formation of CoPraNet Greece and a proposal from Northern Ireland and the Irish Republic to form a CoPraNet Ireland to foster working relations between coastal

managers within the island of Ireland. Various suggestions have emerged with respect to England, including a CoPraNet England, CoPraNet UK, CoPraNet Irish Sea or a regional CoPraNet within the North West.

However several questions need to be answered before any action can be taken. These include:

- There is already a UK coastal network – CoastNET. Would setting up a new national network duplicate the work of this organisation or complement it? Could CoastNET's role be expanded if it was felt necessary or desirable?
- A UK or Regional Sea network would overlap with CoPraNet Ireland. Is this a problem or is it feasible to have many overlapping networks, particularly given point three below?
- How would any network be funded? At present CoPraNet is receiving EU funding through Interreg IIC and the website will continue beyond the life of the current project. The hope is that the expanded network will find ways of supporting future financial costs, perhaps through other EU funding schemes or a membership fee. Would organisations be prepared to pay twice, once for a local network, and once again for the bigger EU network? It is critical that the overall aim of establishing an EU-wide network is not jeopardised by whatever funding mechanism is needed locally.

The answers to the above are not currently clear and feedback from people directly involved in coastal management in the UK would be welcome. Please send comments to Caroline Salthouse at:

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 Tel: **+44 (0)1942 776941**
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Coastal Change, Planning and ICZM: Setting the Context

Graham Lybery

**Project Leader for Coastal Defence, Sefton Council
Chairman of Coastal Cell 11 Working Party
www.nwcoastline.org.uk**

When considering this workshop it is necessary to set the context; issues to be considered include:

- Social Context
- Complexity
- Integrated Coastal Zone Management (ICZM)
- Where we are now
- Where we are heading
- The importance of science informing management

Social Context

Any system or approach is a product of its environment. In the case of the UK we can look at some key events that influence the way in which we approach coastal defence, the 1953 floods being a prime example.

As an industry we are also influenced by fluvial flooding. On the one hand the high profile fluvial floods in the last 10 years have raised the profile of flood defence, whether coastal or fluvial; on the other hand, it has diverted resources towards fluvial flooding. These events have led to specific policies and implementation mechanisms being developed.

Not all national systems are the same. If we look at Europe we can see different approaches to coastal management that reflect social conditions in those areas and differences in how they have chosen to respond to specific events.



A good example of this can be found in the Netherlands, which has adopted high standards of defence. Some may argue that this has left them with the legacy of having to continue defending infrastructure that has been built there because of these high standards and that, with climate change, this represents an ever increasing burden.

Economic importance of the coast, some examples:

- Ports, Development and Fishing
- Recreation and Tourism
- Industry, Power, Aggregates and Fossil Fuels

Complexity

Complexity arising from a natural and dynamic environment – the coastal environment is still poorly understood at both at a scientific level and by the public, who sometimes perceive the dynamic nature of the coast to be a threat.

It is a natural environment containing beaches, estuaries, dunes, cliffs, saltmarsh and more but all on the move within relatively short timescales. This leads to problems when trying to define boundaries on a map. Also, because of the complex nature, it becomes problematic to try and attribute a response of the coast to an action such as dredging.

Jurisdictions – the legislation relating to the coastal zone often has problems in defining relevant boundaries and a range has been used. Look at the inconsistency between jurisdictional boundaries and the variety of legislation that applies to jurisdictions.

It's also worth noting that many of these boundaries are related to MHW or MLW, typically taken from an OS (ordnance survey) map, which will have varying degrees of accuracy depending on the method used and are essentially out of date straight away. This issue is taken up in the ICZM Stocktake Report by WS Atkins (March 2004).

(www.defra.gov.uk/environment/water/marine/uk/iczm/stocktake/index.htm)

Defining Boundaries – If instead of considering jurisdictions we look at trying to establish boundaries for coastal management we can see why this is problematic.

Some are still related to jurisdiction such as territorial waters, but others are starting to look at physical features such as the limit of salt water influence. We could also consider defining inland boundaries by their landscape or cultural influence of the coast. We should also take into account the potential area of flooding but would that be at current day risk or allowing for another 50 years of coastal change, which then leads in to the need to factor in climate change.

Multiple stakeholders and agencies – Because of the wide range of sometimes conflicting interests there are many stakeholders and agencies involved in the governance of the coastal zone. They often have different interests and priorities. There can be difficulties in communicating because of different backgrounds and training; and mechanisms to bring them together are often time consuming.

Climate change – We believe climate change is happening, but because the coast is on the receiving end we can only react to the wide range of scenarios that are suggested and because of our limited understanding of the coastal zone the implications of these changes are poorly defined at best.

Some quotes on climate change:

‘The estimation of future flood risks is difficult due to future uncertainties. However, all scenarios point to substantial increases.’ (Foresight Future Flooding Report – see:

www.foresight.gov.uk/Previous_Projects/Flood_and_Coastal_Defence/index.html)

‘Coastal erosion will increase substantially under the baseline assumption – i.e. spending on coastal defence continues at present levels. The annual average damage is set to increase by 3 - 9 times by the 2080s, although the worst case (£126 million per year) is still much less than current flood losses (£1 billion per year).’ (Foresight Future Flooding Report)

Note: Coastal erosion (coast protection) refers to the erosion of land by the sea whilst the reference to flood losses refers to flooding from either tidal or fluvial sources (flood defence). When referring to tidal flood defence and coast protection these terms are often brought together in the UK and referred to as coastal defence.

What is Integrated Coastal Zone Management?

‘An integrated process which manages all areas of coastal activity which occur along a stretch of coastline, in an holistic manner, so that minimal impacts occur which may be detrimental to the coast itself’ (Peter French 2005)

ICZM Principles:

- Taking a long term view
- A broad holistic approach
- Adaptive management
- Working with natural processes
- Supporting and involving all relevant administrative bodies
- Using of a combination of instruments
- Participatory planning
- Reflecting local characteristics

ICZM is:

- A way of achieving sustainable development
- Multi-sectoral and multidisciplinary
- A process of management
- Focused on a geographical area

Tools for achieving ICZM:

- Information Management
- Auditing techniques
- Assessment techniques
- Spatial planning and the planning framework
- Resource management techniques
- Regulation and management
- Techniques for involving stakeholders
- Partnerships fostering stakeholder participation

See: 'What is Integrated Coastal Zone Management?', Wales Coastal and Maritime Partnership 2004
(www.walescoastalpartnership.org.uk/)

Where We Are Now on Coastal Defence

There are three principal players:

- Department for Environment, Food and Rural Affairs (Defra) - Defra's role is to manage the risks from flooding and coastal erosion in an integrated and holistic way, employing a portfolio of approaches, so as to reduce the threat to human life and property while furthering sustainable development and the strategic objectives of the Government; and to secure rational funding mechanisms that deliver appropriate levels of investments (**see www.defra.gov.uk**)
- Environment Agency - the Environment Agency is the Lead Agency for Flood Defence and delivers Flood Warnings and mapping of Flood Risk Areas (**www.environment-agency.gov.uk**)
- Maritime Local Authorities - Local Authorities deliver Coast Protection (under permissive powers). They can also deliver Flood Defence. They have formed into Coastal Groups in order to co-ordinate their actions.
(**www.coastalgroups.co.uk**)

Where We Are Heading - Future Developments

- Foresight Report – Future Flooding (**www.foresight.gov.uk/Previous_Projects/Flood_and_Coastal_Defence/index.html**)
- Making space for water (**www.defra.gov.uk**)
- Marine spatial planning (**www.defra.gov.uk**)
- Marine bill (**www.defra.gov.uk**)
- ICZM (**www.defra.gov.uk**) and (**www.walescoastalpartnership.org.uk**)

The Importance of Science Informing Management

The main purpose of the workshop is linking science to decision-making.

The first session 'Setting the Context for Coastal Defence' provides the framework within which all this fits and operates. Particularly relevant is the Shoreline Management Plan, the vehicle for delivering coastal defence in England.

'Monitoring for Coastal Change' looks at elements focused on coastal defence at both a local and regional level. Alan Williams will be delivering the local example based on Sefton and whilst we are in the process of establishing regional monitoring in the North West it seemed better to look at an established example from the south coast.

The talk by Proudman Oceanographic Laboratories is looking at a research project examining the delivery of real-time information amongst other things for the Liverpool Bay area. Then Tim Stojanovic will be talking about some of the generic principles for managing information.

The following sessions look at science and informed decisions – these talks start to look at how data gathered on the coast and elsewhere starts to develop into information that can be used to support informed decisions – Climate change, Sand Dunes, Realignment, Visitor Economy (not just physical but also social and economic processes).

We will also see this aspect on some of the field trips where decisions have been taken informed in part by an understanding of the processes and the implications of actions.

Briefing on the UK Shoreline Management Planning System

14

Adam Hosking

Senior Coastal Scientist, Halcrow Group Ltd
Paper compiled by Graham Lymbery

This summary introduces the development of sustainable management policies for the delivery of DEFRA's and NAWs (Department for the Environment, Food and Rural Affairs, National Assembly for Wales) objectives in connection with coastal defence for the coastline of England and Wales.

What is an SMP (Shoreline Management Plan)?

'a (non-statutory) document that provides a large scale assessment of the risks associated with coastal processes and presents a policy framework to reduce these risks to people and the developed, historic and natural environment in a sustainable manner'
Defra/NAW, 2005

The key aspects to draw from this statement are that SMPs are non-statutory documents and as such rely on their adoption by the Local Authorities and key aspects being reflected in statutory documents such as Local Plans. They aim to reduce risks; this is an important aspect to communicate, as there can be the misconception amongst some parties that the risk can be removed.

The reference to sustainability requires not only a consideration of economic, social and environmental factors but also requires us to look to the future considering not only factors such as environmental change but also social change such as how land use might change.

Generic SMP Policies

A Shoreline Management Plan is a strategic document and as such the policy options are limited and generic:

- No Active Intervention
- Managed Realignment
- Hold the Line
- Advance the Line

They do however represent evidence-based policy development having considered a considerable depth and range of evidence before selection.

Background

The current round of SMPs are the second generation, the first having been developed and adopted in the late nineties. The first generation was based on:

- Defra/WO Guidance 1993/1995
- Engineering Driven
- Consequent lack of planning involvement as a major weakness
- SMP Procedural Guidance 2005 (informed by a review of the first generation plans, see table 1 for the summary of the review)
- Promotes planning involvement
- Pilot SMP2's produced 2005

SMPs are promoted by Coastal Groups (see DEFRA's website for a definition of coastal groups and information on SMPs)

Procedural Guidance

The Procedural Guidance for SMPs produced by DEFRA provides comprehensive guidance on the development of SMPs but some of the key points are that it:

- Promotes sustainable management policies into the next century
- Is objectives led
- Has three main time periods: 0-20 years, 20-50 years and 50-100 years
- Is underpinned by coastal process understanding
- Has 'Inclusive' stakeholder engagement

Executive Summary

This research project has been commissioned by the Ministry of Agriculture, Fisheries and Food following a recommendation made by the Shoreline Management Plans Advisory Group. The overall aim of the project is to undertake an objective review of a number of first generation Shoreline Management Plans (SMPs), and to then use information gained in order to provide guidance for the preparation of second generation SMPs.

In order to achieve this aim the project has been split into two distinct components, namely:

Stage 1: SMP Review. The **objective** of Stage 1 is 'to compare a selection of SMPs (as prepared by both various Coastal Groups and various Engineering Consultants) and highlight generic and (in demonstrative cases) specific strengths and weaknesses of both the shoreline management planning initiative and individual SMPs, and to use these findings to make recommendations for future development of the shoreline management planning process'.

Stage 2: SMP Guidance. The **objective** of Stage 2 is 'to provide guidance for delivering the recommendations made in Stage 1, possibly through a draft model brief for the commissioning of Consultants and/or a standard format for the next generation of SMPs'.

The **methods** used in order to achieve these aims and objectives have included: a review of background documents of relevance to the shoreline management planning process; reviews, with respect to fulfilling pre-established assessment criteria, of sixteen individual SMPs from around England and Wales; liaison with key individuals and organizations involved in the shoreline management planning process; and identifying and addressing specific key issues of relevance.

Findings from Stage 1, the SMP Review have been presented in a collated format in this report. Key findings, listed in Sections 3.17 and 4, have indicated that there are numerous and significant benefits associated with the shoreline management planning process, but there are also several areas where limitations or weaknesses exist. Key recommendations for improvements to the existing process are listed in Sections 3.18 and 4 and include:

- (i) there is a need to more precisely define the role and focus of future generation SMPs;
- (ii) there is a need to utilise an improved understanding of both coastal process and coastal morphology information (including long-term predicted evolution, and the implications of future sea-level rise and climate change) in order to identify sustainable shoreline management policies which reduce risks to people and the developed and natural environments;
- (iii) there is a need for SMPs to be more effective in linking with the planning system;
- (iv) there is a need for SMPs to take account of the legal requirements relating to the Habitats Regulations;
- (v) future SMPs could be prepared for either individual sediment sub-cells, groupings of adjacent sediment sub-cells or an entire sediment cell, but whatever the case, there needs to be a clearly defined timescale;
- (vi) SMPs for individual sub-cells should be compatible with those along adjacent sub-cells, with the encouragement of a high degree of consistency (content, format, presentation style) within the relevant sediment cell;
- (vii) there is a need for a greater transparency of the decision making process within SMPs;
- (viii) there is a need to produce SMPs which can easily be updated in the future;
- (ix) there is a need to improve the dissemination of findings from each SMP, and improve the accessibility of all Plans produced in England and Wales (and Scotland).

The **implications** of these findings are that further national guidance is required in order to:

(i) disseminate the examples of good practice experienced during the production of first generation SMPs; (ii) address the existing limitations and weaknesses of the shoreline management planning process; and (iii) incorporate recommendations which have been made for the future evolution of the process. This guidance has been incorporated in the draft guide for coastal defence authorities.

Following completion of this research project, necessary **actions** will be for the Ministry of Agriculture, Fisheries and Food, the National Assembly for Wales and the SMP Advisory Group to jointly consider how and when the guidance which has been provided could be issued to the industry interested in the preparation of second generation SMPs.

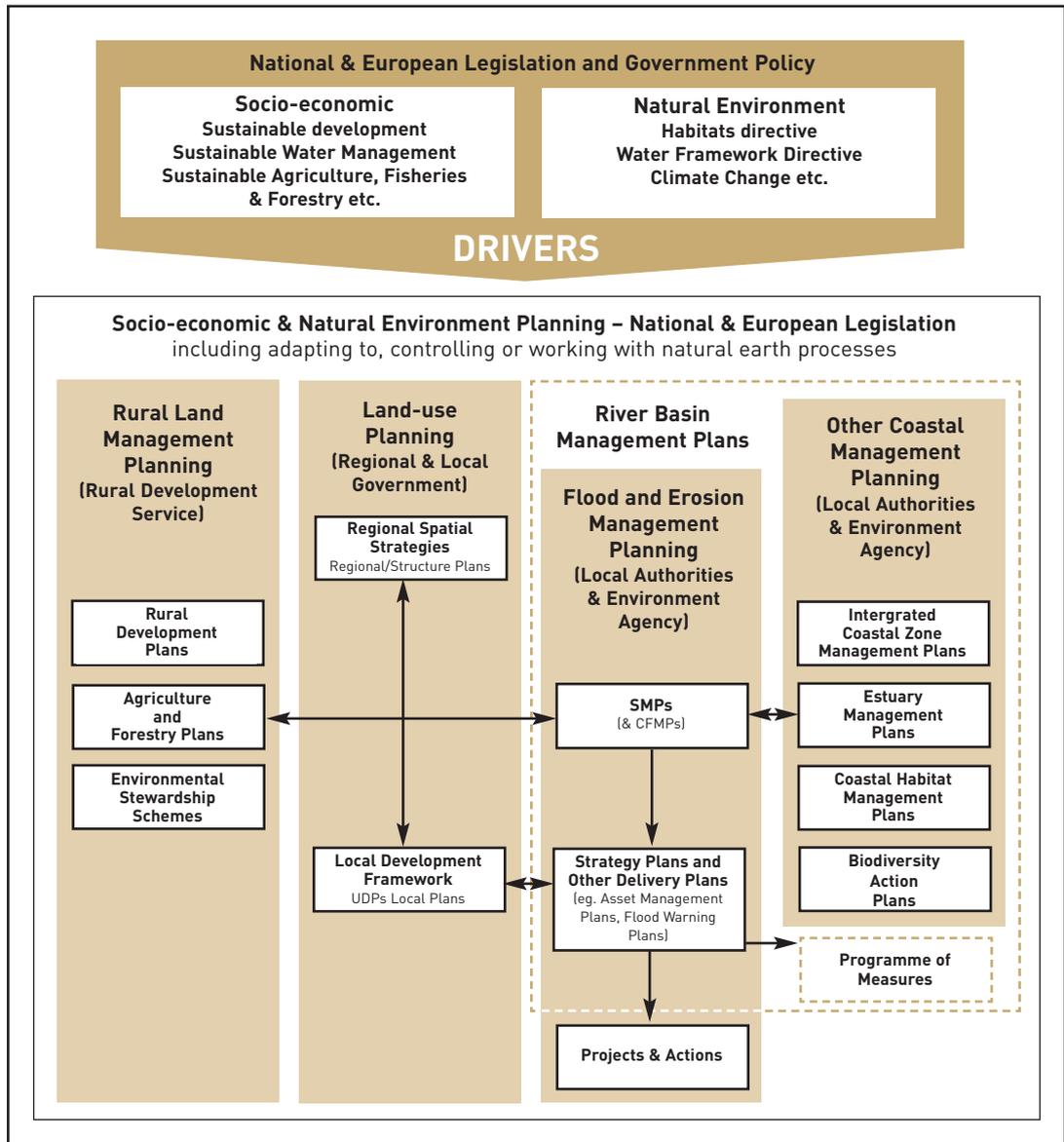


Table 2: how SMPs fit in with other plans

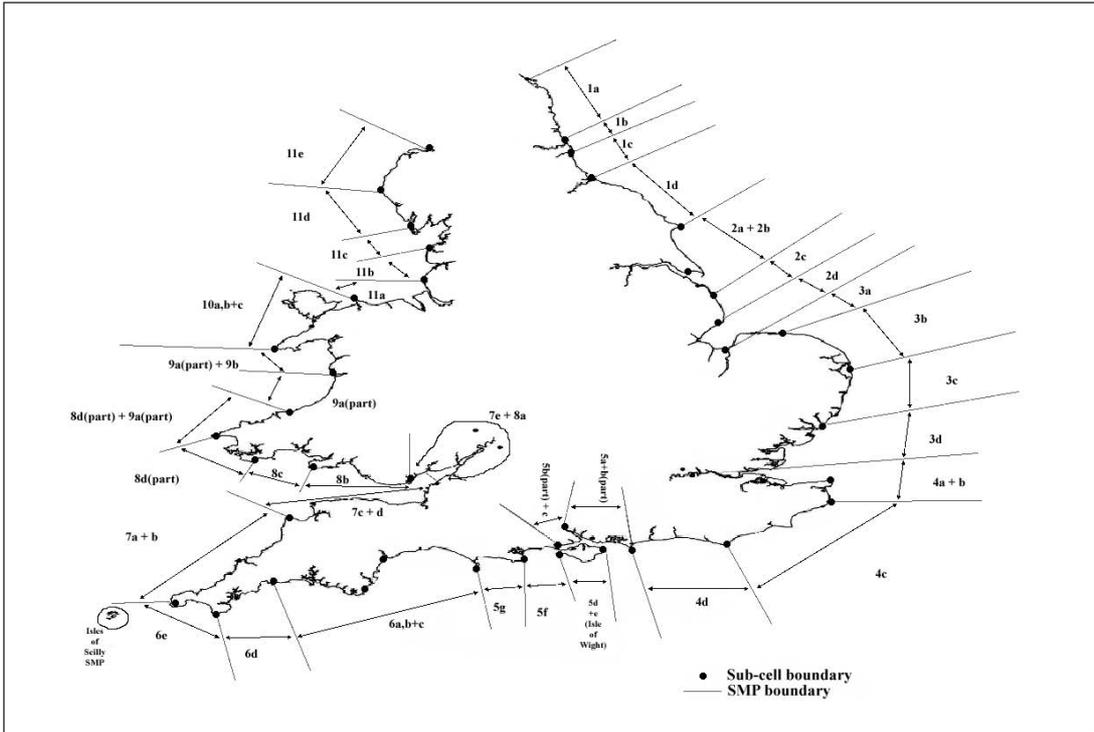
Lessons Learnt from Pilot SMP2s

As part of the development process for these plans it was decided to test the revised guidance on three pilot areas so that lessons could be learnt and incorporated into the final guidance to be issued for other Coastal Groups to follow when developing SMPs.

The key issues that these pilots raised were:

- Stakeholder Involvement
- Planning
- Politics
- Policy Issues

These issues will be dealt with in turn.



Plan 1: showing the process boundaries that the first generation of SMPs followed.

Stakeholder Engagement

The key aspect being tested in the pilots was the use of different approaches to engaging stakeholders. Possible stages of involvement:

- Issue definition
- Data collection
- Issue review
- Objective setting
- Policy scenario definition
- Policy appraisal outputs
- Preferred policy decision
- Draft SMP consultation
- Final SMP agreement
- Dissemination

Whilst there was found to be strong similarities in practice between the different methods, it also highlighted the need to and difficulty of communicating key issues to stakeholders.

'What if we continue with current practices?'

- Hard defences become headlands
- Loss of beaches
- Increased flooding levels and frequency
- Increased erosion
- Need for much more substantial and expensive defences... economic?

**The coast will change...
...our management will have to change**

Importance of Stakeholder Involvement

- Comprehensive information collection and issues identification
- Greater confidence in results
- Education of stakeholders
- Understanding of recommended solutions
- Avoidance of conflicts
- Elected Members involvement
- Avoid consultation fatigue/confusion

Planning Issues

The following issues were identified:

- Spatial planning is critical to the success of SMPs
- Visionary, Wide-ranging, Participative, Integrating, Responsive, Deliverable
- Current lack of use by planners
- Changes to planning process need to be considered:
- Regionally driven (Regional Spatial Strategy)
- RSS feeds into Local Development Frameworks
- Ensuring planning take-up
- How best achieved?

The importance of planning is also identified in the Foresight Future Flooding Report and the DEFRA Policy Development.

(www.foresight.gov.uk/Previous_Projects/Flood_and_Coastal_Defence/index.html)

(www.defra.gov.uk/)

Politics

Where there are no difficult decisions to be taken, then neither the policy or political issues tend to be a problem; where there is the possibility of loss of property through either flooding or the loss of land to erosion, the situation becomes more emotive. For this reason it is important that politicians are involved early so that they have a clear understanding of the evidence and the issues that need to be considered.

- 100 year plan to be adopted by operating authorities
- Sustainable policies (long-term) incompatible with political aspirations
- Elected Member 'ownership' required
- Early Elected Member involvement necessary

Policy issues

- An expectation that defence is a human right
- Housing blight, Human Rights
- 'What about compensation?'
- People issues versus nature issues

Benefits of the new approach

- Clear and consistent representation of future flood and erosion risks
- Recognition of need to change approaches due to climate change impacts
- Involvement/buy-in of Stakeholders
- Positive Plan for defined objectives
- Non-technical plan for a wide audience

SMPs are Planning Documents ...

- Issues don't relate to engineering – that is just one tool that we can use to manage risk
- Climate change means that future risk management can't rely on engineering
- Policy changes have current and future spatial planning implications
- Delivery of sustainable coastal management is reliant upon spatial planning

Monitoring on the Sefton Coast

Alan Williams
Managing Director, Coastal Engineering UK Ltd

Overview of Sefton shoreline

The Sefton shoreline comprises the open coast between the mouths of the River Mersey and the River Ribble (Figure 1).

The shoreline is soft in nature, which up until the 19th century was essentially a sand dune belt across almost all the frontage. Significant sections of dunes still remain but elsewhere the frontage has been hardened by development and intervention by man.

At the southern end the shoreline is dominated by the walls associated with the dock development at Liverpool. Between Seaforth and Blundellsands the shoreline has been hardened by man's intervention over the last 50 or so years.

Up until the 1930's the River Alt, which discharges onto the foreshore at Hightown, used to meander across this frontage causing erosion of the dunes and the loss of some residential properties.

From Blundellsands to the River Alt discharge the shoreline has largely been artificially protected by a revetment of tipped rubble, although at the northern end natural dune frontages re-establish themselves.

The present course of the River Alt runs south hugging the coast for some 2.5 km before it runs out to sea, alongside a training wall originally constructed in the 1930s, which was constructed to prevent the erosion further to the south.

Sand dunes dominate the coastal strip from Hightown to Southport. They form the most extensive dune system in the northwest of England. The dunes most seaward extent occurs at Formby Point just to the north of the River Alt discharge.

The shoreline here is approximately in the same position it was in the middle of the 19th century. Up to 1900 the shoreline was accreting rapidly and at its maximum extent was 300 to 500 metres further to seaward than at present. During the 20th century the shoreline eroded with material from the erosion being transported longshore to the north and south.

Consequently the flanks of the point are presently accreting. To the north the coast is unprotected as far as the southern outskirts of Southport. The inter-tidal zone across this section is characterised by a series of longshore peaks and valleys known as 'ridges and runnels'.

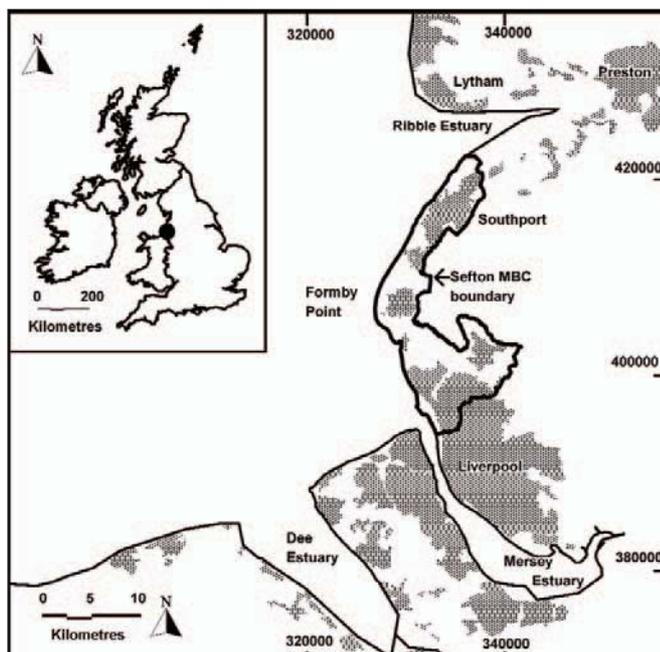


Figure 1



Figure 2: An aerial photograph of the whole of the Sefton shoreline

Across the Southport frontage the shoreline has been artificially hardened from the mid 19th century, with the present shoreline arrangements only fixed at the end of the 20th century. On the north side of the discharge of the River Crossens, an earth embankment now provides protection to high-grade agricultural land.

The Ribble Estuary and its approaching lengths of shoreline to either side are a natural sediment sink being fed from a number of sources by littoral transport. North of Formby Point material is transported in a northerly direction and as the coastline bends into the estuary the width of intertidal zone widens and forms a feed to the complex system of sand banks in the outer estuary.

There is evidence that material from this northerly drift finds its way across the river channels and forms a further bank system on the north side of the estuary. Material from here is driven either into the estuary or further northwards dependent on the prevailing wind/wave conditions.

As a consequence of this accretion and changes in the estuary over the past two hundred years – river training, dredging, land reclamation etc – shoreline conditions have changed with significant growth in areas of saltmarsh spreading south from with the estuary towards Southport and on the south side of the frontage between Ainsdale and Southport.

Monitoring History

The earliest monitoring carried out of relevance to the Sefton shoreline comprises surveys of the Mersey and Ribble estuaries, primarily for navigation, associated with the ports at Liverpool and Preston.

The earliest monitoring of shoreline features was carried out by the Urban District Councils that were eventually brought together to form Sefton Council as a result of Local Government Re-organisation in 1974.

- Foreshore profiles have been monitored between Ainsdale and Southport since 1914
- Foreshore profiles have been monitored from Crosby to Hightown from early 1950s
- Formby U.D.C. and Southport C.B.C. jointly monitored the progress of coastal movements around Formby Point on an annual basis from early 1950s and introduced marker posts to measure dune recession between Ainsdale and Birkdale

Between 1979 and 1982 Sefton Council staff, in collaboration with Liverpool University, produced the 'Sefton Coast Data Base', which collated all the existing research, literature, plans and records relevant to the coastal hydrodynamics of the Sefton area and presented the information in a readily accessible form. (www.sefton.gov.uk/page&4730)

The database deals with general environmental factors and the two major river estuaries that form the boundaries of the Sefton Coast and provides an area-by-area description of information relevant to specific sections of the shoreline. The database is currently in the process of being digitised and updated.

Following the Towyn disaster in February 1990, when coastal defences were breached on the North Wales Coast causing extensive flooding of the low lying hinterland and damages in excess of £50 million, there has been greater emphasis on collaboration with the formation of coastal groups and a more integrated approach to monitoring being developed.

During the 1990s Sefton Council developed a more strategic local monitoring regime that comprised:

- Extension of foreshore profile coverage to include topographic surveys
- Hydrographic Profile extensions
- Sediment sampling collection and analysis
- Regular aerial photography – macro scale changes, habitat extent

Current Monitoring Regime

Following production of the first round of Shoreline Management Plans at the end of the 1990s, a more integrated approach to monitoring has developed amongst the Operating Authorities responsible for shoreline monitoring in the north west of England. (www.sefton.gov.uk/page&4602)

From 2003 to 2005 a Strategic Regional monitoring programme for the whole of the coastline between Conwy in North Wales and the Solway Firth was developed.

The principal objectives of the Cell 11 Regional Monitoring Strategy (CERMS) were:

- To move forward recommendations in the first round of SMP's
- To better informed decision making by Coastal Managers
- To improve the value of data already collected
- To provide a risk assessment based approach to monitoring
- To provide a mix of Local and Strategic arrangements
- To provide a mechanism for cell wide overview / management
- To provide Local and Cell Wide Analysis and Reporting

For the Sefton Coast, CERMS was a further development of the monitoring that had been developed during the 1990's, comprising:

- Coastal Defence Asset Inspections (www.sefton.gov.uk/page&4726)
- Foreshore Surveys – Beach, Saltmarsh
- Sediment Sampling and Analysis
- Hydrographic Profile Extensions
- Obtain Local Forcing data – Wind, Waves, Tides
- Production of Annual Reports (www.sefton.gov.uk/page&4876)

In addition, strategic elements will provide additional data and analysis by way of a Airborne Remote Sensing Data (Aerial Photographs, satellite imagery, CASI); Strategic forcing information (waves and water levels); and Cell wide overview and report.

How Data is Being Used

The monitoring being carried out by Sefton is used as follows:

- To inform Coastal Defence Management & Maintenance by provision of regular repeatable inspections of assets
- To examine foreshore change – changes in the location of the dune/beach interface (see figure 3); beach volume and profile analysis (figure 4); changes in the extent of saltmarsh (figure 5);
- Production of time series databases relating to process forcing – waves from offshore buoys, tide levels and definition of extreme water levels from tide gauges. Identification of year on year change and reconciliation with wave and shoreline response data to identify events that have caused coastal change
- Production of annual monitoring reports

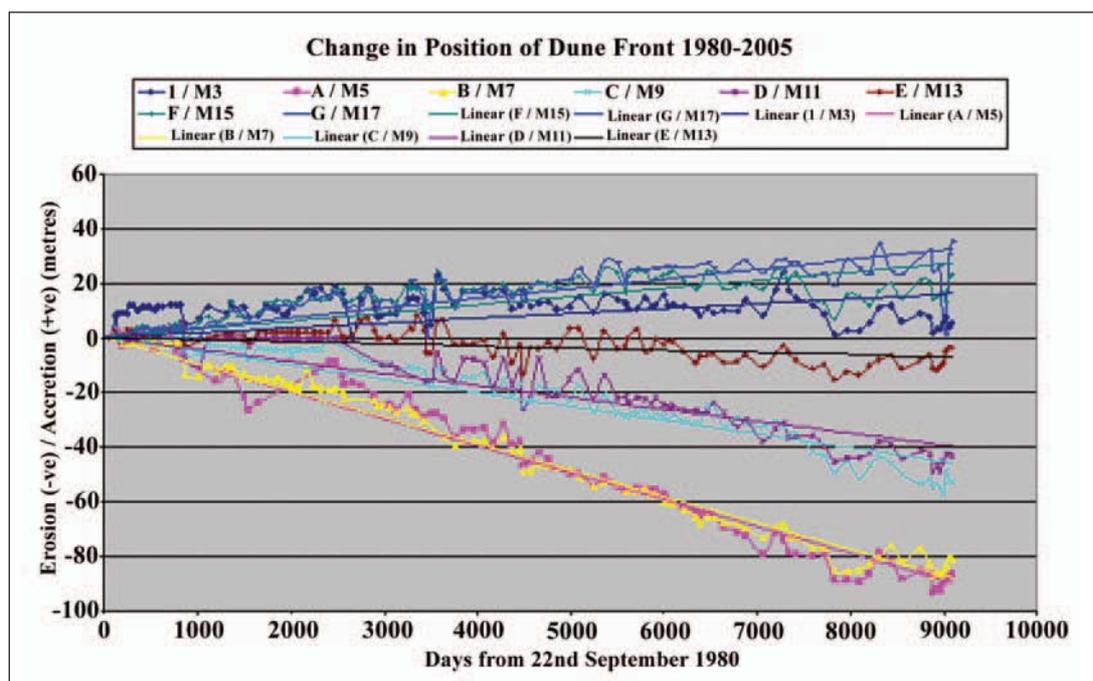


Figure 3: Monitoring Data showing change in location of dune toe across Formby Point

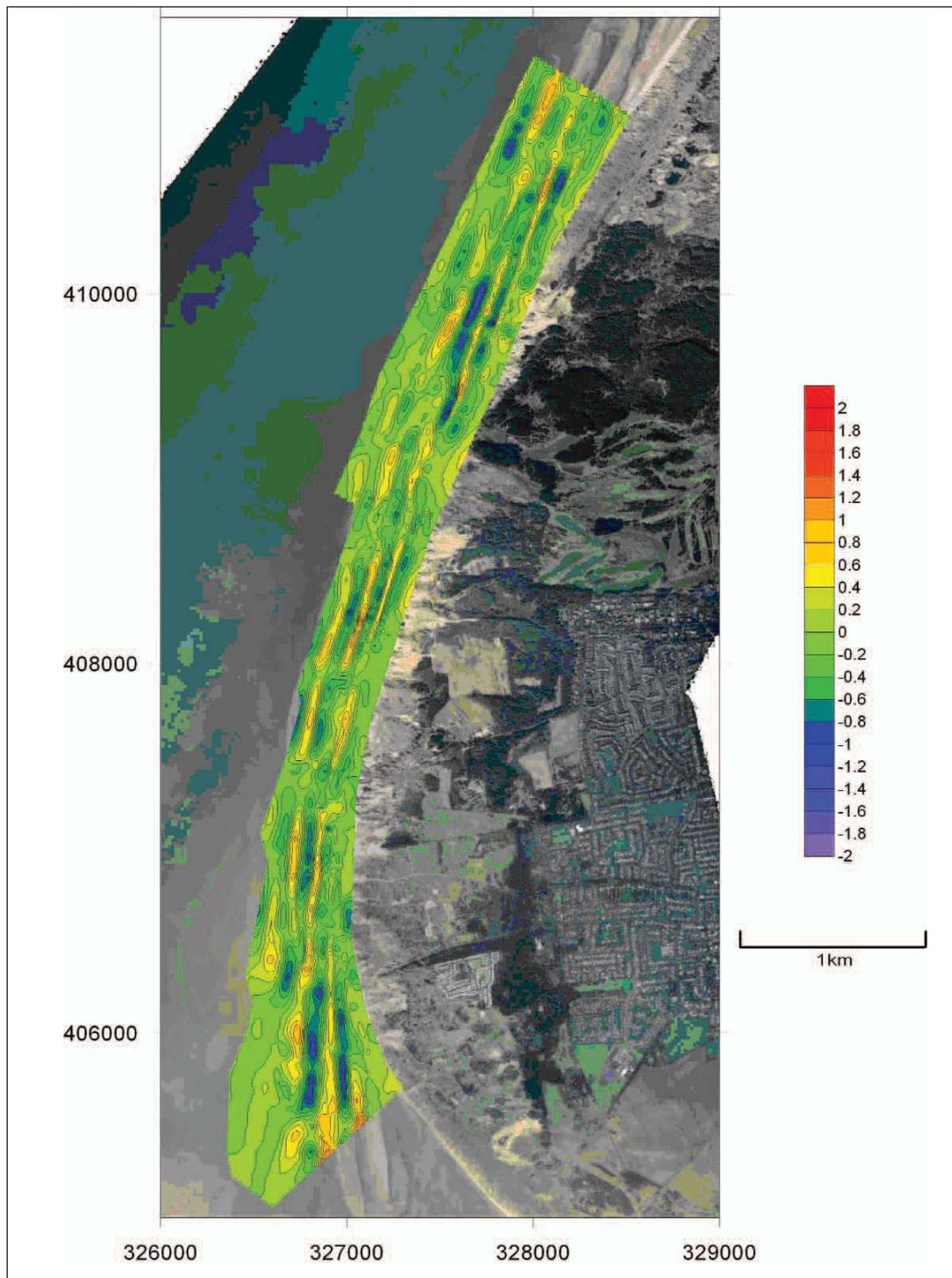


Figure 4: Change in beach elevation across Formby Point. Strips of blue and yellow indicate changes in positions of ridges and runnels

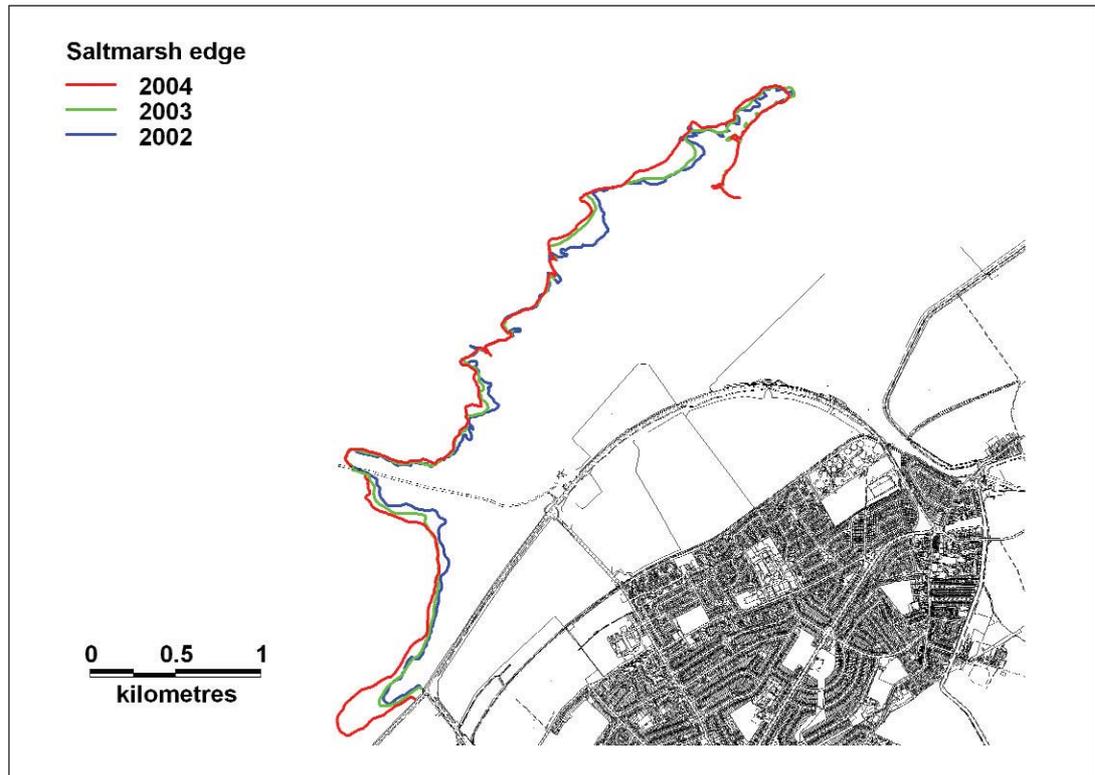


Figure 5: Change in saltmarsh extent north of Southport

What is it Informing?

The data collected and analysed is providing information for:

- Coastal Defence Management and Maintenance - prioritising maintenance works, identifying change in risk to specific assets
- Shoreline Management Plan Process - the first SMP Review is due to start in 2007/8
- Risk Evaluation and Management - improving understanding and evaluation of risks; CERMS is a risk based strategy
- DEFRA High Level Targets for Flood and Coastal Defence - Central Government responsibilities for operating authorities (www.defra.gov.uk)
- Improving the understanding of process behaviour and changes to natural defence forms and habitats

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Real-time Data Collection and Analysis: The Liverpool Bay Coastal Observatory

Phil Knight
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Coastal ocean observing systems are now technically feasible, although no single organisation in Europe has sufficient capability to design or support such a system, to address all marine issues.

The Proudman Oceanographic Laboratory (POL) is, however, uniquely placed in the UK to act as a focus for developing a pre-operational coastal zone observing and monitoring system, through its measurement and modelling capabilities, and existing interactions with key agencies. This represents a major UK innovation in the approach to testing process understanding in shelf seas.

The Coastal Observatory's objectives are to understand how coastal seas respond to natural forcing and to the consequences of human impact, and to demonstrate the value of an integrated approach to marine environmental management.

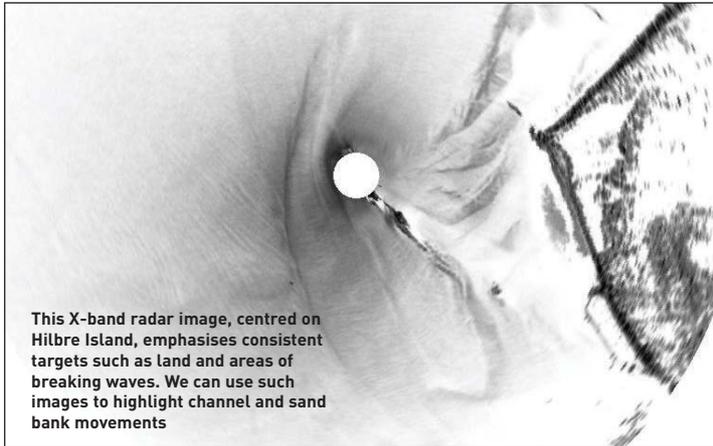
It will achieve this through effective continuous measurement and modelling. Measurements will be used for testing hydrodynamic and ecological models to improve their predictive capability, particularly for events such as storms, floods and plankton blooms. This will also improve the management of the seas and coasts.

Necessary inputs for the pre-operational coastal ocean modelling system will be secured through collaborations with the UK Met Office (operational weather predictions and ocean/shelf circulation models), the Environment Agency (routine monitoring of river discharges, nutrients and contaminants) and Natural Environment Research Council facilities (operational production of regional remote sensing data).

Regulatory bodies such as the Centre for Environment Fisheries and Aquatic Sciences and the Environment Agency are partners in the project, having deliberately aligned their own measurement programmes with the Coastal Observatory.



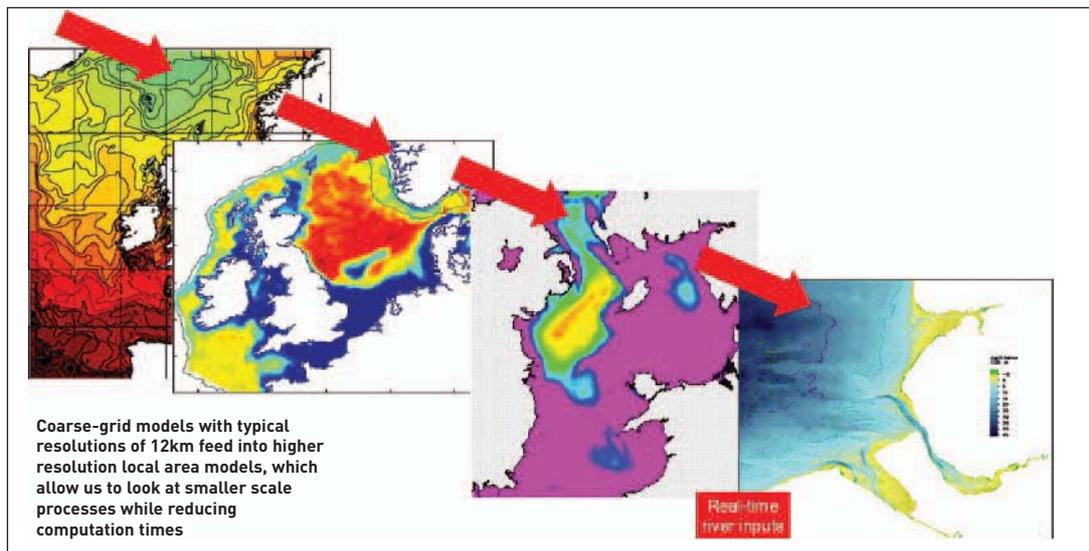
CEFAS Smartbuoy being deployed in Liverpool Bay from the RV Prince Madog



Measurements

The following measurements are taken within Liverpool Bay and the Irish Sea:

- The main mooring site near to the Mersey Bar light vessel (installed in August 2002), records current profiles, sea-bed and near-surface temperature and salinity. A second site (installed in April 2005) near the North Hoyle wind farm also includes turbidity and chlorophyll. Data are presently stored and retrieved during maintenance cruises. Development of underwater acoustic data transmission is in progress, so that the sub-surface measurements can be sent in real-time.
- A CEFAS SmartBuoy, installed in November 2002, records sea surface properties including salinity, temperature, turbidity, nutrients and chlorophyll. It transmits data in real-time. (www.cefasdirect.co.uk/monitoring)
- A WaveNet directional wavebuoy, installed in November 2002, sends spectral wave components in real time (www.cefas.co.uk/wavenet)
- Moorings are serviced approximately every six weeks (four weeks in summer, to reduce biofouling of sensors) on the RV Prince Madog. CTD and nutrient surveys of Liverpool Bay are carried out during each cruise.
- Liverpool Viking sails between Liverpool and Belfast/Dublin, one of nine routes under study in a European Union research project (www.gkss.de/euprojekte/PSP5/Ferrybox.html). It has instruments to measure and record near-surface temperature, salinity, turbidity and chlorophyll. We will soon add a nutrient analyser
- The relevant Irish Sea tide gauges in the UK Tide Gauge Network form part of the Observatory, sending data in real-time data.
- A weather station on Hilbre Island provides real-time information (atmospheric pressure, wind speed and direction, cloud cover, rainfall). There is also a web camera



- NERC's Remote Sensing Data Acquisition Service produces weekly composite satellite images of infra-red (sea surface temperature) and visible (for surface chlorophyll and suspended sediment) radiation
- River flow data collected by the Environment Agency, are sent to us daily. The data are input into our hydrodynamic forecast models to improve predictions in near-shore areas
- Recently, the Observatory has added two different radars: HF radar (12 MHz) with 80 km range records surface currents in 2x2 km bins in 20-minute intervals and surface waves in 5x5 km bins every hour; X-band radar (9 GHz) with a 2 km range records surface waves at 84-second intervals

Modelling

The Coastal Observatory will use POLCOMS (**Proudman Oceanographic Laboratory Coastal Ocean Modelling System**, www.pol.ac.uk/home/research/polcoms), a 3-D modelling system. Its main elements are: a 3-D baroclinic hydrodynamic model linked to a surface wave model (WAM); a sediment resuspension and transport model; an ecosystem model (European Regional Seas Ecosystem Model). In collaboration with the UK Met Office, nested 3-D models covering the ocean/shelf of northwest Europe (12-km resolution), Irish Sea (1.8 km) will focus on Liverpool Bay (100–300 m).

POLCOMS on the ocean/shelf (20°W–15°E, 40–65°N) runs at the Met Office, forced by: the Numerical Weather Prediction model, mesoscale (12 km) meteorology and ocean forcing from the North Atlantic $1/3^\circ$ Forecast Ocean Assimilation Model, operational since December 2002, provides the boundary conditions for the Irish Sea model (which in turn provides boundary conditions for the Liverpool Bay model). Local river discharges will be included in real-time through a link-up to the Environment Agency river-flow network.

The 3-D baroclinic models for the Irish Sea and Liverpool Bay include wave-current interaction, and performance is checked against in situ measurements of temperature, salinity, current and waves and coastal sea-level. Data assimilation techniques enhance the value of the data and improve the accuracy of the model forecasts.

Recently, nutrients and plankton dynamics have been simulated by a coupled ecosystem model and sediment transport module.

These show that suspended sediments are important for controlling biological processes in the shallow eastern Irish Sea, for example, by affecting available light levels. The results have been validated against data from the SmartBuoy, the instrumented ferry and ocean colour information from satellites.

Information Available Online

Collected data and especially real-time data are available, both numerically and in the form of graphics, via a dedicated website (coastobs.pol.ac.uk/). Forecasts (up to 48 hours ahead for most variables) are displayed and compared with measurements where possible (e.g. daily mean sea surface and sea bed temperatures, currents, waves and sea surface heights).

The website is tailored for scientists, coastal zone managers and the general public. Data are freely available after registration, although most graphical information can be viewed without registering.

Researchers and other interested groups are welcome to join the Coastal Observatory, to take advantage of the existing monitoring programme, and to do their own process studies. For more information visit the website or contact Phil Knight (Email: pjk@pol.ac.uk).

Principles for Managing Information: Collaborative Efforts by Local and Regional Initiatives

Dr Tim Stojanovic
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Human Aspects to Managing Information

This paper seeks to address some of 'informational' challenges facing all those who are trying to carry out statutory responsibilities for managing the coast.

The paper starts by reviewing the experience of professionals working with data and information in the coastal zone and continues by describing some of the techniques that have been developed (often in other fields) which support a more systematic and user-friendly approach to managing information. The aim is to identify the priority issues and to assist coastal practitioners in producing good, applied Information Technology.

Whilst the technical possibilities are seemingly limitless, when it comes to setting up an information system for the coast, it is often the human, organisational, or personal obstacles that prove the most intransigent.

The present approach to collecting and managing data at the coast generally focuses on data for a particular project or stage within a process, rather than taking a long-term, systematic approach to data collection and management (Lumb et al. 2004).

Current Approaches to Information Management

Informational Overload

The situation facing coastal managers is one of information overload, with a glut of articles, statistics, surveys and research projects, reports, academic studies, telephone calls and satellite images. Ten terra bytes of relevant Environmental Data are said to be collected each day (Gunter, 1998) and the complex functions between land and sea give rise to over 260 formats of Earth Observation data alone relevant to the coast (Harris, 1999).

To give one example of a representative coastal practitioner, a Sea Fisheries Officer: 40 years ago they would have most likely gone down to the beach armed with a shotgun to scare the birds from the oysterbeds.

Nowadays, their work is filled with surveying the seabed and calculating the biomass of stocks, analysing reports of the impacts of activities on species, collecting more sophisticated surveillance data and much more: basically, dealing with lots of data and information.

To complicate matters even more, there are a variety of commercial, political or environmental sensitivity blocks to the exchange of information, which produce problems such as prohibitive costs for re-using data (Millard and Sayers, 2000).

Coastal Defence, Planning Implementation and Monitoring

Regional Coastal Defence Groups have undoubtedly helped in providing better co-ordination of data and linking national policies on flood protection and coastal erosion with regional datasets, and harmonising the approach to data collection for the production of Shoreline Management Plans.

This kind of regional co-ordination is not yet very common with other coastal functions. (Potts, 1999; Potts et al., 2005). There are still limitations to be overcome, with volumes of information from SMP1 ending up gathering dust in consultancy, authority or agency shelves, but coastal engineers are experiencing the benefits of integrating information through internet enabled GIS, such as that developed Channel Coast Observatory (See Paper by Travis in this collection).

Information Policies

One of the general management tasks that Coastal Partnerships and Initiatives can undertake is to begin to develop information policies in order to overcome some of the blocks to the exchange of information (Severn Estuary Partnership, 2001). The following policy areas can provide opportunities for galvanising action:

- Memoranda of Understanding between Partners to allow information transfer
- Adopting Metadata standards and protocols
- Identifying practicable opportunities to share the cost between agencies of data collection/monitoring
- Integrated/regional approach to GIS/IT development
- Creating Fora/Working Groups/Information Networks to stimulate real collaborative approach to using data
- Identifying gaps for information and needs for research
- Making information available to the public through websites or repositories

Sectoral Harmonisation

There has been some progress in harmonisation on a sectoral basis, with the establishment of gateways to datasets, and online analytical tools. Examples relevant to UK coastal management include:

- Marine Habitats
Website/Tool: MESH
www.searchMESH.net
- Marine Energy & Minerals
Website/Tool: UKDEAL
www.ukdeal.co.uk
- Marine Nature Conservation
Website/Tool: MARLIN
www.marlin.ac.uk
- Oceanographic
Website/Tool: OCEANNET
www.oceannet.org
- Offshore Aggregates: Sand and Gravel
Website/Tool: MAGIS
www.sandandgravel.com

Regional Collaboration

Basic cadastral, topographic, hydrographic and cartographic data are needed as a background against which to display sectoral information. This has only recently begun to be co-ordinated across the land-sea divide through projects such as SeaZone and the ICZMap (Harrison, 2003).

The regional scale is where national policies must be translated into action for a defined section of the coast, so it makes sense to build collaborative efforts at this level. It is impossible to develop a comprehensive system all in one go. Yet without the co-ordination of baseline information, the different agencies will be unable to make sustainable decisions based on incompatible or unconnected datasets.

The solutions lie in developing a shared approach to avoid the duplication of data. A recent edition of Coastnet Bulletin (**www.coastnet.org.uk**) describes a variety of efforts that are being undertaken at the local/regional level in the UK (Stojanovic, 2005a). Experiences in Integrated Coastal Management from around the world provide a number of lessons about what makes for an effective approach.

Sample of Worldwide Tools:

- Great Lakes Information Network (GLIN)
www.great-lakes.net
- Atlantic Coastal Zone Information Steering Committee(ACZISC)
aczisc.dal.ca
- Marine Irish Digital Atlas (MIDA)
mida.ucc.ie/pages/atlas/atlas.php
- Wadden Sea Information System (WADSIS)
www.waddenseamaps.net
- Baltic Sea Online Environmental Information Resource for Internet Access (BALLERINA)
www.baltic-region.net
- Chesapeake Bay Information Management System (CHIMS)
www.chesapeakebay.net

Even where technical solutions are proposed, there is no guarantee that they will succeed in terms of being populated by good quality data or being used on a regular basis by statutory authorities or coastal stakeholders.

Techniques from Other Fields that could be Applied at the Coast

Information Systems at the Coast

The shock message is that information systems for the coast can and do fail. By failure we mean systems that do not get adopted by users, have to be completely abandoned, or which are unable to answer the questions which they are designed to consider.

The main reasons for the failure of these systems has been assessed as the lack of application of a structured and systematic approach to IT development and the failure to involve end users in the design process (Stojanovic, 2005b).

Information Systems Modelling and Mapping

Fortunately, other fields of research such as Healthcare Information Systems, Biodiversity Information Systems and Business Information systems have had to deal with similar issues of integration between different organisations, functions and locations, and there is plenty of good practice to drawn on (e.g. World Conservation Monitoring Centre, 1999).

One approach is to carefully map out the existing information resource. It is important that users are able to build a conceptual sense of who owns what datasets and what use can be made of them (Eurosion, 2004).

This assists in the re-use of data rather than duplicating existing efforts. A second common approach is the application of Soft Systems Methodology to involve the end-users closely in the design of IT (Checkland and Holwell, 1998). An appreciation of these (and other) methodologies can lead to:

- Building a real network before building the virtual network
- Collaboration between key organisations, to develop a pragmatic, incremental approach for constructing an information system – starting with key functions and priority datasets
- Accounting for the informal information flows and carefully understanding the ways that decision-makers use and present information
- Closely basing the system design on working practices and interactions of science and decision-makers, so that the final version is user friendly

Technical Issues

Although this paper has focused on the human issues in developing information systems for the coast, there remain a number of technical challenges to be overcome. Issues such as interoperability, standards, harmonisation and data infrastructure are being addressed through a variety of national and international programmes and there is good coverage of recent initiatives in the online magazine CoastMap News.

(www.cefas.co.uk/coastmap/default.htm) (Harries, 2005)

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COBRA (Coastal Behaviour and Rates of Activity) on the North Yorkshire Coast

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Background

The COBRA project is a four year collaborative research project undertaken between the Geography Department, Durham University and Cleveland Potash Limited. Cleveland Potash operates the Boulby Mine in North Yorkshire, the deepest mine in Northwest Europe.

The mine began production in 1972 and extracts three million tonnes of rock per annum. The main product is potash (potassium chloride or sylvinit) which is used mainly in fertilisers, in addition to one third of the county's road salt or halite. Over 900 km of mine tunnels reach up to seven km out to sea at depths of up to 1,500 metres below sea level.

The Geography Department at Durham University and Cleveland Potash Limited initiated the COBRA project to further understand the behaviour of the coast of North Yorkshire and in particular to understand the role of human intervention upon natural coastal processes. The design of the project focused around three key elements:

- The understanding of the present rates, mechanisms and patterns of coastal cliff change
- The assessment and monitoring of the level of ground deformations currently and historically experienced along this coastline
- The level of historic human modification to the coastline via surface and subsurface mineral extraction operations

The project is overseen by five academic staff and two PhD students. The PhDs focus specifically on firstly coastal cliff processes and secondly satellite remote sensing techniques for detecting and monitoring small scale ground deformations.

The work is undertaken closely with the staff of Cleveland Potash Limited, who have significant knowledge and expertise in both local geology and history. To date the project has generated significant interest both in the UK and abroad.

Further supplementary funding has been received from the European Space Agency to support the satellite remote sensing, to the sum of £250,000. To date, the work undertaken has been published in international standard academic journals in addition to many conferences in the US, Europe and Asia.

Coastal Processes

Conventional methods of assessing coastal erosion involve repeat aerial photographic surveys, walk-over surveys or at best single point stake transects. Steep vertical cliffs are commonly not well represented in this type of assessment, commonly only depicted by a very small aerial footprint.

Cliff top retreat is the resultant effect of an iterative process of material loss from the cliff face and cliff erosion is commonly deemed to be episodic. Conventionally a balance between the speed of survey and the required precision has been sought, with aerial sensors preferred due to the rapid data collection over a long coastline in a single survey.

Ground based techniques such as photogrammetry have conventionally been cumbersome, required extensive processing and are hence costly; there is a dearth of high-resolution, long-term monitoring of coastal cliff processes both in the UK and beyond.

This project aimed to address the lack of direct monitoring data by exploiting new advances in terrestrial laser technology and a rapid survey technique that allows wide areas to be surveyed at high spatial and temporal resolution.

Combined with 3-D topographic modelling and analysis this approach allows individual rockfall to be detected and measured precisely in three dimensions. Rather than relying on an assessment of rockfall debris, this approach measures the scar surface areas and volumes. The laser scanner collects a 'point-cloud' of 3-D data points at rates of up to 250 points per second to an accuracy of 1 in 7,000. The point cloud is then modelled in 3-D and photographs can be draped across the surface.

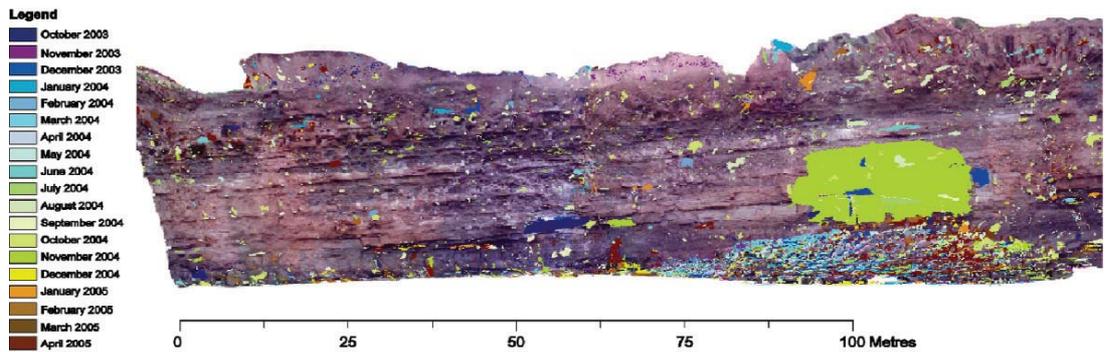


Figure 1. Diagram illustrating the change monitored at a 150 metre cliff section (Cowbar Nab, Staithe), from October 2003 to April 2005. Note the apparently random distribution of rockfall, with no clear preference for wave cut notch development.

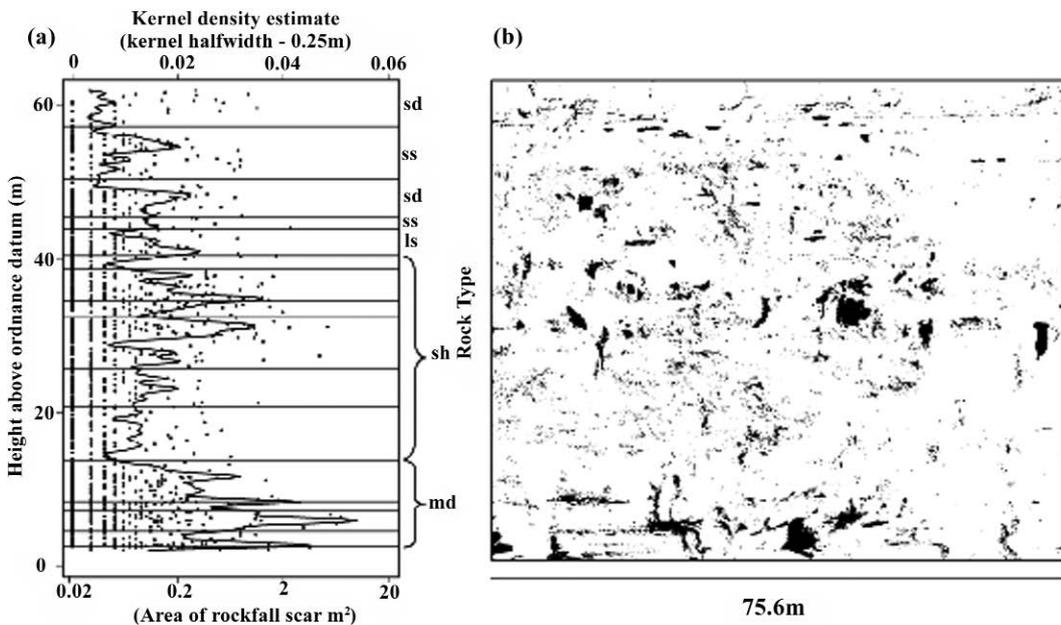


Figure 2. Right: A diagram showing two years of monitoring data for a 75 metre by 75 metre section of cliff face. Left: Shows the same data as a density estimate up the cliff face, indicating the zones of most intense erosion experienced during this period. In addition to erosion at the toe, the interface between rock bands appear particularly susceptible to material loss.

Successive surveys are then overlain and a difference detection undertaken. Objects or individual rockfall can be extracted and measured automatically. Over time a picture of the spatial and temporal pattern of rockfall activity is built up. Relationships between geology, weather and waves can be built up to understand cliff erosion. The data are also used as the input for probabilistic models of cliff development and coastline change.

The results generated from this approach raise several interesting questions. Firstly, the commonly held view that the mechanisms of cliff retreat are dominated by the development of a toe cut notch is questioned.

This monitoring data suggests that the aerial loss of material apparently at random across the cliff face is equally as important. Secondly, the perception that the nature of cliff erosion is episodic appears to be questionable; the results appear to suggest that a steady and iterative nature of retreat is more dominant across the face of the cliff. Third, the rates of iterative cliff change established from this direct monitoring are an order of magnitude less than the rates of cliff retreat established from aerial surveys.

This approach has subsequently been applied to quantitative rockfall simulations in Gibraltar, landslide hazard mapping in the Bhutanese Himalaya, and highway collapse in Japan. The technique has wide applications in the coastal zone, and is particularly suited to undertaking rapid long-range surveys in hazardous areas. Ongoing work is being undertaken into mounting the scanning system on a dynamic (moving) platform to increase the speed and coverage of the surveys.

Deformation Monitoring

Traditionally mining subsidence is assessed using repeat transect surveys across the undermined area. This method produces good and repeatable results, but it relies heavily upon statistical interpretation of the data and is strongly influenced by survey error. Survey points are also confined to lines, commonly dictated by ease of access.

Points also remain difficult to locate and maintain. In addition to contemporary mining subsidence, considerable evidence across the study of ground deformation from both historic causes and natural surface changes. The problem in addressing these using a surface based transect survey is that anomalies in the data are commonly assumed to be erroneous points and the areas beyond those directly covered by the survey cannot be adequately assessed.

The COBRA project addressed this by adopting and developing a satellite based radar interferometry technique, capable of detecting ground deformations of the order of 2.8 mm every 35 days. The approach has been widely applied in urban and arid environments where the character of the ground surface remains consistent throughout the year.

As such the technique is strongly influenced by farming practises, vegetation changes and atmospheric conditions in temperate environments. The COBRA team, working with the Technical University of Delft, Netherlands, have developed a new second generation InSAR technique, which employs persistent scattering ground control points.

These are features within the radar scene that remain constant through the year, such as buildings, walls, rocks and other solid structures. The persistent scatterers are used to calibrate the radar image and can result in a vertical height precision of 2.8 mm, which is equivalent to the radar wavelength. The satellite passes over the study area every 35 days and has done so since 1992, resulting in a large archive of imagery.

The results of the ground deformation mapping using the radar interferometry are surprising. In addition to the predicted ground deformation from contemporary mining, there are significant areas of vertical displacement across the study area. Analysis and field verification of these areas reveals a range of causative factors, including:

- Significant ground deformation around old (abandoned circa 100 years ago) ironstone mine shafts
- Vertical displacement on coastal slope and cliffs
- Subsidence bowls above extensive old ironstone mine workings
- Surface displacement of rotational sliding in till cliffs

It is clear that the technique has the potential to detect small scale surface displacements over wide areas, such as coastlines, at high resolution. The technique therefore can be used for the detection of pre-failure deformations in collapsing rockslopes, which, combined with appropriate temporal modelling, could be used to predict slope failure type and time and hence act as a warning system.

Historic Mining Activity

There is considerable field and documentary evidence of a significant level of modification of this coastline, despite its acclaimed 'natural' beauty. Mining of several minerals has been documented back to as early as 1465. Perhaps the most well known are the ironstone drift mines that sustained the local economy from the 1850s to the early 1950s.

Extraction from these mines is in places up to 70 percent of the seam in plan view at a relatively shallow depth of 100 metres. Less well known is the quarrying of ironstone from the foreshore. Significant exposures of ironstone nodules were quarried from Staithes, Boulby, Kettlewell and Scarborough, removing in places up to four metres of the foreshore platform.

A further significant influence on the cliff-scape is the relatively well documented Alum mining, which involved the construction of harbours cut into the foreshore, Alum houses and steeping pits high on the cliff line in the Jurassic shales.

Despite a general understanding of the occurrence of mining, there is a relatively poor understanding of the impact of these activities upon today's coastline. Significant evidence is available of foreshore quarrying for jet. Extraction over large areas, in places in excess of several ha, has been undertaken, removing depths of up to seven metres of rock.

In the context of coastal processes a loss of seven metres of foreshore material can be considered equivalent to an effective local sea level rise of seven metres. To what extent is today's coast responding to this influence?



Figure 3. Example of foreshore mining – here jet mines have been cut high into the face of the cliff, with unknown influence on the rates of erosion.

The COBRA project has aimed to address this by undertaking an extensive study of historic documents and records in order to establish the volumes, locations and timings of extraction or minerals, including ironstone, jet, alum and cement stone. By assessing the potential volumes of extraction, an estimate of the loss of foreshore depth can be made, when combined with detailed mapping of the foreshore morphometry.

This is also compared with the historic records of cliff retreat, established from historic mapping and imagery, to establish quantitatively the impact of mining activity in the area.

Conclusions

The COBRA project, now in its fourth year, has aimed to use innovative and world leading research to address issues of coastal evolution and ground deformation in North Yorkshire. The new approaches have highlighted some of the shortcomings of other widely used approaches and has begun to present a better understanding of hard rock coastal cliff erosion and ground deformations.

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Future Implications of Climate Change on the Sand Dunes of the Sefton Coast and Ribble Estuary

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Recent Geological History and Coastal Evolution

Key to the prediction of the effects of future coastal change on the sand dune systems of the Sefton coast and the Ribble Estuary is an understanding of past changes and their role in shaping the present coastal configuration and character, and of the geological and human constraints on the future response of the coast and estuary to future changes in environmental forcing factors.

Much of the coastal area of north Merseyside and west Lancashire consists of Quaternary drift deposits, which form a mantle of variable thickness (typically up to 20 metres) above a bedrock surface cut into troughs and highs by the action of ice, fluvio-glacial meltwaters and rivers during earlier periods of the Quaternary.

Aside from the incised valley of the Ribble itself, there are three NE-SE trending depressions in the sub-drift surface (Howell, 1973). Bedrock occurs at or near the surface near Ince-Blundell, around Liverpool and in the Ormskirk area. Elsewhere the largely Triassic age sedimentary formations are buried beneath a drift cover composed of glacial till, Shirdley Hill Sand, peat, marine and freshwater alluvium and late Holocene blown sand (Wray & Cope, 1948).

Dunes began to form on the Sefton coast as early as 5000 years ago (Pye & Neal, 1993), forming a low aeolian capping to a barrier system that extended between the southern side of Ribble Estuary and the River Alt, which formerly entered the sea north of its present position. Behind the barrier lay extensive tidal flats and saltmarshes, crossed by well-developed tidal creek networks.

Marine sedimentation in the area began around 9000 years ago, as the rate of post-glacial sea level rise exceeded vertical rise of the land due to isostatic recovery and a marine transgression moved across the eastern Irish Sea. Several minor fluctuations in the relative levels of land and sea are recorded in the sedimentary sequences preserved on Downholland Moss (Tooley, 1978; Huddart, 1992), although in the past 5000 years change has been less than one metre.

Drilling has shown that the back-barrier marsh and tidal flat deposits of Downholland Moss do not extend beneath the main dune belt and late Holocene-age muddy deposits currently seen on the beach at Formby Point probably represent the remains of a smaller barrier-back-barrier system that once existed further to seaward (Pye and Neal, 1993).

Prior to the 17th century, high dunes probably did not exist in the area. During the Little Ice Age (14-17th centuries), active sand sheets extended up to four km inland in the Formby area, driven by strong winds. From the 17th century onwards, major efforts were made to stabilise the sand, including marram planting, levelling and establishment of woodland and forest plantations. Such activities were actively engaged in until the First World War and contributed significantly to coastal progradation around Formby Point during the 19th century.

Map and chart evidence shows that virtually the whole Sefton coast accreted between 1845 and 1900, after which date erosion commenced at Formby Point (Gresswell, 1953; Pye & Smith, 1988; Pye & Neal, 1994). Based on available chart evidence, it appears that the main factor favouring accretion was onshore transport of sand from a wide area of shallow water (Mad Wharf) off Formby Point.

Prior to construction of training walls and a breakdown in the natural pattern of banks and channels in the Mersey and Ribble estuaries, Mad Wharf and adjacent areas were supplied with sand by ebb-tidal flows from both the Mersey and Ribble estuaries (Pye, 1977).

Following training wall construction, the Formby Channel in the Mersey and the South Channel in the Ribble began to fill in, reducing the ebb-tidal supply to the convergence point off Formby Point. With reduced sediment supply, Mad Wharf shrank in size, allowing larger waves to reach the shoreline. Frontal dune erosion gradually spread both north and south from the point as more sand was transport along shore by littoral drift than was brought onshore by constructive wave action.

With minor modification, this pattern has persisted to the present day. As a result of both natural processes and human interventions (including embanking and land reclamation in addition to training wall construction), large amounts of sediment have accumulated in the Ribble Estuary over the past 150 years (Barron 1938; van der Wal et al., 2002).

Marshes and tidal flats continue to accrete in the area, and in recent decades there has been significant expansion of the marshes north of Southport pier and of low dunes / green beaches between Southport and Ainsdale.

Present Coastal Process Regime

The Sefton coast can be considered to be intermediate in terms of energy regime, including relatively open coast conditions at Formby Point and semi-protected estuarine conditions north of Southport and south of the River Alt.

The prevailing winds are from the southwest, but owing to fetch effects the highest energy waves approach the coast from the northwest or westnorthwest. The tidal regime is macrotidal, exceeding eight metres on spring tides.

Consequently tidal currents are strong. Residual current patterns in the area are affected not only by tidal forcing but also by density (salinity) patterns, and are largely responsible for seabed sediment transport in the deeper waters of Liverpool Bay and seawards of the Ribble bar. Further inshore, waves and wave-generated currents assume greater importance.

Sea level records for Liverpool indicate a slight upward trend in mean level since about 1920, with an accompanying slight increase in mean tidal range. However, the total increase in sea level (← 10 cm) is small compared with changes in standing water levels, which can accompany storm surges (→ 1.5 metres).

Most coastal dune, marsh edge, tidal flat and beach erosion occurs during major storms, and especially when a number of storms follow in relatively quick succession. Observations have shown that up to 14 metres of frontal dune erosion can occur during one or two tides under storm surge conditions (Pye, 1991; Jay, 1998).

When standing water reaches the dune cliffs, recession occurs both due to slumping and direct wave erosion (Parker, 1975). In recent years, high water levels in 1990, 1998 and 2002 caused notable dune erosion and lowering of the intertidal sand flats in the Ribble Estuary.

The precise effect of any given storm on a given section of beach and dunes is dependent on the approach angle and height of the waves around the time of high water, the state of the beach resulting from antecedent weather conditions and the form (height and width) of the dunes themselves. The latter vary significantly along the Sefton coastal frontage (Saye et al., 2005).

Changes in Climate and Sea Level

The effects of climate change on dune systems, and indeed on elements of estuarine morphology such as saltmarshes and tidal flats, can be either direct or indirect (Pye, 2001). Changes in wind strength and/or direction may directly affect aeolian transport rates and the propensity to form mobile dunes.

Blowout formation and the development of elongate parabolic dunes or mobile sand sheets is favoured by strong, uni-directional winds. Changes in wind regime may also affect the dunes indirectly through their effect on wave regime, sediment transport patterns and beach morphology.

Changes in temperature, humidity and precipitation can have a direct effect on aeolian transport rates and an indirect effect via variations in vegetation growth rates. Of greatest potential significance, however, is a change in the frequency and magnitude of major storms, especially those associated with surges, which raise predicted water levels by 0.75 metres or more.

Analysis of water level and meteorological records suggests that the frequency of severe storms has increased since 1960 relative to the period 1930 to 1960 (Neal, 1993; Jay, 1998).

The possible responses of coastal dune systems to changes in storminess, sea level and sediment supply have been discussed in a broader context by Pye & Saye (2005). The nature of the medium to longer-term response depends on the balance between the beach sediment budget and the dune sediment budget, which are themselves dependent on rates on onshore-offshore and longshore sediment supply, local wave energy conditions and local wind energy conditions.

A further factor to be taken into account is the nature of present and likely future coastal management practices. Consequently it is not possible to make generalised predictions and each section of coast must be evaluated individually to reflect local circumstances.

With particular reference to the Sefton coast, an evaluation of all the available evidence suggests that dune erosion at Formby Point is likely to continue, at least in the short to medium term (up to 50 years), and may become more rapid if storm surges become more frequent and/or severe.

However, even with an increase in storminess and mean sea level rise, sediment is likely to continue to accumulate in the middle and inner parts of the Ribble Estuary. There may, however, be some loss of sediment/intertidal area in the outer estuary, resulting in a steepening of the intertidal profile.

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Managed Realignment: A Design Study from the Ribble Estuary

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Introduction

Managed realignment is the process of deliberately removing sea defences and re-introducing tidal regimes to previously reclaimed land. This is usually termed managed retreat or managed realignment and is accomplished by the breaching, removal or modification of the existing defences (CIRIA, 2004).

In the UK, most realignment schemes have been driven by the desire to create new intertidal habitat and to provide flood defence improvements or cost savings (e.g. Garbutt et al., 2003; Cooper, 2003; Pygott et al., 2004; Pontee, 2003, 2005).

In coastal areas, managed realignment options are being promoted through the pilot Shoreline Management Plans (SMPs) that are being developed in the UK's second round of Shoreline Management Planning. In estuarine environments, managed realignment schemes are being considered as one option for the sustainable management of flood risk in a series of Estuary Flood Risk Management Strategy Plans, which are being developed by the Environment Agency (Thomas and Turney, 2002; Cooper, et al., 2003).

Although habitat creation and flood defence issues often drive the implementation of managed realignment schemes, such schemes also provide social benefits in terms of opportunities for recreation, education, and research (see PIANC, 2003).

The present paper explains the rationale behind the design of a managed realignment scheme at Hesketh Out Marsh West in the Ribble Estuary. The scheme is being undertaken by the RSPB and the Environment Agency to create additional intertidal area at the same time as improving flood defence standards.

This paper outlines the site background, the proposed design and the construction works. An explanation is given to the modelling techniques used to develop the morphological design of the scheme.

Hesketh Out Marsh West - Site Background

The study site is located in the Ribble Estuary, which has an extensive history of reclamation (Figure 1, p. 45). The estuary has a spring tidal range of between 4.1 metres at Southport and 4.42 metres at the former port of Preston; receives fresh water inputs from the Rivers Ribble, Darwen and Douglas; and is susceptible to storm surges, which can reach heights of around 7.3 metres ODN at Preston.

The Hesketh Out Marsh West site is located on the left bank of the Middle Estuary. The shoreline is effectively fixed within this section as a result of training walls and the provision of flood embankments to protect agricultural land. The site has an average elevation of 4.5 metres AOD and offers the potential for managed realignment to create around 153 ha of intertidal mudflat and saltmarsh landward of the current embankment.

The site is surrounded by a number of embankments, which range in height from approximately seven to 7.5 metres AOD. These embankment levels provide a standard of service of less than one in 100 years, when wave and water level return conditions are considered.

A small stream, known as Hundred End Gutter, enters the site through an outfall in the south-western corner and flows around the periphery of the site in a ditch, before exiting through another outfall in the outer defence. The site is currently used for arable crops and market gardening. There are no statutory international or national designated areas of landscape importance within the site, although the site is bordered by a Special Protection Area (SPA), Ramsar Nature Reserve and a Site of Special Scientific Interest (SSSI).

Scheme Objectives

The main objectives of the scheme are to create intertidal habitat that:

- Can be utilised by a wide range of wintering and breeding waterfowl
- Includes saltmarsh, creeks and saline lagoons
- Has unhindered tidal exchange, requires minimal management and has the capacity to respond to dynamic estuarine change
- Enhances Biodiversity Action Plan habitats and species

The scheme aims to increase the standard of flood protection to surrounding areas, whilst complying with Conservation Regulations by avoiding adverse effects on the Ribble Estuary SPA, Ramsar Site, SSSI and the UK Biodiversity Action Plan habitats and species.

Proposed Works

- Improvement of the existing Environment Agency owned earth embankment running alongside the south side of the site
- Construction of a new earth embankment along the eastern side of the site to separate the site from Hesketh Out Marsh East
- Construction of a new embankment section in the south west corner of the site, to link the southern embankment to the adjacent defence
- All embankments within the scheme will have levels which exceeds the one in 200 year event
- Excavation of creeks and lagoons
- Creating four breaches in the outer embankment to allow the tidal inundation of the site. These breaches will remove 100 metre wide sections of the defences to the level of the marsh and create 25-40 metre wide channels to connect the creeks to the fronting marsh
- Infilling the existing field drain and borrow dyke system to break the linear drainage system and reinstate the 'natural' creek network
- The installation of an outfall structure containing tidal valves at the point where Hundred End Gutter flows through the new embankment into the south western corner of the site

Design Considerations

The design of the managed realignment scheme at Hesketh Out Marsh West has made extensive use of both Geographic Information System (ESRI - ArcView), and Halcrow's in-house two dimensional depth averaged hydrodynamic model system (DAWN).

The GIS was used to create a digital elevation model (DEM) of the scheme, which was subsequently imported into the hydrodynamic model for testing. The first step in creating a 'Scheme DEM' was the creation of an 'Existing Site DEM', from a mixture of ground-truthed Environment Agency LiDAR data and a detailed topographic survey of the site (see also Pontee et al., 2004).

Following this, the Scheme DEM was created in a number of iterative stages. Since the new defences on the site are to be constructed from material obtained within the site, a mass balance was calculated by considering the volumes of material to be extracted from the creeks, lagoons and breaches, versus the volume required for the new defences and the infilling of existing ditches on the site (after allowing for a wastage of 20 percent).

The construction of the Scheme DTM required the addition of the new proposed defences to the Existing Site DTM. The GIS was then used to calculate the volume of material required for the construction of these defences, which formed the 'target' volume of material to be gained from the excavations within the site.

The next stage in the creation of the Scheme DTM required the design of a creek system that replicated the former creek system as far was reasonably practical in engineering terms. The GIS was used to extract the position and width of the main creek systems from an aerial photograph of the site before its reclamation.

The GIS was also used to examine the Existing Site DTM in order to obtain depths of comparable creeks on the present day marsh in front of the site. Four representative widths of creeks were chosen – 30 metres, 20 metres, 10 metres and five metres – used to form the basis for a creek network in the GIS.

A number of lagoon features with side slopes of around one in 10 were also added after consultation with the RSPB and English Nature. Based on the depths of the fronting creeks, a number of iterations were then carried out in the GIS to obtain a scheme design in which the volumes of cut and fill balanced.

The hydrodynamic model was used to investigate a number of scenarios for realignment at the site, including the performance of the scheme as described above. Preliminary investigations showed that all realignment options increased the shear stresses compared with the existing baseline situation.

This occurs since the water draining into and out of the managed realignment site increases the velocities in the creeks and breaches. For the mean spring tide conditions (maximum tidal height 4.75 metres AOD), only the very highest part of the tide actually overtopped the fronting marsh. Thus, there was very little difference between banked realignment and breached realignment.

Under this scenario, the major control on current speeds and shear stresses in the breaches and the creeks was the width of the basal channels, which connect the existing creeks to the site.

The hydrodynamic model was also used to test the preferred scheme design developed in the GIS (see above). Under mean high water spring (MHWS) tides 30 percent of the site is flooded; whilst under MHWS tides plus an 800 mm surge, all of the site is inundated. High water in the site occurs 30 to 40 minutes after the main channel and water elevations are 0.1 to 0.2 metres lower than in the main channel.

The model predicted that the most significant morphological changes would occur in the vicinity of the breaches, where the higher velocities are predicted to lead to the expansion of the current creeks until a new equilibrium form was reached.

The results show that under MHWS tide conditions the basal channels in the breaches ought to be of sufficient dimensions for shear stresses to remain below the assumed value of 1.7N/m^2 . Under all tides tested most of the locations within the creek system needed to expand to keep shear stresses below the baseline value of 0.5N/m^2 . For MHWS tides, widths were assessed to increase by between seven and 29 metres and depths by 0.1 and 1.6 metres.

Scheme Construction

The Hesketh Out Marsh West scheme is to be constructed in a number of stages over a two year period starting in summer 2006. The construction works have been designed to allow the completion of the earth works within the proposed scheme prior to the removal of the existing sea defences, after which the site will be subjected to daily tidal inundation.

The operations team will be briefed by a member of the site design team to fully explain the objectives of the scheme. Of particular importance will be the creation of conditions (e.g. gradients and elevations) that are suitable for the development of functional intertidal habitats. The construction works will also be supervised by a scientist or engineer with experience in the design of habitat creation schemes.

In the first year, site works will commence with the construction of a haulage road and a working compound area, which will include a plant storage area and site cabins for site personnel. Following this, the new flood defences along the west, east and south of the site will be constructed with material excavated from creeks and lagoon features within the site.

The larger creeks will be constructed with a hydraulic tracked 360-degree excavator. Additional tributary creeks will be constructed with a rotary ditching machine owned by the RSPB. Material will be transported within the site using four 21 tonne tracked dumpers or wheeled dump trucks. The topsoil will be stripped from the location of the proposed new embankment to a depth of 15 cm. The new embankment will be constructed in layers, compacted to the required specifications and allowed to stabilise/consolidate for 12 months.

In the second year of works, four breaches will be created in the existing flood defence in front of the site to link the realigned area to the existing mudflat outside the site. It is envisaged that these works will be undertaken during neap tides. The works will also reconstruct the footpath that runs along the crest of the existing flood embankment on the south side of the site.

Conclusions

Covering a total area of 168 ha, the Hesketh Out Marsh West scheme represents one of largest managed realignments to be undertaken in UK to date. Furthermore, the scheme is one of the first to attempt extensively to recreate the former system of creeks that existed on the site prior to its reclamation. The scheme has a planned completion date in 2008, after which the RSPB will assume responsibility for the site management. A monitoring campaign will document the development of the site including sedimentation, vegetation development and bird usage.

Managed realignment schemes, such the Hesketh Out Marsh West site, provide a valuable contribution to sustainable coastal management offering social, economic and environmental benefits. Predicted increases in the rate of sea level rise in the future, coupled with increases in the maintenance costs of sea defences, means that many more defences are likely to become uneconomic to sustain.

In many areas of the UK, rising sea levels are also likely to lead to increased amounts of habitat loss, as habitats are squeezed between landward migrating low water marks and rising hinterland or sea defences (Taylor et al., 2004). This is likely to lead to an increasing requirement for habitat compensation schemes.

The net effect of these two drivers is that managed realignment schemes are likely to become more popular. Schemes such as Hesketh Out Marsh West represent a happy 'win-win' situation, whereby several objectives can be met in terms of the provision of habitat and sustainable flood risk management.

Acknowledgements

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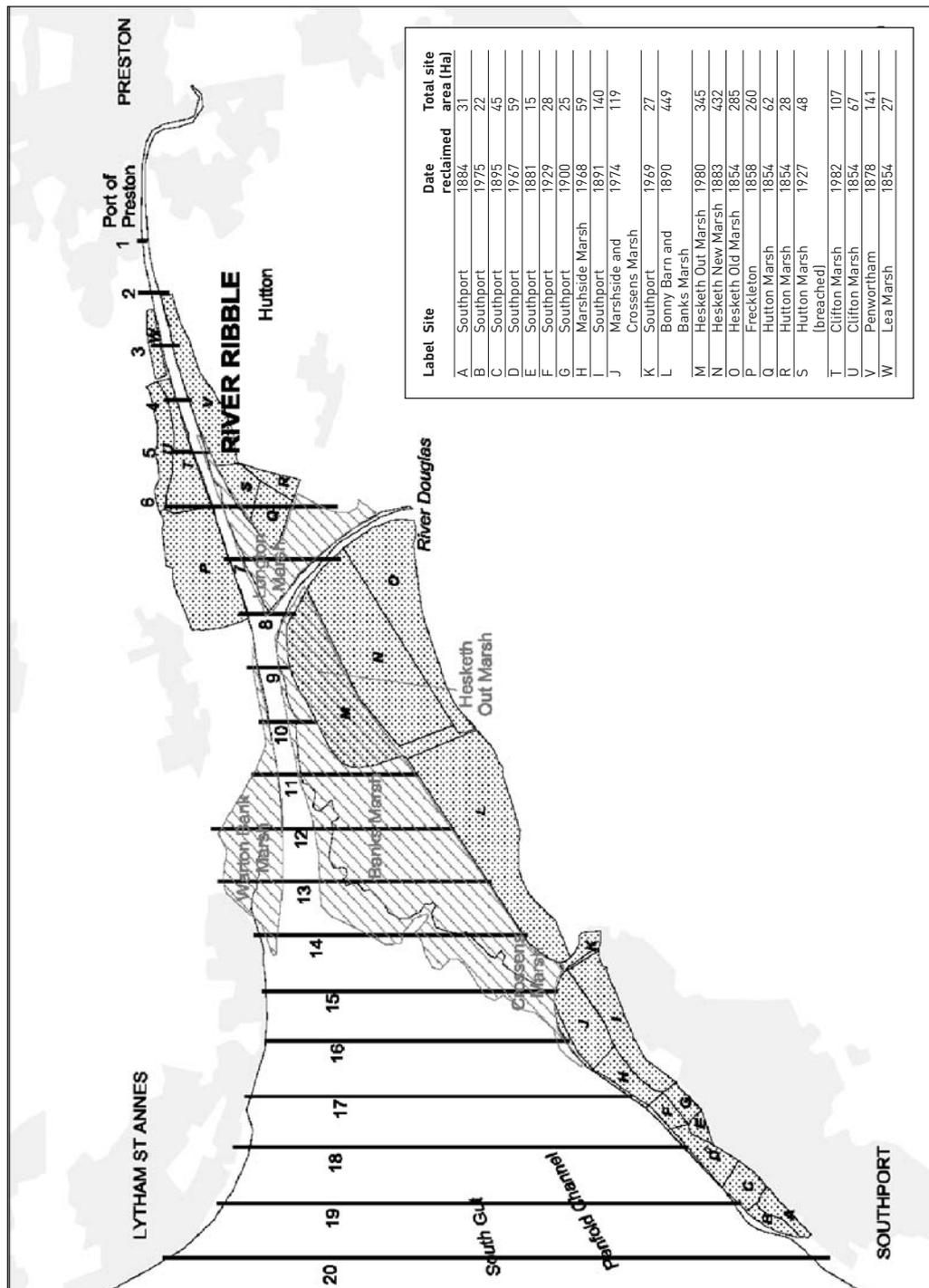


Figure 1: Location of the Hesketh Out Marsh within the Ribble Estuary. The estuary has a long history of reclamation starting in 1854. Hesketh Out Marsh is divided into two halves named Hesketh Out Marsh West and Hesketh Out Marsh East. Reclaimed areas from Halcrow (2003) and Van der Wal et al. (2003). The vertical lines represent the locations of 1km spaced transects used to analyse the geomorphological form of the estuary.

Dr Steven Glynn
Sustainability Northwest

Background

The Climate Change and the Visitor Economy in England's Northwest project is managed by Sustainable Northwest (SNW), with the research conducted by a team from the University of Manchester, led by the Centre for Urban and Regional Ecology (CURE) and supported by the UK Climate Impacts Programme.

The project is funded by the Department for Environment, Food and Rural Affairs, the Northwest Regional Development Agency and the Environment Agency.

The visitor economy represents a significant part of the economy of the Northwest, contributing £7 billion a year. In addition, it is estimated that around 12 percent of the region's workforce is employed in activities related to the visitor economy.

The number of visits in the region have increased by 40 percent since 1990 with an annual figure that currently stands at 160 million. Of these visits it is important to stress that 90 percent are day trips – a factor that emphasises the need to consider the visitor economy as whole rather than just tourism, which we tend to associate with longer stays.

The Research

The main research question that has directed the project is:

'How can those associated with the visitor economy in the Northwest realise opportunities presented by climate change, whilst ensuring the resource base is sustained, despite growing visitor demand and climate related reductions in environmental capacity?'

The project is addressing this question through eight work packages:

1. Understanding weather and climate related visitor response – This has involved econometric analysis of historical (30 years) data series for visitor numbers to attractions to determine how climate has affected demand for leisure over time.
One of the key issues was to tease out how weather, amongst many other factors, influences visitor demand. A major obstacle has been the lack of quality data sets, with only one suitable data set, from Chester Zoo, being identified. The results of the analysis are discussed below.
2. Exploring visitor response to climate change – The aim here was to understand, given any historical influence of weather, what implications future climate changes would have for visit levels. The results of the Chester Zoo analysis have meant that more emphasis is being placed on the influence of socio-economic factors.
3. Changes in visitor demand under two different socio-economic scenarios – It is essential to recognise that in addition to changes in climate, the socio-economic situation will also be subject to change through the 21st century. The research has built on earlier work on developing socio-economic scenarios, to produce two scenarios for socio-economic change. One, 'regional enterprise', has economic development as the overriding concern for policy makers, while the other, 'regional stewardship', envisages a much greater concern for the environmental impacts of economic and social changes. Within these scenarios, possible changes to a number of variables are explored and the implications for the visitor economy considered.¹
4. Interaction of climate change and socio-economic change on regional visitor behaviour – This work will link together the socio-economic scenarios with low and high emission climate scenarios to give four integrated scenarios with storylines developed for each.

5. Influence of climate change on carrying capacity – Carrying capacity here refers to the level of use within a particular area that can be sustained before intrinsic qualities start to deteriorate. At the regional level the research focuses on physical (transport) and ecological capacity.
The landscape scale is being explored through four case studies focused on footpath erosion in the Lake District, moorland wildfires in the Peak District², public spaces in Greater Manchester and the integrity of the Sefton Dune system, which is covered in more detail below.
6. Case studies of adaptation responses in vulnerable locations and their costs – The costs and benefits of different options for adapting to the impacts of climate change will be explored using the newly developed UKCIP Costings Methodology³ and other techniques described in Stage 5 of the UKCIP decision-making framework.⁴
7. Case study analysis of capacity building in less vulnerable locations – It is important to consider possibilities for developing new ‘climate proof’ capacity in less vulnerable locations, including proposed regional parks.
8. Interaction with related sectors especially farming, forestry, health and transport – This final workpackage is investigating the possible relationship between the visitor economy under changed conditions resulting from both climate and socio-economic change and other sectors such as agriculture, forestry, transport and health.

The project requires a multi-disciplinary approach and the team includes landscape ecologists, geographers, meteorologists, planners, and statisticians. To inform the research a series of workshops have been held with key stakeholders. Engagement with policy-makers is an important aspect of the work and is ongoing throughout the project.

The Chester Zoo Work⁵

As was mentioned previously, the only reliable data set of daily visitor numbers that was obtained was for Chester Zoo, covering the period from 1979 to 2004. This was matched with weather data and holidays etc. were added. This data was analysed, using multiple regression techniques, to tease out the influence of weather compared to other variables.

Some of the key findings were:

- Weather has very little influence on visitor levels. Rainfall does result in a shift in visits, e.g. from one weekend to another, but has a minimal effect on overall visit levels.
- Temperature has even less of an effect. In comparison, a month with a bank holiday will see an additional 6,930 visitors, while the school holidays see an additional 1,850 visitors for every day of the holiday.
- The main impact of climate change is likely to be on infrastructure, with for example, need for more shading, additional water, responses to changes in vegetation and, in certain cases, a need to consider how animals are managed.
- Visits are readily explicable and forecastable, allowing for more considered planning.
- The best way to increase visit levels is through repeat visits from enthusiasts.

It is recognised that this only reflects the picture for one example, making generalisations difficult to draw. It may be that the results would not be replicated for a beach. However, without the data to analyse it is impossible to say.

The Integrity of the Sefton Dune System⁶

The dune system along the Sefton coast is the largest of its type in the UK. The dune system performs many functions. It is an internationally significant haven for biodiversity and is an important area for conservation and subsequently ecotourism. In addition, this is part of the Northwest golf coast and has a world class cluster of links golf courses.

Table 1 below details the predicted changes in the climate expected to occur under the UKCIP high and low emissions scenarios. Measurements at Liverpool show that sea levels have risen by about one mm a year since the mid 1800s. As the climate changes this trend may accelerate and by the 2080s, sea levels could have risen by between seven and 67 cm.

In addition, it is predicted that the number of depressions crossing the UK in winter will increase, with a subsequent increase in the occurrence of storms.⁷

The influence of the changing climate on the visitor economy of the region is uncertain, particularly in light of the Chester Zoo results discussed earlier. However, it would seem likely that hotter summer weather, bringing more uncomfortable conditions in urban areas, would make the coast an attractive destination.

What is more certain is that the climate change will strongly influence the physical parameters that shape the ecology and subsequently the environmental capacity of the dune system. One issue of concern is increased coastal erosion due to changes in physical variables such wind speed and direction, frequency of storms, temperature, and sea level rise, and the impacts that these changes may have on, for example, growth of marram grass and visitor loading.

However, the dune system itself provides an effective, flexible defence against coastal erosion, protecting settlements and the important agricultural resource. Hence, it is essential that the physical integrity of the dunes continues to be monitored and that visitor access is managed to maintain the sand mass close to the point of wave attack.

With changes in variables such as rainfall, radiation and humidity, in addition to temperature and wind speed, the most important impact of climate change in the dune system will be on the water table, which provides a connected layer beneath the entire dune system.

The water table fluctuates seasonally, falling in summer and being recharged in winter – and over longer time periods – reflecting changes in the balance between water input (principally from rainfall) and output (principally through evapotranspiration).

The level of the water, and variations in this level, are of critical importance to the biodiversity of the dune system and also to recreational use, including golf, where there is a need to maintain greens and fairways in the summer and avoid course closure due to flooding in the winter.

Variable	1961-1990 average	2020s	2080s	Max change
Average summer maximum temperature (°C)	17.5	19.0 (L and H)	20.2 (L) 22.2 (H)	4.7 warmer
Winter minimum temperature (°C)	2.7	3.4 (L and H)	4.3 (L) 5.8 (H)	3.1 warmer
Average summer rainfall (mm)	194	-10% (L) -15% (H)	-20% (L) -40% (H)	40% drier
Average winter rainfall (mm)	207	10% (L and H)	15% (L) 26% (H)	26% wetter

Table 1: Predicted climate change for the Sefton Coast under UKCIP high and low emissions scenarios⁸

Ainsdale Nature Reserve records provide evidence of historical changes in the water table levels. Researchers at Southampton University have developed a model of dune hydrology, which successfully tracks these historical changes. This model is being projected forward to take account of the changes envisaged under the different climate scenarios. Preliminary results⁹ show:

- Increased variability in predicted water levels
- Drier average soil moisture content in mid/late summer
- The possibility of runs of more than five years with water table levels one metre lower than at present
- Slightly larger winter – summer range (amplitude) of level change
- Continuation of occasional years with high water table levels, but with longer drier periods between these

Such changes will have significant implications for dune system. There could be major pressures on biodiversity, particularly in the 'fixed' dunes with reduced biodiversity in dune slacks and increased vulnerability to destabilisation by 'blow-outs'. Golf courses will need to cope with the changes and the impacts that this may have on course management.

Emerging Messages

Although the research is ongoing, a number of messages are beginning to emerge:

- Visitor behaviour may be resilient to the weather. The Chester Zoo work indicates that weather and changes to climate may have less influence on visitor behaviour than has been thought. Socio-economic changes are likely to be a bigger influence in visitor patterns
- Environmental capacity in vulnerable locations important to the visitor economy of the region is likely to be negatively impacted by climate change. This is demonstrated clearly in the Sefton example and is also being seen in the Lake District and Peak District case studies.
- If the quality of these landscapes is to be maintained then there is a need to develop

adaptation strategies. Management of these areas is already a significant challenge and ways of coping with these new pressures will need to be explored.

If this is to be done successfully then it is key that relevant organisations work together to understand, monitor and manage the landscapes. In the case of Sefton, such a partnership, the Sefton Partnership, is already in place and the opportunity exists to provide an international demonstration project for anticipating and managing the response to climate change.

It needs to be recognised that adaptation measures may have significant costs and there is a need to finance prevention measures, rather than curing the problem once it has occurred.

Outcomes of the Study

- The results from the study need to be considered in the development of policy at the sub-regional, regional and national level. A process of engaging directly with policy-makers is being undertaken through the study.
- The study is focused on the North West; however, it is clear that the results are applicable beyond the region. For example, the issues at the centre of the cases studies – footpath erosion, moorland wildfires, integrity of dune system, and the use of public spaces in an urban area – are not location specific, and results will be of use in other areas of the UK and internationally.
- The methodology and tools developed through the study also have much wider applicability, enabling others to undertake more detailed assessments of what impacts climate change may have on the visitor economy in their locality.

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- ² See McMorrow J et al (2005) *Moorland wild fires in the Peak District National Park*, available at www.snw.org.uk
- ³ Metroeconomica (2004) *Costing the Impacts of Climate Change in the UK: overview of guidelines*, UKCIP Technical Report. UKCIP, Oxford
- ⁴ Willows R.I. and Connell R. K. (eds) (2003) *Climate adaptation: Risk, uncertainty and decision-making*, UKCIP Technical Report. UKCIP, Oxford [all UKCIP publications are available at www.ukcip.org.uk]
- ⁵ This discussion is based on the work detailed in Albertson K, Aylen J and Cavan G (2005) *The impact of weather and climate on tourist destinations in the Northwest: the case of Chester Zoo*, available at www.snw.org.uk/tourism
- ⁶ This discussion is based on the work detailed in Carter J et al (2005) The integrity of the Sefton dune system: the relationship between climate change, environmental resources and the local visitor economy, available at www.snw.org.uk/tourism
- ⁷ The probability of any one depression being a storm is not expected to increase, however, the increased number of depressions will lead to an increased number of storms. See Hulme et al (2002) *Climate Change Scenarios for the United Kingdom: The UKCIP02 Scientific Report*, Tyndall Centre for Climate Change Research
- ⁸ From CURE (2005) *Risk Workshop: Climate Change Impacts on the Sefton Coast*, available from www.snw.org.uk/tourism
- ⁹ These are from one run only of the model and are hence only tentative. Further runs will be conducted to enable a more robust statistical analysis of the results.

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Graham Lymbery
Sefton Council

Corepoint (Coastal Research & Policy Integration) is an Interreg IIB-funded project running from November 2004 to April 2008. It shares four partners with the CoPraNet project, including Sefton Council. The project aims to:

- Provide **concrete solutions** for current problems in the North West region using current **best practice** approaches and identify models for sustaining ICZM initiatives
- Promote **social and political responsibility** for coastal environment
- Influence national **spatial policy** development in response to the EU recommendation on ICZM
- Build European and **local capacity** to implement integrated coastal management programmes
- Develop an integrated coastal **information management system** for Northwest Europe

Task 4.6 of Corepoint is to provide Local Information System decision-making tools through:

- Enhancing and developing models for the UK on the North West Coast (Sefton), Essex Estuaries and the Severn Estuary
- Testing the Implementation of models in other areas to ensure the transferability of the tool to spatial planners in North West Europe
- Building generic Local Information System (LIS) decision support system for NW Europe spatial planners as a component of the resource centre

Sefton Council Case Study **Background**

Sefton Council developed the Sefton Coast database between 1979 and 1982 in collaboration with Liverpool University. The stated aim of the project was 'to collate all the existing research, literature, plans and records relevant to the coastal hydrodynamics of the Sefton area and to present the information in a readily accessible form.' (Guide to the Sefton Coast Database 1982 p1: www.sefton.gov.uk/page&4730).

A further aspect of the development of the database was a document that acts as a guide to the database that is titled (unsurprisingly): 'A guide to the Sefton Coast Database'; this brought the information contained in the database into readily accessible summary descriptions of the different areas and processes. The project also identified deficiencies in the existing information and as a result of this a three-year research programme was initiated to develop a numerical model of waves and tides for this area.

The guide has been a useful document since its development, both as a reference for further research, to inform understanding of the coastal processes applying to this area, and to inform management decisions. It does however have a number of inherent problems.

The guide and the database are static. The database has never been formally added to or maintained. The guide has only recently been transferred into digital format with some of the more obvious changes made but essentially still the same document as it was in 1982. The guide can now be copied for dissemination, but the database is not easily accessible; much of it is paper copies of original documents in varying standards of reproduction.

Maps and plans have suffered from poor storage, some materials have been lost and some documents are either rare or unique and as such present a high risk of loss of information if mishandled or mislaid. Some of the data collected and referred to lacks any form of metadata and as such can be both difficult to use and of uncertain accuracy.

A further limitation of the current guide reflects the changes in attitude and approach to the implementation of the coastal defence function; there has been a change towards a more risk management orientated approach involving a move towards a more holistic assessment of the implications and sustainability of coastal defence policy.

This means that the current coverage is deficient in a number of areas such as climate change, archaeology, habitats, human use, soils, hydrology and management. Because of the increasing emphasis upon inclusivity there is a need for the information to be made much more accessible to the layperson in order that they can participate and/or understand the decision-making process.

Definition of what is meant by a 'Database' in this instance

Dictionary Definition (Collins, 2002):

- (1) A systematised collection of data that can be accessed immediately and manipulated by a data-processing system for a specific purpose
- (2) Informal any large store of information (also referred to as Data Bank)

In this instance it is the informal definition referring to any large store of information that is relevant; it is necessary to be clear on this matter to avoid confusion. Whilst it is a large store of information, that should not imply a lack of order. There is a need to have some sort of retrieval system; what is not anticipated is that any data accessed will be directly manipulated in some form of data processing.

When discussing this with other professionals, particularly those from an Information Technology background, it may be more appropriate to refer to the structure of the 'database' and the retrieval system in the context of a document management system.

Key changes since the original database was developed:

Technology: There have been massive strides forward in technology relating to data collection, analysis, storage and dissemination. The ease with which accurate surveys can be undertaken has increased, as has the range of techniques, particularly remote sensing. Analysis has improved in terms of computing power for models and also instrumentation for analysing samples such as laser granulometry.

The ability to store data in a digital format has aided both secure storage of information and improved the ease of replication of the data; some of the datasets would be excessively large to either store or handle in a format other than digital. The World Wide Web has improved our ability to disseminate information and has increased our expectation as users that information will be available via this medium.

Social: As already mentioned, there has been a change in the approach that society adopts when considering coastal defence, with a more holistic approach been deemed appropriate and a move away from the assumption that engineering solutions are always appropriate. This has resulted in a need for an improved understanding of the coastal processes applying to different areas and the inter-relationships between these processes over wider geographical areas.

There is also an increased expectation from the public and other stakeholders that they will be involved in the decision-making process with a tendency towards this being more participatory rather than purely consultative. This means that the public expect information to be provided in an intelligible format and that it is important for practitioners to communicate the science behind decisions in order that the stakeholders can participate in discussions on an informed basis.

Economic: Whilst there is not yet whole-hearted acceptance from government (in the form of funding) that accessible information needs to be widely disseminated, it is strongly implied in guidance, such as Shoreline Management Plans.

Where Government has accepted the economic argument is in relation to data collection, collation, analysis and storage – specifically where it can be shown to have financial benefits in relation to reduced capital scheme costs. The two key principals behind this are that the value of datasets accrues with time (the longer the data set, the greater the value) and that data needs to be properly managed in order to realise its full value (metadata and secure storage).

Considerations in the review of the database

There were three key aspects to be considered: human, technical and organisational. Human aspects cover issues such as how people use the database, from problems getting people to enter metadata and maintain it in an up to date form through to how people will access the database and the identification of intuitive keywords.

Technical relates to a range of issues from what file format should be used to the use of a map based front end for the web site to make searching more intuitive. The organisational aspect covers issues within our control such as how to integrate the database within our office systems to those aspects related to the broader organisational framework such as copyright issues that the Government needs to address.

The list below is a starting point and is by no means finished:

- Use of metadata to ensure the quality of data is known
- Use of Quality Control systems to check the quality of the data prior to addition to the database
- Integrate into office systems so that it is not an additional task to maintain in an up to date form but an integral part of the way we work
- Dissemination of the information at a number of levels accessible (in terms of language used and level of detail) to different users but with the ability to 'drill' back down to the source data
- Use of the web to disseminate
- Some form of record of who is downloading data in order to be able to assign a value to this activity; to be used for future justification
- Use of the Sefton Coast Partnership Research Task Group to provide a guide on areas that should be developed
- The system adopted should be able to deal with a broad range of topics to enable expansion as and when there is a desire to do so or a legislative driver requiring it to be done

Resourcing

The project will clearly require a significant amount of work collating the data, getting it into a suitable form and providing the analysis and interpretation. This will be an ongoing task but in the first instance an individual will be appointed for a two-year period to bring it up to a basic level.

The principal resource from Corepoint will be in the form of assistance via the expert couplet with Cardiff and support from other Partners in the form of technical support and input based on Partners' experiences.

Key areas to identify possible support from external sources are:

- Document management systems
- Web based dissemination, particularly the use of online searchable databases
- Use of map front ends within web based dissemination
- The use of metadata including identification of key words for the coastal zone
- Problem identification based on Partners experiences
- Advice on the valuation of benefits for justification of the work

Benefits

The benefits to Sefton relate to the management of information in a secure and accessible way that facilitates decision-making based upon an understanding of the science applying.

Benefits to Corepoint are a project with clear deliverables with minimal risk due to the Project being under the control of a Partner and minimal external inputs required. From this a number of generic lessons can be derived that can be transferred to other projects and a practical example will be in existence and maintained for the foreseeable future.

Limitations

The main limitation with this project is that it does not address the issues around the involvement of a number of Partners who are responsible for populating a database that will inform decision-making – as is often the case.

Whilst this is a limitation it is also the reason why this element is relatively low risk in terms of delivery as working with additional partners or stakeholders can often be problematic. The principal risk to this element of the project relates to the technical side, particularly the web dissemination; we would look to identify what support Partners can provide in this area to minimise this risk.

Liverpool Bay Coastal Group

Background

Liverpool Bay Coastal Group was formed in 1988 to co-ordinate coastal defence activities and exchange information for the geographical area covered by the local authorities for Conway, Denbighshire, Flintshire, Wirral, Sefton and West Lancashire. Other Partners in the group are DEFRA, WAG, English Nature, Countryside Council for Wales, Liverpool University, English Heritage and the Port of Liverpool.

In 1991 the group established a Forum made up of Elected Members to bring some form of political representation to the activities of the group and as a means of informing politicians of those activities.

As part of the development of the first round of Shoreline Management Plans (SMPs) a database and associated context report was developed. The review of the SMP for this area (11a) is due to commence in April 2007 and there is a requirement to bring the database up to date as it has not been maintained in the intervening period. There is also an increased emphasis within the guidance for the second generation of SMPs that there should be 'education' of stakeholders with regard to the understanding of the science relevant to this coastline.

The problems associated with the SMP database are very similar to those found with the Sefton Coast Database. The key difference is that in this instance there are a number of Partners involved who all hold data relevant to the database and would be required to participate in updating and maintaining the database. You would also expect these Partners to find the database a useful resource both for their own use and to refer people to.

By seeking to transfer knowledge from the Sefton Coast Database to the Coastal Groups activities with the SMP database it would not only demonstrate the transferability of the generic elements developed, but would also enable lessons to be learnt in relation to multiple and trans-national Partners being involved with the development and maintenance of a database.

From this we would seek to identify key generic lessons focusing on the human and organisational issues identified within this case study.

Both the case studies above would generate generic transferable lessons that could be applied in other geographic locations. Given the social and organisational differences across Europe, it is unlikely that a single model would be appropriate, but the techniques identified and lessons learnt can be placed in the appropriate context so that practitioners can judge their applicability to their own situation and adjust the method of application as required.

For further information visit www.corepoint.ucc.ie/

Professor William Ritchie

Aberdeen Institute for Coastal Science & Management (AICSM)

Coastal erosion is regarded as a serious problem for most lowland and soft coastlines in Europe. In some areas, the possibility of sea level rise has also to be taken into consideration. Although most coastal geomorphologists regard erosion as a wholly natural process in response to a reduction or cessation of mobile sediment in the near shore zone, many coastlines have either invested in costly defence structures, which need to be maintained/renewed, or have permitted high value assets, e.g. tourist facilities to be constructed along dynamic and vulnerable types of coastline.

In both of these situations, the preservation of the asset is deemed to be worthy of expenditure on defensive structures or procedures on a cost-benefit appraisal.

Part of the assessment of the problem of erosion of asset value is some measurement of the amount and rate of change. This is not an easy question to answer, except at a general level over long time scales. Normally, the question is posed in an historical context of 100 years or so, but in recognition of changes that might be caused by more recent factors, a 20 to 50 year timeframe is used.

The main methods of measuring change fall into two groups: comparison of maps, charts and aerial photographs of various ages; and direct measurement on the ground or photogrammetrically. All these methods have defects, sources of error and degrees of uncertainty.

A brief summary of maps and charts reveals several error sources:

- Scale resolutions
- Cartographic conventions
- Accuracy of original survey
- Use of tidal lines (often interpolated from tide tables and not actually surveyed)
- Contour intervals
- Date and time of survey
- Different projections
- Different datum (in time and space)

All these errors need to be quantified and used as the basis for giving error margins and variances on the measured amount of change.

With mobile coastlines, the question is 'How typical was the survey of average to extreme coastline conditions?' In other words, any survey that leads to a map or digital output is a sample at a particular point in time.

Direct surveys take two forms: by ground surveys and by photogrammetry. Beach profiles are in common use and have the following defects and inaccuracies, some of which are similar to the list for maps and charts:

- Short term
- How typical
- How good are the fixed references for control
- Frequency of survey
- Accuracy of measurements
- Typicality of date, time and place
- Density

Moreover, and with particular reference to coastline dunes, what is actually measured each time for the purposes of measuring coastal advance and retreat. For example, is it some feature on the beach, the lowest vegetation, the toe of the dune, the eroding scarp, the ridge of the crest, or what? All of these are difficult to detect on a consistent basis. Some are ephemeral. Most are intrinsically inconsistent.

As before, all such methods, unless closely spaced, based on fixed markers and surveyed very frequently, have inbuilt errors and variance values. Few, if any, such schemes or profiles have a sufficient history to provide a useful model for future predictions.

At first sight, photogrammetric methods using high quality true-vertical, large-scale aerial photographs are intrinsically better. Nevertheless, they are not without problems and defects, some of which are insurmountable.

Whether historical, photogrammetry, or modern Digital Terrain Model techniques are used, with photographs or others forms of aerial remote sensing, e.g. LIDAR, the requirements are similar, i.e. an unambiguous control framework, two sets from different dates, precise calibration of sensor and, most important, the inescapable problem of sampling and typicality at time of exposure. In addition, there are few sources of aerial photographs prior to the 1940s.

The measurement of some types of coastlines is easier than for rapidly changing coastal dunes, e.g. soft cliffs, salt marshes, because the definition of the 'edge' is easier. More dynamic features, such as ebb and flood sand bars, deltas and zones that are hidden by vegetation, are almost impossible to measure with any degree of confidence.

Although SPS (Satellite Positioning Systems) is a major asset for all types of surveying and measurement, the intrinsic problems of accuracy, typicality, sampling and time interval (especially historical), cannot be overcome.

For most soft, mobile coastlines, estimates and indicative measures can be provided, but – and this is normally not true – should have reservations about accuracy, variance and error margins, no matter how large, for this will not mislead the user into a position of near-confidence in the 'accuracy' of the measures and therefore the value of any model or scenario for the future evolution of the coast in question.

The Channel Coast Observatory: Southeast Strategic Regional Coastal Monitoring Programme

Dr Travis Mason
Channel Coast Observatory

The programme began in August 2002, comprising the 31 coastal Local Authorities from Portland Bill to the Isle of Grain in the Thames Estuary, plus the Environment Agency (Southern Region), and is grant-aided by DEFRA. The primary purpose of the programme is to provide a standard, repeatable, cost-effective and regionally consistent coastal monitoring programme.

The first action was to set up a new GPS survey control network, tied in across the whole region and using common transformations and geoid models. A series of E1 stations was installed at approximately 50 km intervals along the coast, with interspersing E2 stations every one to two km. All data collected by the Programme (topographic and bathymetric surveys, aerial photography and LiDAR), uses this control network and therefore can be spatially related to each other.

The survey programme was designed on a risk basis, with exposed, highly managed sites having the most frequent and most detailed surveys; for example a Beach Management Plan beach site will usually have a profile survey twice a year and a detailed spot height survey once a year, plus annual aerial photography (ortho-rectified every five years) and a five yearly LiDAR and bathymetric survey. A shallow water wave and tide network has been deployed and wave and tide data are relayed to the Programme's website in real-time. The information



Figure 1: Extract from Poole Bay Annual Report

is used for long term wave climate studies and production of design parameters, but also has a valuable role in operational management – text alerts are sent to Local Authority engineers when measured wave heights or tide levels exceed a threshold, indicating the possibility of coastal flooding or a requirement for a post-storm survey.

Data are analysed in a consistent manner across the region and the results reported annually – Figure 1 shows an example from Poole Bay, where the location of the profile lines is superimposed upon the most recent ortho-photograph and colour coded according to percentage change in cross-sectional area during the last year. The reports span an entire coastal process sub-cell and therefore allow some measure of strategic thinking, across municipal boundaries.

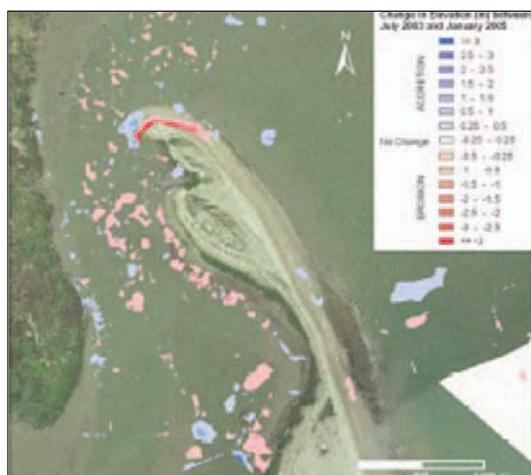


Figure 2: Bathymetric difference model at North Point

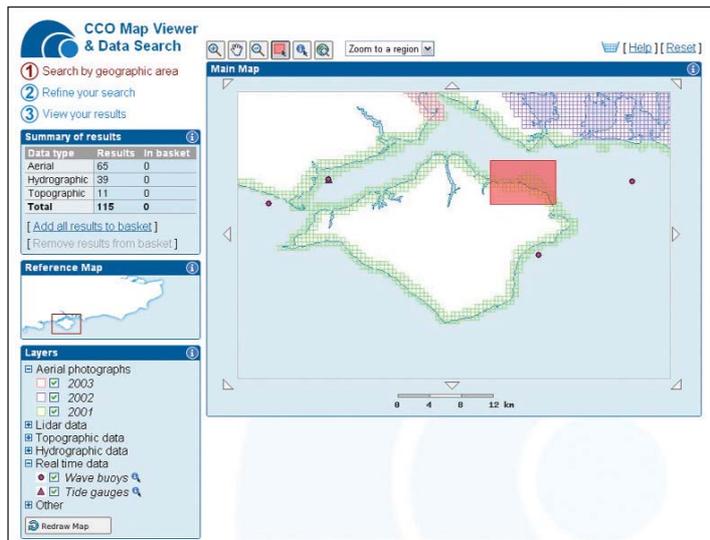


Figure 3: Website Data Catalogue and Map viewer

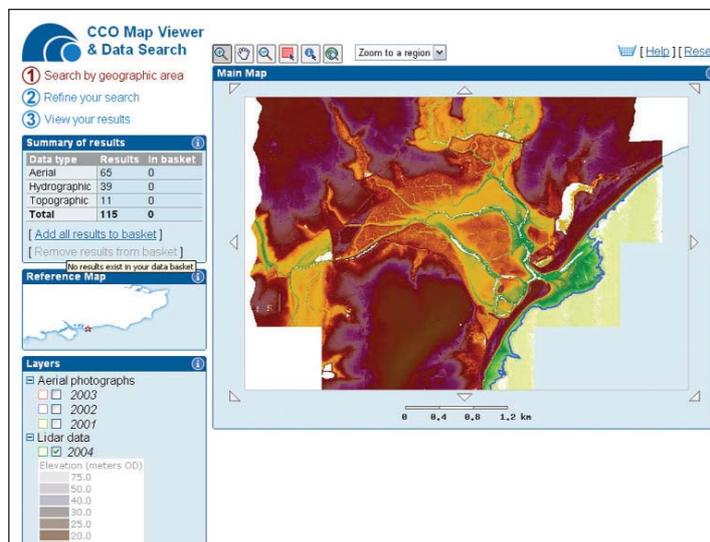


Figure 4: Pagham Harbour LiDAR

In some regions, bathymetric surveys are conducted every two years. In this case, digital terrain models can be constructed and the difference model can show areas of erosion or accretion, as in the example shown in Figure 2. Again, consistent methods of such data analysis and gridding methods are used across the entire region.

All data collected by the Programme are freely available and, in order to simplify delivery of the data to external users, an automated delivery mechanism, directly from the website, has been implemented by the Programme's website managers (Geodata Institute, University of Southampton).

Essentially, the user can draw a box around the area of interest and a summary of the data spanning that area will be shown (Figure 3). Various other search criteria are possible and then the data can be downloaded.

Each data file is accompanied by an extensive metadata file containing all the information which is vital for use in years to come, but which is so often lost, such as the instrument type, transformations, datums etc.

The online GIS also enables users to view the ortho-photos and, more recently, the LiDAR data which has been in particular demand; see Figure 4 which shows the gridded LiDAR data for Pagham Harbour (the full legend is visible on the website)

Although the Programme is run by and for the Local Authorities, there has been considerable interest from other users both in the data themselves, typically from academic and strategic researchers, and in the data management techniques employed by the Programme.

The Programme distributes a bi-monthly e-newsletter, the Channel Coast News to Programme partners and other interested parties, with news from the coastal group regions and a feature article on some aspect of the data collection programme. Recent articles have included post-storm surveys, ecological monitoring and CASI.

For further information see: www.channelcoast.org

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Abstract

This paper outlines the plans for a strategic monitoring programme for Morecambe Bay. It addresses the need for a coherent and integrated monitoring and associated data handling, processing and analysis and numerical modelling for interpretation. The information collected through the monitoring programme will provide the opportunity to develop an understanding of environmental conditions in the Bay and support the future strategic decisions and management.

Introduction

Morecambe Bay is the second largest embayment in the UK (34,339 ha) influenced by waves, tides and river flows (Mason et al., 1999, French and Livesey, 2000). It links Irish Sea with the Kent, Leven, Lune and Wyre estuaries. The Bay can be considered as a wide area of shallow water (with exception of the Lune Deep, Lancaster Sound and Heysham Lake), intersected by a network of channels that drain the aforementioned estuaries. The channels are dynamic, meandering through the Bay, causing erosion and accretion and affecting its margins and associated coastal habitats.

Effective coastal management is based on understanding of coastal processes and the effects that these processes have on shoreline evolution (Bradbury et al., 2002). This requires high quality information to support future strategic development and planning. The information currently available to the coastal managers concerning the physical processes and coastal behaviour around Morecambe Bay is incomplete.

There has been little study in the Bay, while the existing measurements are usually sparse in time and space, and the monitoring programme lead by Local Authorities around the Bay concentrates mainly on observing beach profile changes in a very limited area.

The recent review of Shoreline Management Plans recommended a strategic approach to regional monitoring (Bradbury et al., 2002). Recently two monitoring programmes have been established; the Channel Coastal Observatory (Bradbury et al., 2002) and Liverpool Bay Observatory (POL, 2005).

The first one provides an example of a new strategic regional coastal monitoring programme that is driven by coastal managers' needs; whereas the second is mostly driven by research needs, in particular by the development of operational numerical models.

Following these two examples, the aim is to develop an integrated and coherent assessment of Morecambe Bay and its fringing coastal zone, in order to understand the environmental processes and their interactions with man-made changes. It would combine expertise across academia at the Lancaster Environment Centre and governmental institutions around the Bay to facilitate appropriate management decisions.

The key objectives are to:

- Obtain 'baseline information' on the key processes occurring within Morecambe Bay
- Assess the changes in the conditions within the Bay, particularly relating to: channel movements, sediment erosion and deposition, habitat loss or regeneration
- Assess the impact of human activities such as changed water quality, coastal defence structures or any other structure that might be built in the Bay
- Ensure effective data collection, transfer, storage, processing, access and dissemination to all partners and the wider public
- Predict storm impacts such as coastal flooding, beach erosion and environmental changes
- Facilitate the implementation of appropriate management decisions
- Raise public awareness

Monitoring and Measurements

Coastal areas are complex systems of high dimensionality that operate over a wide range of spatial and temporal scales (Gunawardena et al., 2005). Consequently, integrated monitoring needs to be introduced, spanning over several spatial (metres to km) and temporal scales (days, weeks, months and years).

Various physical, chemical, biological and ecological processes interact within the Bay, continuously changing its morphology and habitats. To assess these processes, various parameters need to be monitored and measured. Recently, the concept of coastal indicators that can be directly measured or derived from measurements has been introduced (Van Koningsveld et al., 2004); these are defined as 'a reduced set of parameters that can simply, adequately and quantitatively describe the dynamic-state and evolutionary trends of a coastal system'.

In addition, knowledge of the past evolution and driving mechanisms behind past changes are highly valuable for setting up the monitoring programme. Thus it is very useful to obtain historical data at different spatial and temporal scales.

Therefore, the prerequisite is to develop a monitoring system that can yield: frequent and reliable measurements of relevant coastal system indicators, which can be used to manage and plan the coast; the design of the new coastal protection schemes; management of coastal habitats; to rise public awareness and support research.

Considering the morphological changes, one would both estimate and take measurements of sediment budgets, shoreline changes, channel dynamics and salt marsh changes. In order to gain knowledge of the processes involved in these changes, and be able to make future prediction, additional measurements can be taken.

These would include wave properties, currents and sediment transport in marine environment, fluvial inputs into the Bay such as river discharge and sediment transport and useful physical parameters such as wind, temperature and rainfall. The monitoring of marine habitats (e.g. mussel and cockle beds) and bird colonies will require additional measurements of water quality parameters.

Some of these parameters, such as weather or fluvial parameters, are already monitored and measured by the Met Office and the Environment Agency respectively.

Also there has been ongoing monitoring of coastal habitats by English Nature and North Western and North Wales Sea Fisheries Committee. However, the measurements in marine environments have been irregular and usually not coordinated between all interested parties.

Data Handling and Processing

Field measurements in marine environments have normally a degree of logistical difficulty associated with them. The equipment is usually deployed in hostile environments, has limited memory and usually samples with pre-set regular frequency.

A number of new technologies are currently available to support the monitoring in hostile environments. There have been developments in hardware as well as in communication technologies. For example, ad-hoc wireless communication can facilitate the creation of sensor network in hostile environments.

Even so, direct measurements of coastal processes remain expensive and the instrumentation, being exposed to severe weather conditions, has often limited life. The frequency and duration of measurements usually do not cover a range of spatial and temporal scales needed for the assessment of future changes. To overcome these problems, different remote sensing techniques can be used as stand alone or in combination with field measurements.

For example, beach and salt marsh changes and channel dynamics can be regularly monitored several times per day over an area of few hundred meters to few kilometres by video monitoring systems such as 'Argus'. The changes over a larger area such as a several kilometres of coastlines can be monitored on bi-annual or annual basis using aerial photography or airborne topographic LIDAR (Light Detecting and Ranging) images. The changes in the whole Bay can be captured from the satellite images over longer time periods.

The monitoring programmes such as the one proposed create a considerable amount of data, which needs to be stored, analysed and easily accessible from all contributors and users. Standard meta-databases, databases, Geographical Information Systems (GIS), data exchange procedures and data analysis can be used.

However, with further developments of Internet and Grid Computing, there will be the possibility of integrating a variety of information from different sources and presenting and visualising this information on the desktop (Coulson et al., 2004). The presentation of measurements and visualisation is very important to build up public awareness of local processes and associated risks.

Operational Modelling

Besides the knowledge of past and current processes, effective management and planning of coastal areas requires the prediction of future coastal behaviour and/or the future impacts of coastal interventions. These predictions can be obtained using physically based models or alternatively with data-based models.

Data-based modelling, which implies that the entire model structure and the model parameters are inferred directly from the analysis of observational time-series, requires field measurements of high spatial and temporal resolution. In case of physically based models data assimilation can further improve the model predictions.

Furthermore, numerical models can be used for setting up the observations, providing information on which parameters need to be measured, where and when. In the future, new eScience techniques will enable the numerical models developed by different institutions and running on different machines to exchange information; Grid technologies will allow models to be updated with real-time measurements and allow a more complete quasi-real-time picture of coastal processes and conditions to be built.

The Observatory, which provides integrated and coherent information about processes in the Bay will be crucial for strategic planning and initiatives, operational management, research and education, as well as for the dissemination of information to all interested parties and general public. However, the initial costs of setting up a comprehensive and integrated monitoring programme are relatively high and initial benefit to cost ratio quite low (Bradbury et al., 2002).

Hence, it makes sense to roll the activity out gradually, taking some time before the full proposed programme is in place. In the mean time, two smaller scale monitoring programmes using remote sensing techniques have been started, which are described in following section.

Current Examples

Earth Observation and GIS Methods for identifying channel dynamics in Morecambe Bay Lancaster City Council (LCC) in collaboration with British National Space Centre (BNSC), Remote Sensing Applications Consultants and Plymouth University tested the application of Earth Observation and GIS methods for identifying positions and time-dynamics of low-water channels in Morecambe Bay.



Figure 1: Argus video image taken from one of seven cameras in Cleveleys (courtesy Wyre Borough Council)

The aim was to assess whether these techniques can provide useful information, which than can be used to describe channel behaviour over several months and years. The ERDAS/Imagine based software was used to process satellite images obtained from both optical and radar (Synthetic Aperture Radar, SAR) sources. The accuracy of the methods used was validated by comparing derived information with field measurements.

It was found that the Lancaster Sound associated channel, as well as Cartmel and Yeoman's Wharf, have moved significantly between 2002 and 2004 (Greening et al., 2005). This study confirmed the high potential of using satellite images in monitoring the dynamics of larger areas over a period of several years.

Argus Video System at Cleveleys

The aim of this project is to assess the impact of the new seawall in Cleveleys on the adjacent beach morphology by using video imaging techniques (Figure 1). In order to assess the performance of the new defence structure on the adjacent shoreline, information on the current state of the system, the evolutionary changes induced by the new structure and the driving mechanisms behind these changes are needed.

The advantage of the 'Argus' system, developed by Coastal Imaging Lab at Oregon State University (Holman et al., 1993), is its high frequency and measurement resolution, as well as large spatial coverage. The area that can be monitored using such a video system can span several km in the long-shore and cross-shore.

Although the system was mainly used for research purposes in the past, it has started to have applications in coastal management (Wijnberg et al., 2002). To our knowledge, this is the first time that the system would be used in conjunction with a seawall, where there is a significant presence of wave reflection, beach scour processes and frequent overtopping.

A new robust analysis system will be developed to derive the coastal parameters (e.g. shoreline position, beach elevation) from the video images, which will be used for the assessment of the impact of the new sea-wall on the adjacent beach. In addition, the images will be used to assess any potential overtopping or scour development. The project is funded by the Wyre Borough Council and run by Lancaster University in collaboration with Delft Hydraulics.

In summary, this paper outlined the plans for a strategic monitoring programme for Morecambe Bay. The size and dynamic character of Morecambe Bay requires a coherent and integrated management to make sure that the future strategic decisions and management are supported with best available scientific evidence (DEFRA, 2002), thereby helping to maintain the good condition of the important marine sites in the Bay and its surrounding.

The information collected through the monitoring programme will provide the opportunity to develop an understanding of the way in which the marine environment in the Bay operates. Also, the size and dynamic character of the Bay offers the prospect of developing and testing new technologies, which can be applied for monitoring, data handling and computing elsewhere.

Acknowledgements

Mr Ron Eckersley from Lancaster City Council is gratefully acknowledged for initiating the programme and organising meetings to discuss these plans. A special thank you also goes to Mr Nigel Cross from Lancaster City Council for providing a copy of the report 'Implementation test on the application of Earth Observation and GIS methods for identifying positions and time-dynamics of low-water channels in Morecambe Bay' and to Dr Peter Vincent for his advice and help.

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Formby Point

Led by Andrew Brockbank, National Trust

At this site erosion averages about 4.5 metres per year. As a result, there is a need to relocate infrastructure such as the car park and coastal path. This site is also a good example of past problems of recreational pressure, which aerial photography images will be supplied to illustrate.



Ainsdale National Nature Reserve

Led by Alice Kimpton, English Nature

Ainsdale Sand Dunes National Nature Reserve is made up of 508 ha of beach, dune and pinewood habitat. The sand dune habitat is especially important as it is rare in Britain and provides a home for important populations of natterjack toads, sand lizards, over 460 flowering plants and a wide range of invertebrates.

The pine woodland was planted behind the dunes between 1890 and 1940, and has a good population of red squirrels. The sand dunes are now being squeezed between an eroding coastline and the pine woodland. In order to maintain the sand dune habitat tree removal in frontal area of the pinewood is necessary.

Areas of the frontal woodland were felled in 1992 and 1996. The change has been dramatic with nationally rare plants such as seaside centaury and yellow bartsia appearing in the restored areas and real improvements for natterjack toad and sand lizard populations.

There has been some public concern over removal of areas of the pine woodland due to the red squirrel population, potential loss of shelter and coastal defence and a significant change in local landscape.



An Environmental Impact Assessment was carried out in 2004 and concluded that partial or complete felling the proposed area of the frontal woodland would produce significant gains of internationally important habitats and species and suggested that small pockets of the frontal woodland could be left to reduce the landscape impact. It also emphasised the importance of working closely with other partners along the coast.

Much work is being carried out by English Nature to increase understanding of the issues involved. A real difference can be seen in the restored areas of sand dune.

Sefton Green Beach

Led by Rachel Northover, Sefton Council's Coast and Countryside Service

This site illustrates the coast's response to a change in management practice. When cars were restricted there was a rapid change in the foreshore area with sand dunes forming to the seaward in front of an area of saltmarsh. The saltmarsh is considered to be transitional and is expected to form a slack as the dunes develop seaward.



Walking tour of hard coastal defences at Southport

Led by Graham Lymbery, Sefton Council

This walk took in some of the historic development of the town since its formation and illustrated the scale of land reclamation that has been undertaken. It looked at the latest coastal defences and the influence they have had in relation to the development of the seafront.



Visit to 'Another Place' coastal art installation Led by Caroline Salthouse, North West Coastal Forum Secretariat

'Another Place' is an art installation at Crosby Beach, Sefton, by sculptor Antony Gormley. The installation takes the form of 100 identical cast iron figures which life-sized and are evenly spaced, looking out to sea, along three km of shore and up to one km out to sea.

Each figure, cast from the artist's body, weighs 650 kg. The installation is in place until November 2006 and this is the first time it has been exhibited in the UK and the first time it has been exhibited in a truly coastal location. It has previously been seen in Cuxhaven in Germany, Stavanger in Norway and De Panne in Belgium and will move to New York after November 2006.

According to Antony Gormley, Another Place harnesses the ebb and flow of the tide to explore man's relationship with nature. He explains: 'The seaside is a good place to do this. Here time is tested by tide, architecture by the elements and the prevalence of sky seems to question the earth's substance. In this work human life is tested against planetary time. This sculpture exposes to light and time the nakedness of a particular and peculiar body. It is no hero, no ideal, just the industrially reproduced body of a middle-aged man trying to remain standing and trying to breathe, facing a horizon busy with ships moving materials and manufactured things around the planet.'

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Please note - Crosby beach is a non-bathing beach with areas of soft sand and mud and a risk of changing tides. Visitors should stay within 50 metres of the promenade at all tides and not attempt to walk out to the furthest figures.

The artwork was brought to the area by South Sefton Development Trust with funding from Mersey Waterfront, the Mersey Docks and Harbour Company and the Arts Council.

For further information see www.southsefton.co.uk/html/spotlight.htm



Study Visit to the Coastal Resorts of Blackpool and Morecambe

Walking tour of Blackpool South Shore coastal defences and art work Led by Mike Pomfret, Blackpool Borough Council

The sea wall and promenade at Blackpool's South Shore was in need of extensive work to reduce the increasing risk of flooding to adjacent properties.

A new sea wall, 1.96 km in length, with a re-curve profile was constructed, fronted by a 'Sea-bee' revetment. The promenade was designed on a split level, providing a secondary defence wall and an area for overtopping waves to disperse safely. 35,000 tonnes of demolition material was reused on the site.

On the landward side of the promenade a landscaped embankment planted with around 5,000 shrubs softens the works, providing a pleasanter outlook for properties fronting the promenade, which had their sea views substantially reduced by the new works.

Pieces of artwork such as the world's biggest mirror ball are being installed along the promenade as part of 'The Great Promenade Show' and use has also been made of coloured concrete finishes to the promenade surface and textured finishes to the sea walls to add further aesthetic appeal. Shelters along Blackpool's promenade have always been an important and useful feature in the scenery, so a series of architectural shelters are being constructed.

The final cost of the scheme is approximately £24.5 million, including contributions from Defra (Department for Food, Environment and Rural Affairs), Blackpool Borough Council, the Single Regeneration Budget and The New South Promenade Hospitality Group.

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The Scheme was highly commended in the Institution of Civil Engineers North West Merit Awards and received a Bronze Certificate from the Considerate Constructors Scheme.



The Tern Project, Morecambe Led by Ged McAllister, Lancaster City Council

The Tern Project is a major programme of public art which has been woven into the reconstruction of the sea defences along Morecambe's promenade and into the redevelopment of the town centre. The programme arose through the recognition that the sea defence and town centre proposals offered the opportunity to create a major environmental initiative. This was to be aimed not only at improving the resort's appearance, but also the image that it presented to visitors and to the kind of tourist destination that the town might become over the next few years.

Problems and Opportunities

Morecambe was hugely popular from its Edwardian hey-day until the 1960s. The 1930s splendour of the Midland Hotel and other splendid buildings, now sadly faded and neglected, are reminders of this prosperity. However, by the late 1980s, with changing patterns of tourism meaning many British visitors choosing to holiday abroad, Morecambe, like many other UK seaside resorts, had become seriously run down. The traditional two-week holiday market disappeared, replaced by a reducing number of day or weekend visitors, oriented increasingly towards the elderly age groups.

Many hotels and guesthouses became redundant, reverting to cheap, shared accommodation for people attracted to the coast by the lure of seasonal employment and cheap housing. The results included rising unemployment, large numbers of multiple occupancy housing (MHOs), the reduction of visitors and the closure of many visitor facilities. The tourist heart of the resort was a huge area of railway land, which was almost entirely neglected, with limited services running into one platform of the listed but neglected station. The remaining Pier was underused and decaying and the Promenade Gardens were tired and dated.

Nature's intervention provided the catalyst for change - major storms caused extensive flooding and huge damage. The analysis of the courses of action available led to a huge programme to rebuild the resort's coastal defences, funded largely by the then Ministry of Agriculture, Fisheries and Food (MAFF).

As new coastal defences were being planned, a review identified the need for physical renewal and a new direction for the resort to replace the declining role as a traditional seaside holiday centre. The idea of a major environmental renaissance began to emerge, inspired by the magnificent natural arena of Morecambe Bay, its internationally important birdlife and its role in developing new forms of tourism.

To take the idea forward Lancaster City Council established a design team. It linked the local authorities (District and County), other agencies i.e. RSPB, English Nature, local businesses and the project team. The project team was multi-disciplinary and the project became a common interest that stimulated and united the efforts of a number of colleagues from different departments.

One of the first steps was appointing lead artist, Gordon Young. He led the process of identifying design ideas and commissioning the selected artworks. A series of main sites for public artworks was identified, then artists' briefs were prepared and artists' sketch books commissioned for each site. Each artist was appointed on the basis of the ideas in the sketchbook. In this process, the lead artist's knowledge, experience and contacts proved invaluable.

The redesigned promenade, the new outdoor arena and the Stone Jetty have provided in effect a major new street theatre, and the idea of festivals was very much in mind when the scheme was being designed. These are now a feature of Morecambe's tourism product, a response to the loss of the more traditional resort activities.

The challenge now is to use the inspiration from the programme to ensure that each new development in and around the town centre contributes to the continued improvement and development of the resort's



environment. These improvements have not just made Morecambe look better. They have brought interest and fun to visitors and to residents, young and old alike. They have helped to underpin a new approach to tourism in the resort, by providing indoor and outdoor stages for the performing arts and have gone some way at least to putting to rest the old music hall jokes about Morecambe.

There remain many other important challenges for the resort. The Midland Hotel was in a bad state, but is currently being redeveloped. The Winter Gardens Theatre, a 2,000 seat structure on the Promenade, has been successfully restored externally, but needs a new use and a complete internal restoration. Both buildings are listed, and both lie in key locations in relation to the Tern programme. Their survival is fundamental to the continued regeneration of the resort.

Lancaster City Council has recently secured a Townscape Heritage Initiative for the town centre area, which will bring significant grant assistance for conservation work, and should help in the continued efforts to rescue important features. The Council will now, with its partners, be looking at all new development proposals for the town, whether large or small, to see how they can contribute to the continued upgrading and enhancement of the environment, and to the regeneration of the resort.

For more information see www.tern.org.uk/about.htm and the Tern case study on the CABI (Commission for Architecture and the Built Environment) website at www.cabi.org.uk/library/casestudy.asp?id=193

Visit to Hilbre Island **Led by Diane Bennett, Wirral Ranger Service**

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Hilbre is a small sandstone island in the mouth of the Dee Estuary on the North West coast. It is a Local Nature Reserve with significant biodiversity and local heritage assets. It is accessible only at low tide. This visit comprised a walking tour of the island and its smaller neighbours and discussed various aspects of coastal erosion and accretion and how they might affect future management of the islands.





Jeff Lang

**Chairman, North West Coastal Forum
Chief Operating Officer, Wastewater Treatment, Unites Utilities**

Jeff Lang is the Chief Operating Officer Wastewater at United Utilities (UU) and was appointed Chairman of the NWCF in March this year. He is responsible for 600 wastewater treatment works and 40,000 km of sewer network. Jeff is a Chartered Engineer and Chartered Environmentalist. He is a fellow of CIWEM and has an MBA and a BSc Hons in Gas Engineering (a hybrid of Chemical and Civil Engineering).

Jeff joined UU in November 2002 as Asset Management Director and in March 2003 became Asset Operations and Maintenance Director, before moving to his present role in September 2004. Prior to working for UU Jeff was employed by Transco and worked throughout the UK on the gas network. Married with four children and two grandchildren, Jeff has recently taken up golf as his knee no longer enables him to play tennis or football.



Caroline Salthouse

**North West Coastal Forum Secretariat
Regional Coastal Project Officer, North West Regional Assembly**

Caroline Salthouse is the Regional Coastal Project Officer for the North West Regional Assembly. She has provided the Secretariat for the North West Coastal Forum since 2003 and has extensive experience of coastal issues in the North West, gained at both local and strategic levels. She was previously the Manager of the Mersey Strategy, a local coastal partnership, which was part of the Mersey Basin Campaign and has taken an active part in several European projects funded by Interreg including Sustainable Port Cities and CoPraNet. In addition to her work for the North West Coastal Forum she is currently involved in developing coastal policies for Regional Spatial Strategy.



Graham Lymberry

**Project Leader for Coastal Defence, Sefton Council
Chairman of Coastal Cell 11 Working Party**

Graham Lymberry trained as a Civil Engineer at Liverpool University and on completion of a degree and MSc went to work for Sefton Metropolitan Borough Council. Within a short space of time he had drifted onto the coastal defence side of things and found a niche in which he was very happy. Initial experience related to the construction of the Seawall at Southport; subsequent experience relates more to the understanding of coastal processes and prediction of future coastal evolution. Graham has experience of working in Coastal Partnerships both at the local (Sefton) level and the regional (North West and North Wales) level and has recently been involved in the development of a Regional Monitoring Strategy working with other Partners throughout the area. He has also recently completed an MSc in Management and so occasionally lapses into talking complete gobbledegook.



Adam Hosking
Senior Coastal Scientist, Halcrow Group Ltd

Adam is a Senior Coastal Scientist with the Halcrow Group. He took his first degree at Portsmouth University, then an MSc in Coastal Zone Management at Bournemouth University. Adam has been with Halcrow for 10 years, involved primarily with flood and coastal defence management planning, through Shoreline Management Plans and Coastal Strategy Plans. He has also managed projects looking at the impacts of climate change on the English Channel coast and a habitat management study for the Lune Estuary, in Morecambe Bay. Adam was a key member of the Halcrow team on the Futurecoast Study. He has managed the recent review of the Beachy Head to South Foreland SMP, and the Development of Procedural Guidance for SMPs. The experiences from the SMP review and the procedural guidance are the subject of his presentation.



Alan Williams
Managing Director, Coastal Engineering UK Ltd

Alan Williams is a Chartered Civil Engineer and is the Managing Director of Coastal Engineering UK Ltd, a consultancy he established in 1999 to provide specialist advice and assistance in the field of coastal and maritime engineering to a wide range of clients – public authorities, consultants, contractors, developers, etc. He has over 25 years post-graduate experience in the field of Coastal & Maritime Engineering. Born on the Wirral, Alan has spent the majority of his working life involved with coastal engineering and associated work in and around the coasts of the United Kingdom and has been involved with coastal matters on the Sefton shoreline since 1987. For the first 10 years of his career he worked in the Coast Protection section of the Wirral Borough Council before moving into private practice.

He has extensive knowledge of the behaviour of coastal processes, particularly in and around Liverpool Bay and in the eastern Irish Sea having worked on numerous coastal projects from the Llyn Peninsula in North Wales to the Solway Firth. He has over 15 years particular experience of coastal defence assessments, coastal monitoring and analysis, preparation of studies, coastal strategies and Shoreline Management Plans. He is actively involved in the provision of specialist consultancy services for a number of Maritime District Councils in the northwest of England and Wales and has been providing specialist coastal engineering advice and professional services to Sefton Council since 2000. He is currently retained to carry out annual inspections of coastal defence assets and reviews of coastal process behaviour. Since 2003 he has been responsible for development, on behalf of the Coastal Groups of the Cell 11 Regional Monitoring Strategy (CERMS) from the Great Orme, Llandudno to Solway Firth.



Phil Knight
Data Scientist, Proudman Oceanographic Laboratories

Philip Knight graduated from the University of Lancaster in 1985 with a degree in Environmental Sciences. He joined the Proudman Oceanographic Laboratory (part of the Natural Environment Research Council) as a Data Scientist in 1986. Since then he has taken part in a number of large NERC projects, by collecting and analysing marine data. Within the last three years he has been involved in the Coastal Observatory project, which includes measuring a wide variety of parameters in real-time, as well as in 'delayed mode', to critically test oceanographic computer models and to display data and forecasts on the Internet.



Dr Tim Stojanovic
Research Associate, University of Cardiff

Dr Tim Stojanovic is a Research Associate of the School of Earth, Ocean and Planetary Sciences, Cardiff University. He gained his PhD from Cardiff Business School with a study of Integrated Coastal Management in England and Wales. His research interests include environmental management, information science and the coastal environment, and he has conducted research projects with maritime partners in these fields as a member of the Marine and Coastal Environment Research group (MACE) at Cardiff University. He is presently working within the EU Interreg COREPOINT North West European Research programme. With a team of academics and practitioners he is responsible for the development of a series of Local Information Systems at the coast. He has extensive experience of working on a number of coastal projects including EUROSION DG Environment Project, COASTATLANITC, ECOPORTS DG Transport and Energy Project, the Wales Coastal and Maritime Partnership and the Severn Estuary Partnership, UK.



Dr Nick Rosser
Senior Research Associate, University of Durham

Nick is a senior research associate at the Geography Department, Durham University, specialising in innovative terrestrial and space borne remote sensing techniques for the analysis of ground deformation. Nick's PhD research examined the long-term evolution of hyper-arid rock deserts using a combination of low altitude digital image analysis and field experiments to characterise the relationship between ground surface form, geological age and landscape evolution in Jordan. More recently techniques have been developed and applied for examining rates and processes acting upon steep unstable slopes working within the International Landslide Research Centre at Durham. A particular emphasis examines the interface between engineered structures, for example dams and highways, and natural slope instability problems and remediation. Work in the UK focuses on coastal cliff stability developing terrestrial laser scanning and satellite interferometry for quantifying changes to the ground surface and in particular approaches for predicting slope failure.



Professor Robert Devoy
Associate Professor, University College Cork

Born in a seaside town and growing up on a small island, not surprisingly Robert has long been drawn to things of the coast and sea: a youth misspent in beachcombing. Graduating in the 1970s from the universities of Durham and Cambridge (UK), his long-term interests in physical geography and the earth environment reflects this attraction to coasts. His early research centred on London and the coasts of southern England, with PhD work on the analysis of sea-level changes and land subsidence in the Thames Estuary. Aspects of these studies also included the environmental reconstruction of ancient coasts and the vegetational history of the region.

Moving to Cork in 1977 this coastal-based research has continued in Ireland and also more widely in the eastern USA, in Atlantic Europe from Scandinavia and the Baltic to Mediterranean Spain, Australia, Tahiti and New Zealand. This work has led to the publication of research papers and books on many aspects of sea-level changes, ancient shorelines and coastal processes, on the development of landbridges and their use in plant and animal migration, marine science and of coastal management. More recently, people's concerns for the repercussions of climate change and sea-level rise have resulted in work on the prediction, through numerical modelling, of the impacts of changes in storminess patterns on European Atlantic coasts. Coastal erosion, wave, sediment and water dynamics on the south coasts of Ireland, together with work on tsunamis in New Zealand are topics of current research.

In 1993 this coastal research led to the founding of the Coastal Resources Centre in UCC, now the Coastal and Marine Resources Centre (CMRC), of which Robert was Director until 2001. Activities in the CMRC have involved many different types of marine-related work at both research and commercial levels. Physical geography is as much about people as it is about the analysis of environmental functioning. An aim of studying the Earth environment is to provide better knowledge of how it operates, enabling people to find improved ways of living and working in the environment. Communicating the results of environmental research has been an important part, therefore, of Robert's contribution to helping promote this aim. This has led to regular newspaper, TV and film coverage of coastal management, sea-level and related climate change topics. Community based work also includes the development of university courses in Environmental Studies and in the diploma in Environmental Science and Social Policy. More recently this work has expanded to include people's interests in relationships between beliefs, God and the environment, through talks on Faith and Science.



Professor Ken Pye
Director, Kenneth Pye Associates Ltd
Visiting Professor, Royal Holloway University of London

Ken Pye is currently Director of Kenneth Pye Associate Ltd and Visiting Professor at the Department of Geology, Royal Holloway University of London. He completed his PhD in coastal geomorphology at Cambridge University in 1980 and subsequently held academic appointments at the Universities of Cambridge (1980-88), Reading (1989-99), and London (1999-2004). His research interests include coastal and estuarine processes, sediment analysis and prediction of coastal morphological change in response to fluctuations in environmental forcing factors. He has undertaken research in numerous parts of the world and has worked on the Sefton coast for more than 25 years.



Dr Nigel Pontee
Senior Scientist, Halcrow Group Ltd

Nigel graduated from Bangor University in Wales in 1990 with a 1st class honours degree in 'Geological Oceanography'. He then went on to complete an MSc in 'Sedimentology' at the University of Reading, during which he carried out a research project on saltmarsh processes. Nigel then undertook a PhD, also at Reading, relating to 'the morphodynamics mixed beaches'. Following this, he spent 18 months in France researching the Holocene evolution of saltmarshes and dune systems. Nigel joined Halcrow in October 2003 and over the past 3.5 years has worked on over 25 projects for habitat creation schemes within estuaries around the UK. These have involved:

- Regional studies to locate suitable realignment sites and provide outline designs
- Detailed design work as compensation for port related projects
- Analysis of the local and estuary wide impacts of these schemes as part of Environmental Impact Assessments
- Government funded research to define generic guidance for the monitoring of managed realignment sites in the UK
- Government funded research project to define generic guidance for the selection of managed realignment sites in the UK
- National guidance for the design of managed realignment sites in the UK
- International guidance for wetland restoration



Dr Steven Glynn
Sustainability Northwest

Steven's work at Sustainability Northwest focuses on climate change. He manages the Defra, Northwest Regional Development Agency and Environment Agency funded project, 'Climate Change and the Visitor Economy in England's Northwest'. He is also co-ordinator of the Northwest Climate Group, a partnership of public, private and non-governmental organisations that aims to ensure that climate change becomes a central consideration in all decision-making processes in the region.



Dr Travis Mason
Channel Coast Observatory

Travis has been at the Channel Coast Observatory since its inception in late 2002. She is involved with the overall data management of the Regional Monitoring Programme as well as the analysis techniques for the data. Her main role, however, is to manage the new waves and tides network, which comprises 6 directional WaveRider buoys, supplemented by several inshore wave and tide measuring stations and some meteorological stations. Previously, she was a senior lecturer in oceanography, meteorology and underwater acoustics at Britannia Royal Naval College, Dartmouth. This followed two years as a Research Fellow in the School of Civil and Structural Engineering, University of Plymouth, on the EU-funded COAST3D project. Her research area is shallow water hydrodynamics and sediment transport on mixed beaches, together with groundwater flow through beaches.



Professor William Ritchie
Aberdeen Institute for Coastal Science & Management (AICSM)

Professor Ritchie returned to Aberdeen University in 2002 from being the Vice-Chancellor of Lancaster University so he knows the North West well. His main research area is sand dunes, and he spent between three and four years predicting hurricane impact on coastal Louisiana whilst in Baton Rouge. He is also a Professor at the World Maritime University, Malmö. He is currently engaged with long-term monitoring especially for the oil industry and is based at the Aberdeen Institute of Coastal Science and Management, University of Aberdeen.



Rachel Northover
Principal Coast & Countryside Officer, Sefton Council

For the last four years Rachel has been the Principal Coast & Countryside Officer for Sefton Council, responsible for the day to day management of the Coast and Countryside Service, including 30 staff (up to 70 in the summer), volunteers, and site management – both habitats and visitors. She has a degree in Geography and Botany from Liverpool University and Post-graduate Diplomas in Countryside Management (Manchester Metropolitan University) and Ecology and Environmental Management (Liverpool Hope University). She worked as a Ranger and in Parks Development with Knowsley MBC for 11 years prior to joining Sefton.



Andrew Brockbank
Countryside Property Manager, National Trust

Andrew is employed by the National Trust as a Countryside Property Manager looking after their coast and countryside sites in Merseyside. He has over 20 years experience working in local authority warden and ranger services. Andrew currently chairs the Access and Interpretation Task Group of the Sefton Coast Partnership and is a member of the Cheshire and Cumbria Wildlife Trusts, the RSPB and the Wildfowl and Wetland Trust.



Alice Kimpton
Site Manager, Ainsdale Sand Dunes and Cabin Hill NNR

Alice is the Site Manager of Ainsdale Sand Dunes and Cabin Hill National Nature Reserve (NNR) and is responsible for managing all aspects of Ainsdale Sand Dunes and Cabin Hill NNRs within the context of the Sefton Coast. She has worked on the Sefton Coast on and off since 1989 and became Site Manager at the NNR in 2004.



Dr Suzana Ilic
Lecturer in Physical Geography, University of Lancaster

Suzana has a BSc Civil Engineering (Rijeka, Croatia), an MSc in Hydraulic Engineering (IHE, Delft, The Netherlands), and a PhD Coastal Engineering (Plymouth, UK).

Since September 1999 she has worked as Lecturer in Physical Geography in the Geography Department at Lancaster University. Between 1993 and 1999 she worked on two EPSRC funded projects studying offshore breakwaters at the University of Plymouth. She has published several papers related to this topic. Her main research interest continues to be in the field of coastal processes, namely the understanding of nearshore processes on complex bathymetries and in the vicinity of structures, and their impact on the shoreline using field and laboratory measurements and numerical models. Her work includes the validation of the existing numerical models, which can then be used as a generic tool for designing and planning coastal schemes. Supported by an EPSRC Fast Stream grant, she has recently completed the development of finite-volume numerical models for the prediction of nearshore circulation.



Ged McAllister BSc., C.Eng., MICE
Senior Engineer, Lancaster City Council

Ged is a Senior Engineer at Lancaster City Council and a trustee of the Morecambe Bay Partnership. He joined Lancaster City Council in late 1983 to head the Derelict Land Team, carrying out varying types of reclamation and development schemes including demolition of redundant factories and a power station; new roads and infrastructure; asbestos removal; pollution remediation; and the design and construction of an artificial sports pitch and an athletics track. In the late 1980's he started to get involved in Morecambe Coastal Works and since then has been responsible for the five completed breakwater and rock armour coastal defence schemes along the Morecambe frontage. He has also been responsible for the infrastructure works around the Supermarket / Festival Market area at Morecambe including the construction of the new dual carriageway, Central Drive, and demolition of various redundant buildings including a cinema; a dolphinarium; the old railway station platforms and a garage dealership. With the development of the Tern Project Ged became the engineer on the team, which included artists, ; graphic designers; planners and landscape architects and I have been responsible for the construction side of the project. The Tern project was also integrated with Phases 4 & 5 of the Morecambe Coastal Works. He is currently working on the Phases 6 & 7 of Morecambe Coastal Works, which are planned to commence construction later this year.

Appendix A The Programme

Tuesday 6th September

Morning

Set aside for delegate arrival, Corepoint and North West Coastal Forum meetings

Afternoon

14:00 Registration and coffee

14:30 Formal welcome

Jeff Lang, Chairman, North West Coastal Forum

Session 1: Setting the context for coastal defence

14:40 Introduction to CoPraNet

Caroline Salthouse, North West Coastal Forum Secretariat

14:55 Coastal change, planning and ICZM – setting the context

Graham Lymbery, Sefton Council

15:40 Break

16:10 Briefing on the UK Shoreline Management Planning System

Adam Hosking, Halcrow Group Ltd

16:50 Wrap-up discussion

17:15 Close

Evening

19:30 Civic Welcome

The Worshipful The Mayor of the Metropolitan Borough of Sefton, Councillor John F Walker

19:45 Conference Dinner (advance booking via North West Coastal Forum required)

Wednesday 7th September

Morning

Session 2: Monitoring for coastal change

09:30 Registration and coffee

10:00 Welcome

10:05 Monitoring on the Sefton Coast

Alan Williams, Coastal Engineering UK Ltd

10:40 Real time data collection and analysis – the Liverpool Bay Coastal Observatory

Phil Knight, Proudman Oceanographic Laboratories

11:15 Break

11:45 Principles for managing information

Dr Tim Stojanovic, University of Cardiff

12:20 COBRA (COastal Behaviour and Rates of Activity) on the North Yorkshire Coast

Dr Nick Rosser, University of Durham

12:50 Wrap-up discussion

13:00 Lunch

	Afternoon
	Session 3: Human issues and climate change
14:00	Climate change and erosion in Ireland Robert Devoy, University College Cork
14:35	Future implications of climate change on sand dunes Professor Ken Pye, Kenneth Pye Associates Ltd
15:10	Break
15:40	Managed realignment: a design study from the Ribble Estuary Nigel Pontee, Halcrow Group Ltd
16:15	Climate Change and the Visitor Economy Dr Steven Glynn, Sustainability Northwest
16:50	Wrap-up discussion
17:15	Close

Thursday 8th September

Morning

Session 4: Examples from around Europe

9:30	Registration and coffee
10:00	Welcome
10:05	Corepoint Project – the Decision Support System Graham Lymbery, Sefton Council and CoPraNet partner
10:25	Measurement of coastal erosion in dunes Professor William Ritchie, University of Aberdeen and CoPraNet partner
11:00	Break
11:30	The Channel Coast Observatory Dr Travis Mason, Channel Coast Observatory
12:05	CoPraNet in the UK Caroline Salthouse, North West Coastal Forum Secretariat
12:15	Wrap-up discussion
12:30	Lunch

Afternoon

Session 5: Field Visit – Coastal Change on a Soft Coast

13:30	Board bus for travel to Sefton coast
14:00	Walking tour of soft coast, meeting: Sefton Green Beach Rachel Northover, Sefton Council's Coast and Countryside Service Ainsdale National Nature Reserve Alice Kimpton, English Nature Formby Point Andrew Brockbank, National Trust
16:30	Walking tour of hard coastal defences at Southport Graham Lymbery, Sefton Council
18:00	Arrive back at hotel

Friday 9th September

Full day

Session 6 Field visit to the Coastal Resorts of Blackpool and Morecambe

9:00	Board bus for travel to Blackpool
10:15	Walking tour of Blackpool South Shore coastal defences Mike Pomfret, Blackpool Borough Council
10:45	Arrive Solaris Centre, Refreshment Break
11:15	Blackpool's coastal defences and the Resort Master Plan Mike Pomfret, Blackpool Borough Council
11:45	Morecambe Bay Coastal Observatory Dr Suzana Ilic, University of Lancaster
12:15	The Tern Project, Morecambe Ged McAllister, Lancaster City Council
12:45	Lunch
13:45	Board bus for travel to Morecambe
14:45	Walking tour of Morecambe coastal defences and the Tern Project Ged McAllister, Lancaster City Council
15:45	Board bus for travel to Southport
18:00	Arrive back at hotel

Saturday 10th September

Morning

8:30	Board bus for travel to West Kirby
9:30	Walking tour of Hilbre Island Diane Bennett, Wirral Borough Council Ranger Service
12:30	Board bus for travel to Crosby
13:15	'Another Place' – visit to Antony Gormley art installation on Crosby Beach (time permitting)
13:35	Board bus for return to Southport
14:00	Arrive back at hotel

Appendix B

Planning, Implementation and Monitoring of Coastal Defences Field visit to the Sefton Coast, Thursday 8th September

What is CoPraNet?

The Coastal Practice Network is a three year - Interreg IIC project to help establish a coastal practitioners network and bridge the gap between planners, managers and the research community throughout Europe. It has been set up to develop and exchange information on best practice in the coastal zone on the issues of sustainable tourism and coastal erosion and beach management. The network will serve to equalise the differences in regional coastal development by bringing together Priority 1 and 2 partners in a partnership embracing research, advisory and implementing organisations.

What are the project's objectives?

CoPraNet has two primary objectives:

1. To develop a network of coastal stakeholders to exchange information and examples of best practice which will support local and regional efforts for an integrated planning of coastal areas. This network must bridge the gap between planners, managers and the research community throughout Europe.
2. To support interregional exchange of best practice information on (a) sustainable tourism and (b) coastal erosion and beach management through an integrated approach.

Aims of the Sefton workshop

- to examine key issues for the sustainable management of coastal erosion and flood defence using examples from the North West of England as a basis for discussion
- to review the national, regional, sub-regional and local approaches to monitoring for coastal erosion within the wider context of ICZM
- to demonstrate differing approaches to coastal defence and their implications for sustainable use and management of the coast
- to consider the type of research that needs to be undertaken in order to better inform coastal management

Introduction to the Sefton Coast

The Sefton coast, which extends over 36 kilometres (21 miles), comprises soft and granular estuary deposits of sand, silt, clay and peat. There are no outcrops of rock on the shoreline. Hence, the forces of nature readily mould the coastline and as a result it is constantly changing in response to the fluctuating influence of wind and water, and as a result of human activity. Its overall shape derives from two major river estuaries, the Mersey and the Ribble.

The sand dunes, beaches and marshes of the Sefton Coast are one of the most important areas for nature conservation in Europe. The coast is also an important visitor destination with popular bathing beaches, open countryside, and the seaside resort of Southport.

The local authority, government agencies, landowners and community groups have formed the Sefton Coast Partnership for the sustainable management of the coastal zone.

Site visit to Ainsdale National Nature Reserve and National Trust at Formby

The site visit will take in two sites experiencing coastal erosion but with different pressures and management responses. The group will be split into two with one group doing the reverse route. Approx 3 hours (at a leisurely pace). Bus departs from Price of Wales Hotel at 13:30 and returns at 16:30.

Please wear sensible clothing and footwear as we are visiting exposed sites with unstable surfaces underfoot.

Ainsdale Sand Dunes NNR

Because of the erosion being experienced in this area the dunes are receding towards woodland that was planted approximately 100 years ago. The trees were planted at a time when there had been accretion and wind blown sand was a problem. Whilst marram planting was used to control wind blown sand in the frontal dunes it was not effective in the rear areas where trees were planted to control the sand. An area has been cleared to enable restoration of the sand dune habitat due to concerns over maintaining continuity of the sand dune habitat.

It should be noted that there is significant public concern over this approach to management.

National Trust at Formby Point

At this site erosion averages about 4.5 metres per year, as a result of this there is a need to relocate infrastructure such as the car park and coastal path. This site is also a good example of past problems of recreational pressure for which aerial photography images will be supplied to illustrate.

Additional visit to Smith's Slack on Birkdale Beach and a walking tour of the hard coastal defences at Southport.

For those of you still keen for more the bus will drop you off at Weld Road for a talk about the development of Smith's Slack and then a stroll along the hard coastal defences ending up back at your hotel. Approx 1 hour.

Smith's Slack

This site illustrates the coasts response to a change in management practice. When cars were restricted there was a rapid change in the foreshore area with sand dunes forming to the seaward in front of an area of saltmarsh. The saltmarsh is considered to be transitional and is expected to form a slack as the dunes develop seaward.

Southport's Coastal Defences

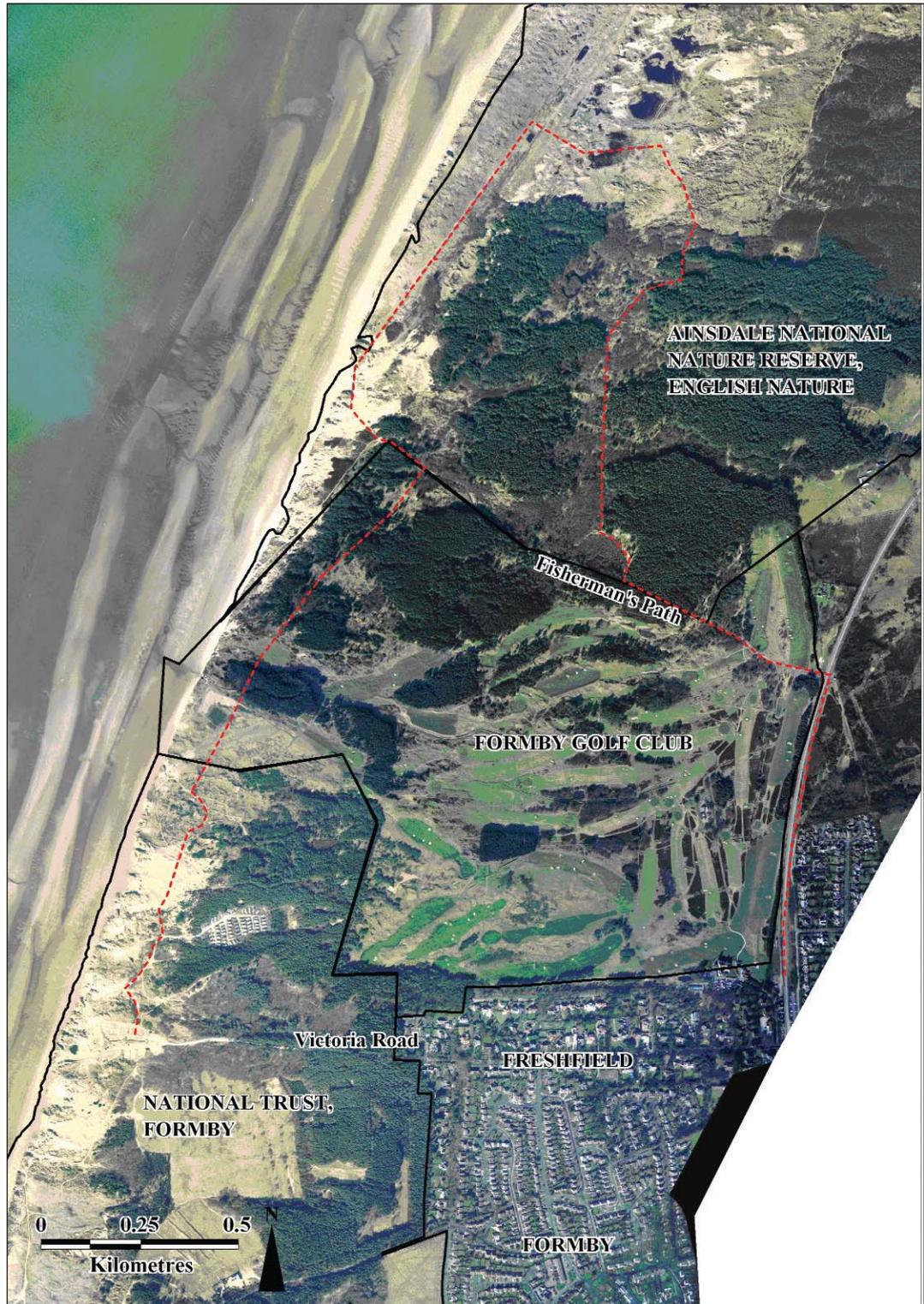
This walk will take in some of the historic development of the town since its formation and illustrate the scale of land reclamation that has been undertaken. It will then look at the latest coastal defences and the influence they have had in relation to the development of the seafront.

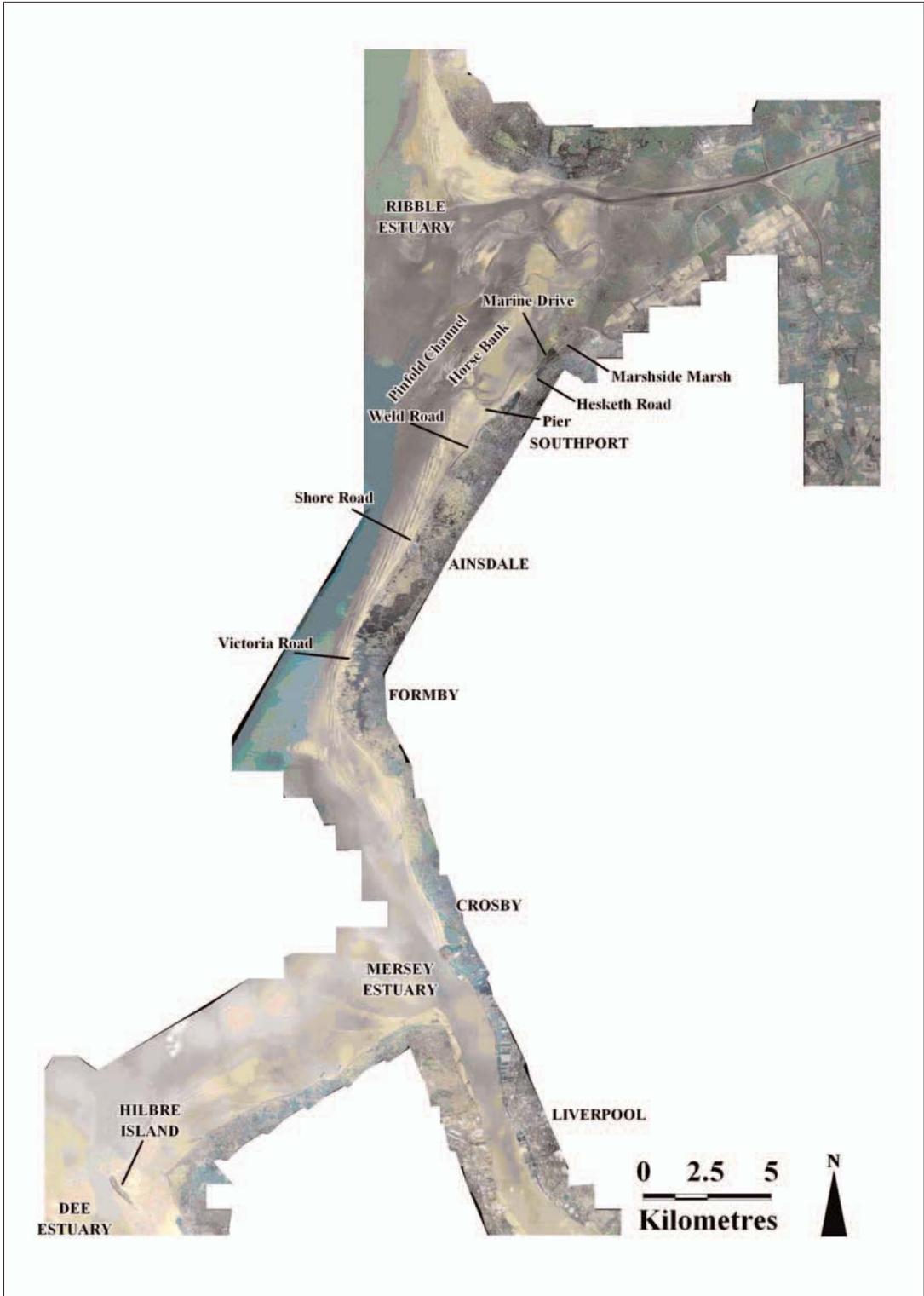
For Further Information, Contact:

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Southport History

Southport was built on reclaimed land that was once within the Ribble Estuary. "South Port" was developed as a bathing resort in the early 19th century. Hotels were built near the sea and in 1835 a promenade and sea wall were built.

As the sea receded further it was relatively easy to excavate the first Marine Lake and later, in 1895, to enclose its seaward edge with a Marine Drive. The Marine Lake of 1887 did not extend beyond the Pier (1860) but was such a success that a further lake and park were joined in 1895. In the 1960s the lake was again extended north to Fairway.

Marine Drive was then extended north to Crossens in stages, on top of an embankment enclosing the extended Marine Lake and on sea embankments around the edges of Marshside Marsh.

Until 1998, the central part of Marine Drive was still at its original low level and was frequently closed during periods of high tides. Flooding during severe storm surges damaged the road and funfair. A new sea wall and promenade, completed in 2002, removed the need for road closures and facilitated the re-development of the seafront.

Site Description

The Southport foreshore varies in character from the sandy beaches south of the Pier to the Ribble Marshes north of Marshside Road. The coastline north of Weld Road, Birkdale, may be considered as part of the Ribble Estuary as the foreshore widens and flattens, the ridges and runnels begin to decay and mud deposition is progressively more apparent.

The sea embankments north of Hesketh Road have saltmarsh in front of them. Coastal process conditions across the northern section of this area were changed in the 1970's when the marsh land was reclaimed and the coastal road with sloping artificial defences was built along this length.

About 2km from the coastline and parallel with it, lies the Horse Bank. This is a broad-crested bank, composed of clean sand on its steeper seaward slope, which falls into the Pinfold Channel.

Formby to Ainsdale History

The recorded information available indicates a period of accretion in the 19th century followed by erosion in the 20th. Since the turn of the 20th century the action of coastal erosion in this section has blunted the northern apex of Formby Point. By the end of the 20th century the change between accretion and erosion fluctuates between Fisherman's Path and the Freshfield/Ainsdale boundary. Thus a straighter coastline replaced the more angular form that existed in the early 20th century.

Dune restoration work was undertaken along the National Trust and the National Nature Reserve frontages. During the 1990's the policy changed from attempted dune reclamation to a more natural system of dynamic management.

Site Description

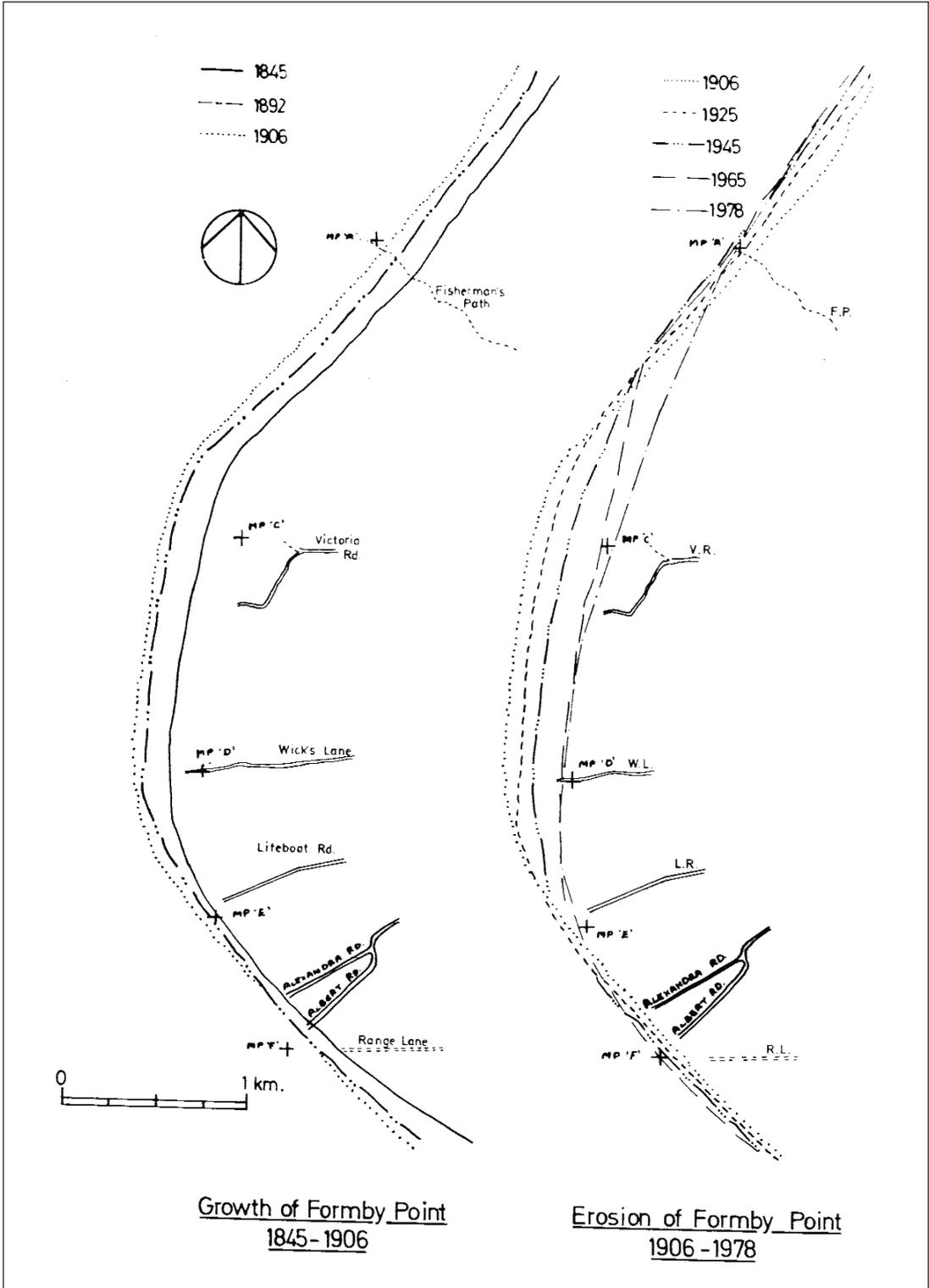
Sand dunes stretch the length of this section. The upper foreshore is relatively steep and generally dry. Hence, during periods of onshore winds, sand is readily transported into the dune system. The foreshore also has a well developed a ridge (crest) and runnel (trough) formation.

Victoria Road, Freshfield, is a main pedestrian entrance that has suffered from serious erosion due to these visitor pressures. Now a series of marked paths protect the frontal dunes from further damage.

Further north where the frontage is managed by the English Nature, public access is limited. However there are still pressures. There is an area of sand blow at Fisherman's Path, exacerbated by visitors to the Nature Reserve. Over-mature frontal coniferous woodlands were felled to compensate for the loss of rare coastal habitats to erosion.

The foreshore begins to widen north of Fisherman's Path and erosion becomes progressively less severe, giving way to dune accretion north of the Freshfield/Ainsdale boundary.

About one km north of Shore Road and continuing to Weld Road a new dune ridge has developed on the foreshore since the cessation of car parking about 12 years ago. The ridge has created an enclosed slack.



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