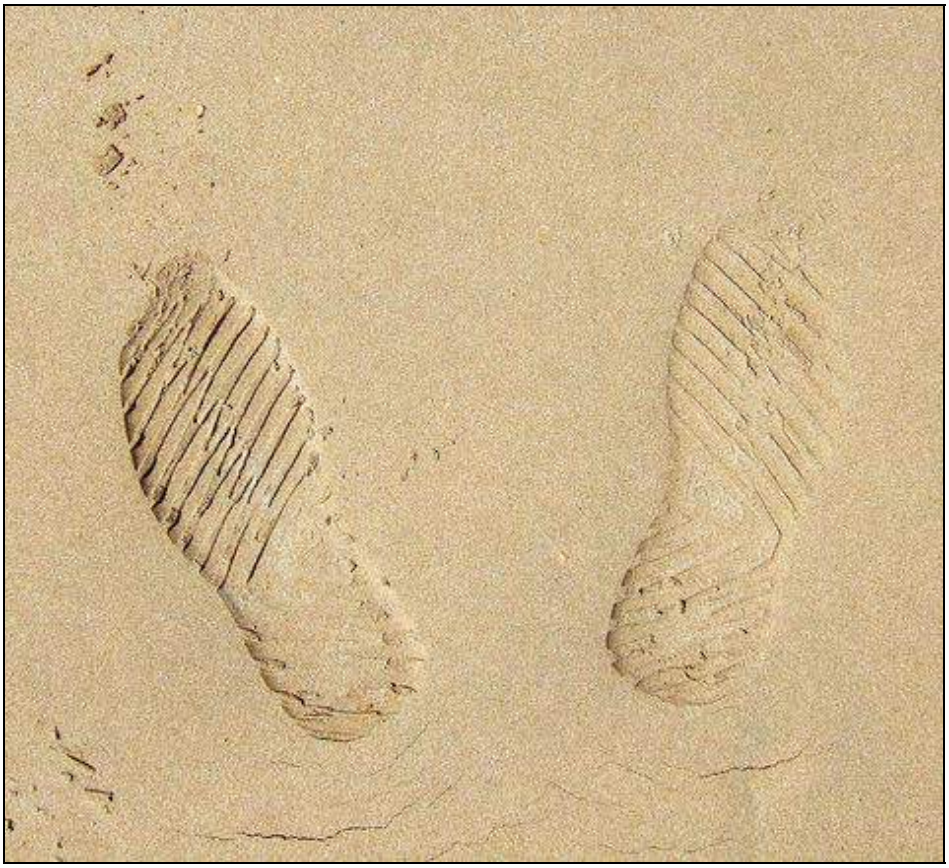
# Identifying Coastal Specific Vulnerabilities to Climate Change and Related Issues

## Original Process, Outputs, Lessons Learned

**October 2009**



## Contents PAGE

## Introduction

We need to increase our capacity to respond to the ecological, social and economic impacts of climate on the viability of coastal sectors such as fisheries and aquaculture, ports and shipping, marine recreation, and the defence of coastal communities from flooding and erosion. To date, most attention has been focused on predicting the types and rates of change likely to occur but what is needed now is a method to identify the adaptation measures that need to be applied to coastal use and management.

The IMCORE project aims to address this by developing a methodology and templates to aid Coastal Managers across NW Europe in developing the required options necessary to adapt to climate change. Because of the innovative approach of this project, scientists and practitioners involved in coastal management from Ireland, the UK, France, Belgium and the Netherlands will be working together as expert couplets. This is how local government authorities and research groups will work together to identify the key processes that lead to the socio-economic consequences of climate change of their local area, supported by a network of trans-national cooperation. Ways to address these consequences will be tested in real projects.

### Developing management options to adapt to climate change

While couplets are developing various activities at a local level, a variety of innovative approaches and methods will be researched, identified and developed by partners to demonstrate how they can be effective and useful to coastal managers and decision makers who need to visualise the future and plan how to respond to the changes happening on their coasts. For this purpose, options which will facilitate adaptive management will be developed, implemented and evaluated at each of the 9 couplet locations

Coastal managers and policy makers from across NW Europe will be mentored and assisted to plan responses to climate change scenarios through building capacity and online learning. The regional viability of our coastal communities and sectors will be improved by developing techniques for future planning.

## Purpose of the report:

The purpose this report is to set out an approach for the identification of coastal specific vulnerabilities to climate change. A key element of this is a workshop that describes and evaluates the main climate change impacts for the area being considered. This workshop is part of a series of workshops on adaptation to climate that will culminate in the development of an Adaptation Strategy.

The approach presented is based on the results from eight of the nine IMCORE case studies. These have been collated and analysed in an attempt to provide regional comparisons of vulnerabilities. The eight which are included are highlighted in bold.

The nine expert couplets of IMCORE are (Figure 1):

**Maritieme Dienstverlening en Kust (MDK) – Coastal division & Maritime Institute, University of Ghent (Belgium)**

**Cork County Council & Coastal and Marine Resource Centre, University College Cork (Ireland)**

**Donegal County Council & Centre of Coastal and Marine Research, University of Ulster (Northern Ireland)**

**Severn Estuary Partnership & Marine and Coastal Research Group, Cardiff University (Wales)**

Aberdeen City Council & Aberdeen Institute for Coastal Science and Management University Aberdeen (Scotland)

**SIAGM - Intermunicipal Syndicate for Planning in the Gulf of Morbhian & Centre for Maritime Lax and economyn University of Western Brittany (Brittany)**

**Durham Council & Envision, Newcastle University (UK)**

**Sefton Council & Edgehill University (UK)**

**Government Office (East of England), Colne Estuary Partnership & CoastNet (Essex) (UK)**

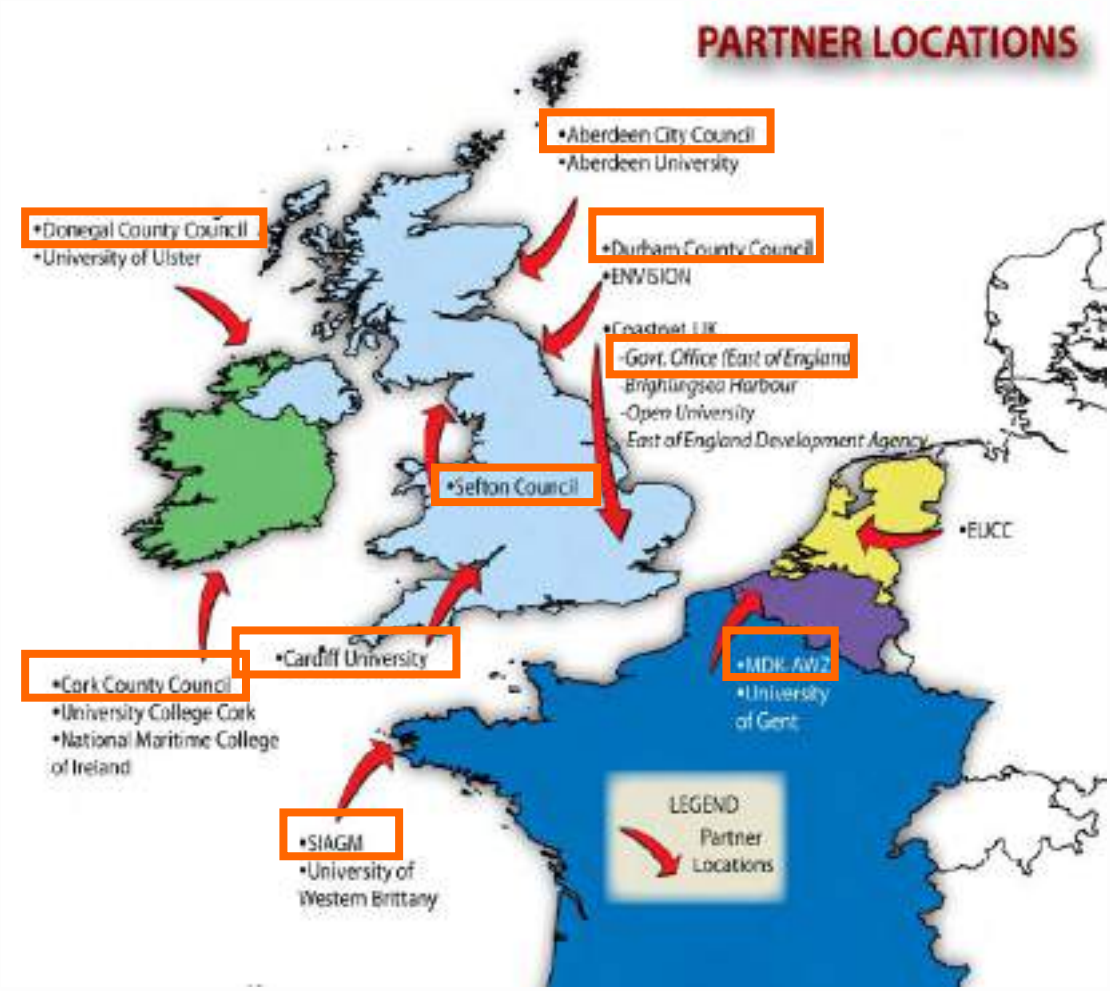



**Figure 1.** Locations of each of the nine IMCORE expert couplet areas.

## Original approach to the workshop

### IMCORE WP2.3: Stakeholder Driver and Issue Identification Workshops (based on the experience of Sefton and UBO)

### GUIDANCE NOTES FOR WORKSHOP 1

IMCORE involves a number of linked workshops that involve engagement with stakeholders. It is intended that a core group of workshop participants will be involved through the process and that some might even participate in the "training of trainers" course (WP 4.2). The first workshop (WP 2.3) is to take place at each of the nine study sites by the end of March 2009. Its purpose is to introduce the project, describe the main climate change drivers and impacts, and, together with the workshop participants, assess the implications for the study area. (The results will be collated and analysed to provide a regional comparison). The second workshop (WP3.3) in May 2010 follows on from this and considers future scenarios for each of the study areas. These then lead to the development of adaptive strategies (WP 4.3).

The purpose of this document is to provide guidance on the running of the first workshop and the reporting of its findings in order to aid comparison between sites. The guidelines are indicative and it is acknowledged that there may be local reasons for deviations, but please try and stick as closely as possible to the guidelines in order to facilitate comparison between the sites.

## A: Running the Workshop

(1) Who to Invite:

Professional local authority staff who can consider directly how Climate Change might affect their daily work

Number of participants: 10-20

Suggested time: 2-3 hours

(2) Objectives:

Identify drivers and issues (ecological, social, and economic) associated with Climate Change *(NB: At this stage we are not discussing adaptive strategies)*

(i) To impart information on drivers and impacts (see Appendices 1 and 2)

(this is done by the Corepoint Academic/Research partner in each couplet)

(ii) To assess implications for the local study area only *(i.e. not a generic list)*

(this is done through discussion between practitioners and researchers)

(3) Suggested Format for Workshop:

(i) 5 minute introductory presentation on IMCORE

(ii) 10 minute presentation on the science of climate change – drivers and the chain of drivers (see attached review) and prepared by the scientific partner in each couplet)

(iii) Discussion (rest of available time) – nature and level of risks and impacts in the local study area, with the focus on each participant's area of responsibility

**B: Reporting the Workshop**

(1) Identify the sectors to be impacted (e.g. aquaculture, sea defence, infrastructure, tourism, conservation etc.) (*These should be specific to the immediate study area – not a generic list)*

(2) For each sector describe the anticipated impacts. Indicate whether short-, medium- or long-term

(3) For each sector indicate how well you are equipped to deal with these impacts. Use a scale of Poor/Medium/Good

(4) For each sector indicate any constraints on dealing with future changes (e.g. funding, staff, training etc.)

## Issues/vulnerabilities identified in workshops

The trans-national working group on vulnerabilities found that there were a number of statements made in discussions that did not identify impacts, there were also a number of questions raised relating to the process or in relation to what the risk might be and there was frequent identification of options without first having clarity on the vulnerability. All of these then gave the impression of much information being captured during the workshop when the amount of information relating to identification of vulnerabilities was limited. The original workshop also aimed to identify how well each area is equipped to deal with the impacts. The ability of the area to adapt to the impacts of climate change can only be classified after the vulnerabilities have been identified and the potential options recognised, however some key constraints have been identified.

## Review of themes from workshops

**Tourism**

- Primary impacts from climate change relate to predicted changes in tourist behaviour with hotter drier summers leading to increased visitor numbers.
- Secondary impacts relate to predicted damage to infrastructure on which tourism depends, this could include damage to promenades (direct damage or wind blown sand limiting use), shops and restaurants or to habitats such as beaches and dunes including not only their loss but degradation.

**Fishing and Aquaculture**

- Primary impacts relate to changes in populations either due to migration (cod, haddock) or population expansion (such as jellyfish or algae blooms). Also to adaptation of infrastructure such as boats and harbours to cope with predicted climate.
- Secondary impacts relate to the changing economic value of the fish stocks in relation to availability.

**Land and Property**

- There was a common issue where coastal defence was identified as a sector as opposed to an option in relation to dealing with the risk to damage of assets on land from tidal flooding or coastal erosion.

**Industry**

- Change in risk to industry due to design standards of coastal defence infrastructure being exceeded by increasing sea-level and increased storminess. Change in operational conditions for ports and harbours due to changing movement of sediment and changing water conditions for the ships to operate in leading to decreases in the number of available shipping days and the safety of operation.

**Agriculture**

- Low-lying lands liable to flooding.

**Transport**

- Increased risk of flooding.

**Nature Conservation**

- Primary issues relate to changes in habitats and the knock-on impacts for species. Also loss of habitats through erosion and flooding.

- A secondary issue the change in conservation status of certain habitats as a result of climate change.

## Stimulus for adaptation

The working group also examined the workshop data in order to identify what the motivations for adaptation were at the local level. The specific topics were grouped into categories of:

Political, economic, social, technical, legal and environmental

Some of the incentives for adaptation intersect numerous categories but in general it was found that the main stimulus for adaptation is the economic impact of climate change drivers on local industry. In developed/industrial areas the economic impact of climate change drivers provoked the desire for change while in general environmental vulnerabilities induced the need for adaptation in rural less developed areas. Examples are given below of some of the specific issues driving the need for adaptation:

ECONOMIC – Reduction of shipping fishing days

ECONOMIC – Reduction of species which are of commercial interest

ENVIRONMENTAL/LEGAL – Threat to SACs and SPAs from pollution and flooding

TECHNICAL/ECONOMIC – Loss of transport systems

SOCIAL – Loss of locally important archaeology

## Constraints identified through the workshops

**Communication and understanding**

Issues raised around the language used, the communication of climate change, better information about cause and effect, clarity of purpose of advice, different communication approaches required for different audiences.

**Institutional**

Lack of leadership at a range of geographical levels (especially at National and European level) and associated lack of guidelines. Lack of statutory approach. Short term thinking too prevalent. Need to move away from local interests dominating decision-making.

**Economic**

Lack of investment and cost of change.

**Information needs**

Absence of baseline information. Need better information about climate change. Need to improve information about the impacts of climate change. Specific information needs to be generated at the local level about impacts.

## Trans-national working group review of guidelines and approach to workshop

Use of visualisation tools for capacity building and climate change adaptation presentation – Based on experience from the workshops it has been identified that there was a need to better inform the audience as to the reasons for adaptation. It is felt that some of the visualisation tools being developed in work package three could be usefully deployed at this stage.

Audience- There were clear problems in getting the right audience to attend and the original guidance was felt to be too general. By making the guidance more specific it enables those undertaking the work to not only invite the right audience but also to be clear on the importance of follow-up work in association with those who can't make the workshop. The guidance should be revised to target high level sector specific practitioners and policy makers working in the coastal zone and include the need for follow up work if there are some gaps in the audience during the workshop.

Objectives: The objectives require clarification to ensure optimum delivery. The first section of the workshop should be clearly identified as capacity building where predicted climate changes are communicated as well as a clear case presented for the need for adaptation to climate change.

The second section is about getting information from the audience on the identification of vulnerabilities; but in order to ensure that this discussion is focused there is a need for additional guidance on the structure. Across the case study reports there was a

wide range of outputs and approaches to undertaking the discussion and documenting the results.

The additional guidance is dealt with in turn:

- Vulnerabilities should be coastal specific – a number of the workshops reported issues that are general and do not relate purely to a coastal location, it is felt that this distracts from identification of coastal vulnerabilities.
- Vulnerabilities should be climate change specific – in some of the workshops there were problems identified that were independent of climate change and again distracted from the identification of coastal vulnerabilities.
- Following on from the above two points it was felt that it would be useful to identify the link between cause and effect, i.e. between the predicted change in climate and the anticipated vulnerability. This would be useful in later stages and would also act as a check for the above two points.
- Vulnerabilities should be related to general time epochs defined as short, medium and long term relating to 0-20, 20-50 and 50-100 year time periods. Whilst this was identified in the guidance it was not always done, for this reason the guidance needs clarifying along with clear reasons for the need for this element stating.
- Whilst the original guidance chose not to identify sectors that should be considered it is felt that a non-exhaustive check-list should be supplied to aid those undertaking this process and to ensure that lack of information in certain sectors is down to a lack of importance or presence at the site under consideration rather than an oversight.
- It should be made clear that this stage is identifying vulnerabilities rather than options and that these vulnerabilities are based on management and policies continuing as at present.

## Limitations

This report lists the vulnerabilities identified at any of the workshops carried out as part of action 2.3 but it is limited in its ability to compare and contrast this data. It was not possible to construct a matrix for each area with the available data. The reasons for these limitations are:

a. Some locations did not hold a workshop specifically for the purpose of vulnerability/issue identification. This meant that the data provided did not contain the information required to analyse vulnerabilities in the area. The reasons given for not carrying out specific workshops were workshop fatigue and areas' being at different stages of the management process; language was also a problem in the reporting for some.

b. The workshops which did take place exclusively for vulnerability identification were each reported in a different way. It is clear that the original guidelines were interpreted differently and this has made direct comparisons between workshops unfeasible. The original guidelines were accurate but the disparity shown between the reports highlights the need for further clarification and more detailed guidelines for any future workshops. This emphasizes the need for workshop facilitators to request clarification on any issue which is uncertain as future workshop outputs will require comparison and this can only be done if workshop reporting is consistent. At the start of any action it is important to clarify which areas will be holding a workshop exclusively for the purpose intended. This way useful data may still be gained from any past experience in areas where workshops will not be held.

c. The variation in both workshop type and reporting means that it is not possible to present the workshop data in a standard format. The selection of a non .pdf format for data reporting in future would facilitate unproblematic inclusion in other reports. Reports provided for action 2.3 are presented in appendix 1 (word versions) and as attached files (pdf).

## Appendix I - list

Report data from each of the participating partner areas.

1. Belgium
2. Cork, Cork Harbour
3. Donegal
4. Severn Estuary/Cardiff (two separate pdf files)
5. Gulf of Morbhian, France
6. Durham
7. Sefton (separate pdf file)
8. East of England (link to internet report)

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## October 2009

## Appendix I

Report data from each of the participating partner areas. Page

**1.**

# *Report of the Workshop:*

## *"The impacts of climate change in the marine environment and coastal zone"*

*21 April 2009, Ostend*

*WP 2.3.*

*Organized by the Maritime Institute*

*and*

*Agency for Maritime and Coastal Services – Coastal division*


Willekens Marian
Maes Frank
Van Poucke Lie
Cliquet An

Ghent University
Maritime Institute

Bertelsen Miguel

Agency for Maritime and Coastal Services

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# *The impacts of climate change in the marine environment and coastal zone*

## Workshop 21 April 2009, Ostend

### 1. Purpose of the workshop

The purpose of the workshop was to describe and evaluate the main climate change impacts for the Belgian part of the North Sea and to introduce the IMCORE project. This workshop is part of a series of workshops on adaptation to climate change impacts organized by the IMCORE partners in their local area and implementing WP 2.3. The results will be collated and analysed in order to provide a regional comparison.

The nine expert couplets of IMCORE are:

- Maritieme Dienstverlening en Kust (MDK) – Coastal division & Maritime Institute, University of Ghent (Belgium)
- Cork County Council & Coastal and Marine Resource Centre, University College Cork (Ireland)
- Donegal County Council & Centre of Coastal and Marine Research, University of Ulster (Northern Ireland)
- Severn Estuary Partnership & Marine and Coastal Research Group, Cardiff University (Wales)
- Aberdeen City Council & Aberdeen Institue for Coastal Science and Management University Aberdeen (Schotland)
- SIAGM - Intermunicipal Syndicate for Planning in the Gulf of Morbhian & Centre for Maritime Lax and economyn University of Western Brittany (Brittany)
- Durham Council & Envision, Newcastle University (UK)
- Sefton Council & Edgehill University (UK)
- Government Office (East of England), Colne Estuary Partnership & CoastNet (Essex) (UK)

The participants in the Belgian workshop, representing various coastal and marine sectors, were stimulated to assess the impacts of climate change on their specific activities at sea and on the beach, what they experience as clear signals due to climate change effects and how they think these impacts will evolve over time as well as how they plan to anticipate them. In order to prepare an adaptation strategy for the Belgian part of the North Sea and the coastal

zone, it is necessary to point out what the adaptation priorities are for coastal and marine sectors. The workshop created the opportunity to prioritise the responses to these impacts alongside any other issues that need to be managed.

## 2. Audience

The intention was to have all main coastal and marine sectors represented in the workshop. 84 invitations were sent a month before the workshop took place. However, not all sectors were represented, probably due to an overload of workshops on coastal zone related matters during that period. Best represented was part of the invited research community. None of the 10 local municipalities was represented (cf. table).

| Sector | Invited | Present |
|---|---|---|
| *Local authorities* | 10 coastal municipalities | 0 |
| *Federal government* | 4 (three of the federal public service health, food chain safety and environment; one of the federal public service mobility and transport; one of the federal public service economy and energy) | 0 |
| *Province West Flanders* | 5 | 1 |
| *Flemish government* | 3 | 2 (one responsible for the coastline defence and the other responsible for mobility) |
| *Tourism* | 5 | 1 (mainly a representative of the marina) |
| *Ports/Shipping* | 5 | 1 |
| *Coastguard* | 3 | 0 |
| *Fisheries/Aquaculture* | 8 | 1 |
| *Dredging* | 6 | 1 |
| *Shipping assistance/Pilotage* | 3 | 0 |
| *Nature conservation* | 13 | 1 |
| *Energy* | 4 | 0 |
| *Sand and gravel extraction* | 1 | 0 |
| *Researchers working on climate change and the Belgian Coast* | 14 | 10 |
| **Total:** | **84** | **18** |

The above table shows that the results of this workshop have to be read with caution. Firstly, not all sectors were present at the workshop. Secondly, the number of people representing the sector was limited (see Annex 1 for the list of participants).

## 3. Location and timing

The workshop took place in Ostend, Conference Room Marine Board – Wandelaarkaai 7, one of the largest coastal cities in Belgium. The UGENT IMCORE team chose this location for two reasons: 1. it is the place of residence of our partner in our Expert Couplet; 2. it is the central place for the stakeholders invited to the workshop. The workshop was held in a round table format and ran for two and a half hours. The language was Dutch.

## 4. Resources

A week before the workshop took place templates were distributed to the stakeholders that confirmed their participation. The template was based on the Annual Report Card 2007-2008 of the Marine Climate Change Impact Partnership, as further developed and proposed by our IMCORE partner from the University of Ulster. The template was adapted to the specific conditions of the Belgian coast. The potential effects of climate change for this area were identified in the ongoing Belgian research project CLIMAR in which the Maritime Institute is a partner too (see Annex 2 for the CLIMAR report 1st phase).

The templates listed a number of climate change effects (temperature rise, rise of seawater temperature, sea level rise, increased storms and waves, acidification, coastal erosion, changes in fish population, impacts on wetlands, plankton and seabirds, harmful algal blooms) (see Annex 3 for a template model). Each potential climate change impact was briefly explained. Current impacts of climate change were identified and an assessment was made of future impacts. Together with the template, the stakeholders received a list of specific questions that gave them the opportunity to reflect in advance on these issues and the respective impacts for their sector. These questions were:

- How do coastal- and marine-stakeholders experience the impacts of climate change in their sector today?
- Which impacts of climate change will affect the sector in the future according to coastal- and marine-stakeholders?
- Over what period will these impacts occur according to coastal- and marine-stakeholders (short-, medium- or long-term)?
- What impact will most affect the sector?
- How well is the sector equipped to deal with these impacts?

## 5. Structure

9.30: Introduction Frank Maes (MI)

The IMCORE and CLIMAR projects were explained. CLIMAR is a Belgian research project funded by Belgian Science Policy with focus on adaptation of the coastal area and sea activities to climate change impacts. IMCORE is a 4 year project funded by the EU in the INTERREG IVB NW Europe program. Various sectors are involved e.g. universities, researchers, local authorities. Ghent University and MDK are the Belgian Expert Couplet. IMCORE contains several Work Packages. Focus of the Workshop is on Work Package 2 'identification of drivers for climate change related issues'.

10.00: Sectoral impact analysis

Subsequently, the main climate change effects were expounded by Prof. Dr. F. Maes, as well as the potential impacts of climate change as a result of these effects both today and in the future. Every climate change effect and its potential impact were introduced, followed by a time slot of 10 minutes to allow the participants to fill in the template. Eleven climate change effects were introduced. Participants were asked to write down their experiences with climate change impacts to their sector and sectoral adaptation proposals. Furthermore they were asked to classify the climate change effects for their sector according to a scale from least important (0) to very important (10).

11.30: Roundtable discussion An Cliquet (MI)

Prof. Dr. A. Cliquet led a discussion, inviting stakeholders to present their main experiences with climate change effects and the impact for their business. Experiences and visions were expressed by representatives of the sectors tourism, fisheries, dredging, ports/shipping, nature conservation and the Flemish government. The representative of nature conservation could not produce a vision on climate change and nature conservation yet, as the sector is still working on a report related to this topic. The release of this report is expected at the end of August.

## 6. Results of the workshop

***How do coastal- and marine-stakeholders experience the impacts of climate change in their sector today?***

All participants noticed changes in the marine environment. They observed an increased presence of cormorants, seals, porpoises, dolphins, sea birds and warm water species (e.g. anchovies, Japanese oyster and sea horses) in the Southern part the North Sea. As an example, the Japanese oyster is on a large scale present in the ports, on the quays and on palisades. The question remains what the cause is of the increasing presence of these species. It can be expected that the presence of this exotic species is due to ballast water exchanges from ships and not due to climate change. The vast majority of those present noticed that there occur more storms than 20 years ago (more storm days) and that the intensity of the storms is more severe. They also stated that harbours after heavy storms are more bogged than before, what makes dredging more necessary and more often applied. The Flemish government also stated that sea level rise already has been recorded at the Belgian coast.

***Which impacts of climate change will affect the sectors in the future according to coastal- and marine-stakeholders and over what period will these impacts occur? How will the different sectors adapt to these impacts?***

**Tourism (coastal marinas/ water recreation):**

*Ecological impacts*

The presence of more marine mammals along the coast result in an increase of sailing days and will most likely result in more tourists excursions at sea.

*Economic impacts*

The main impact of climate change for this sector will be the increase of frequency and intensity of storms, followed by sea level rise and changes in coastal erosion and sedimentation processes. These impacts can lead to more damage to yachts and marinas, less available shipping days and more dredging activities. Consequently the exploitation and damage costs can increase due to higher maintenance and reparation costs of the marinas.

According to the sector these impacts will only be visible on the long term (100 years). It is not yet required to anticipate these impacts. As adaptation will depend on the financial condition of the marinas, the question remains whether the adaptation of marinas to sea level rise and

increased storms will be payable. Nevertheless, the sector already took into account the increasing number of storms by installing more ports poles to better anchor the boats during heavy storms.

*Social impacts*

Extreme weather conditions and sea level rise will negatively influence the safety on board the yachts and in the marinas (on quays and jetties). The presence of marine mammals, however, could lead to more tourists and tourism activities.

**Ports and maritime transport:**

*Ecological impacts*

Changing coastal erosion and sedimentation processes can have an increased impact on shipping lanes (displacement of sand, sedimentation, etc.) in the Belgian part of the North Sea that will on its turn require more dredging.

*Economic impacts*

The main climate change impact on harbours will be the rising sea level. Since increases from 1 to 1.5 meters can cause problems related to safety and protection of harbours, higher safety factors will be required to anticipate sea level rise. The sector assumes that rising sea level will only take place gradually and in the long term (100 years). Adaptation is therefore not immediately required, but major infrastructure changes will be needed in the future. The main constraint to anticipate sea level rise will be the outline of costs.

The second most important impact will be increased frequency and intensity of storms and the wave height. This situation will be more damaging to ships and harbour infrastructure, might result in less available shipping days and difficulties in executing certain harbour activities the year round.

Another economic impact indicated by the sector is the fact that temperature rise will increase the need for cooling. Consequently technical measures will have to be taken to adapt ships to this primary impact.

*Social impacts*

Climate change impacts (extreme weather events, sea level rise, etc.) will negatively influence the working conditions on board ships and increase the risk on accidents.

*General comment*

The sector noted that mitigation policies on climate change will have a major impact on international shipping, which will take place in a short term (10-20 years). Carbon Dioxide ($CO_2$) emissions represent about 60% of the global Greenhouse Gas emissions and its most important sources are the industry, the energy sector, traffic and transport. From 2011 on, also the aviation sector shall be covered by the European Emission Trading System which intends to reduce $CO_2$ emissions. Therefore, it is likely that in the future also the international shipping sector will be covered by an emission reduction obligation. The question remains on which international decision-making level the reduction requirements will be established: the UNFCCC/Kyoto Protocol, the International Maritime Organization or within the European Union. If emission reductions of ships will be regulated on the European level, there may also be changes in the import/export patterns and fuel consumption.

**Fisheries:**

*Ecological impacts*

The main impact of climate change on the marine environment will be the shift of species. Due to a rise in seawater temperature, a northward shift of marine species is already taking place in the North Sea and will occur more in the future. The northward shift will have an impact on the presence of cod, haddock and halibut in the North Sea, as these species inhabit in colder waters and there will be a higher incidence of warm water species in our region (including anchovies, sardines, seahorses and mullet). However, not all of these species are of interest for commercial fishing, such as seahorses. Besides the northern shift of marine species, it is likely that the rise in sea level, changes in wetland areas and in erosion and sedimentation processes can affect the existing nursery areas for shrimps, sole and plaice.

Another ecological impact would be the increase of harmful algal blooms due to rising seawater temperatures. At present we read in the newspaper about contaminated mussels, but this coverage is often not correct. Harmful algal blooms are indeed a problem, but the amount of harmful algal blooms is primarily dependent on the tidal force. Therefore, the sector should reckon with the harmful algal blooms during the harvest of mussels which they do by taking daily samples of the water quality. Finally, although the presence of marine mammals is of interest for tourism, it is not for fisheries. The increase of marine mammals is detrimental to fisheries as these animals also eat fish, and thus create food-web competition. Food-web competition occurs when there is potential overlap of the trophic flows supporting a given group (e.g. marine mammals) with the trophic flows supporting another group (e.g. fisheries).

For the sector there are two problems to anticipate climate change effects. The first problem of anticipating these changes is the European Common Fisheries Policy. This policy is based on a set of quotas for species that can be caught. Each country is given a quota based on the total allowable catch and their traditional share of the catch. Up till now, the Belgian fishery vessels do not have a quota for the capture of anchovies. As the changes of climate change will become more visible and perceptible, the European Common Fisheries Policy should be adjusted accordingly.

The second problem is lack of scientific knowledge in the sector. Scientific research regarding the relationship between temperature, seabed and fish populations is already carried out, but there is little cooperation between scientist and fisheries. Various maps (including bathymetry, tidal currents and sand banks) are available at the MUMM (Management Unit of the North Sea Mathematical Models) but the fisheries sector is not aware of the existence of these maps. In order to adapt to the ecological impacts of climate change, more and detailed research will be needed and a better cooperation between scientists and fisheries should be established. Scientific documents must be accessible and understandable for the fishing industry. The sector does not see a threat in the cooperation with scientific researchers, but rather an opportunity to develop a better Common Fisheries Policy while these quotas are not attuned to the reality.

*Economic impacts*

Due to an increase in storms and inclement weather, there will be more annual storm days and thus less shipping days. This is especially important for inshore fishing; they can only fish at sea up to 4-5 Beaufort. These climate change impacts will also adversely affect the safety on board vessels and in harbours. According to some, storms also have a positive impact on the catching of fish. After a storm the seabed is turbulent, therefore more food is available and more fish can be caught. But this theory only applies to bottom fish. Another reason for the increasing presence of fish could be that there was no fishing for a period of time in that area due to risk of storm.

*Social impacts*

Extreme weather events and sea level rise will negatively influence the safety on board the fishing vessels and in harbours. Climate change together with other stress factors on the sector (e.g. fuel and fish price) could lead to a further reduction of the Belgian fishery fleet.

*General comment*

Climate change is still not the biggest threat for the Belgian fishery sector. The Belgian fishery fleet is characterized by strong specialization with regard to fishing method (93% beam trawlers) and target species (mainly flatfish). Beam trawling is very fuel consuming and has a heavy seafloor impact. This and declining fish stocks and changes in fish prices make the

Belgian fishery sector more vulnerable than effects of climate change. The sector stated that today climate change is not the biggest threat for the fisheries but the fuel and fish prices. Nevertheless the sector is aware of climate change and believes that within 15 years climate change could indeed be a serious threat if by then the sector is not sufficiently adapted to the effects of climate change.

**Dredging:**

*Ecological impacts*

Massive algal blooms can lead to problems with the engines if these algal blooms are sucked through the cooling water and result in blockage of the engines. As such problems are already taking place today (e.g. India), the sector is searching for possible solutions to avoid these problems.

*Economic impacts*

The dredging sector has stated that temperature rises have an impact on the rate of corrosion of ships and the operation of the engine cooling and acidification influences the wear of ships. However, according to the dredging industry, the impact on ships and their machinery will be rather minimal and thus controllable as the sector is already equipped to anticipate these impacts (e.g. material selection, installation of protection layers).

Another economic impact will be the reduction of cargo that can be transported since the rising of sea temperature will lead to lower water density which ensures that ships submerge in the sea and consequently are less able to carry cargo. Even today there are differences in water density across the world although the sector can do little against this impact.

As already stated by the fisheries and shipping sector, the dredging sector would also have less shipping days, due to more intense and frequent storms and waves.

Climate change could also create opportunities for the sector since sea level rise and the increase of storms and wave height would ensure more need for constructing and maintaining coastal defence in which the dredging industry can play a very important role. Thus, the sector sees sea level rise as the main impact of climate change but in a positive sense since it would create new opportunities. In what rate climate change would be an opportunity depends on the coastal defence policies that will be implemented by governments around the world. The Dutch government has already chosen for beach nourishment and also the Belgium government chooses to give priority to soft coastal defence structures (e.g. beach nourishment). The British government on the other hand, intends to give more attention to managed retreat.

*Social impacts*

Demand for more dredging activities, due to sea level rise and changes in sedimentation processes, will lead to a growth of the sector with more jobs as result.

*General comment*

The sector noted that alongside the primary effects of climate change (e.g. temperature increase, sea level rise, changing fish populations, harmful algal blooms, changing wetlands, acidification, etc.) also legislation effects the sector, albeit indirectly. Due to the impact of climate change, there would be more need for protective legislation (more marine protected areas and more protected fishing areas), which might hamper dredging and building constructions at sea.

**Flemish government (AMCS - Coastal division)**

One of the main tasks of the Coastal Division of MDK is to guarantee the safety of the population and cultural heritage against storms and floods. In order to achieve this objective, MDK mainly focuses on sea level rise, since this climate change impact will have the greatest impact on the safety of the entire coastal zone.

To protect the coast and the hinterland against flooding, MDK is preparing a coastal safety plan (Masterplan 2050). This Masterplan employs a 'hold-the-line' policy and outlines actions in the short term (2010-2015) and a long-term approach (2050). The 'hold-the-line' policy implies that the Flemish government works with a fictitious line. The line must be maintained and no flooding may exceed that specific safety line. Actions in the short term imply that every five years the entire coastline is subjected to a so-called safety check. The safety line must be resistant against a 1000-year storm (=super storm); if this is not the case, the coastline needs further protection. The long-term approach takes not only super storms into account but also sea level rise, coastal erosion and sedimentation processes. To assess the future sea level rise, MDK relies on the findings made in the IPCC. The IPCC climate report assumes an average sea level rise of ± 22 cm the first 50 years (period 2000-2050) and ± 38 cm the next 50 years (2050-2100). Take also into account that the observations along the Flemish coast indicate an increase of the high waters of ± 30 cm to 2050 and ± 80 cm to 2100. With regard to coastal erosion and sedimentation processes various studies are carried out.

The adaptation measures that will be taken by the Flemish government to protect the coastline against super storms and sea level rise are divided into 2 categories. On the one hand, soft coastal defence measures which are measures that respond to the dynamics of the coast. The best example is sand nourishment. On the other hand, hard coastal defence measures, hard, inflexible structures that directly intervene in the dynamics of the coastal processes. Examples of hard coastal defence are dikes, beach managers, cribs beach, breakwaters.

Furthermore, some problems are encountered in the planning of adaptation measures. Firstly, there must be enough sand available to implement the sand nourishment. Therefore, further research is needed to establish new sand mining areas. Secondly, the government needs to take into account nature conservation legislation when planning adaptation measures (e.g. environmental impact assessment, environmental permits, strategic environmental assessment).

Another task of the MDK is to support coastal and marine tourism, recreational activities and cultural and educational initiatives. With respect to this task, MDK expects in the medium term (2050) more tourists due to rising temperature. This has implications for the policy since more budgets will be required to develop tourism infrastructure along the coast. Other climate change impacts of importance for the Flemish government are acidification and harmful algal blooms as these impacts have an influence on the water quality.

***Classification of the effects of climate change per sector according to their impact on the sector to a scale from least important (0) to very important (10).***

| Sectors | Temperature | Seawater temperature | Sea level | Storms and waves | Acidification | Coastal erosion | Harmful algal blooms | Fishing | Wetlands | Plankton | seabirds | Legislation/ Policy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Tourism* | 8 | 8 | 8 | 10 | 0 | 6 | 7 | 0 | 0 | 0 | 0 | 0 |
| *ports and shipping* | 1 | 1 | 10 | 9 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 0 |
| *Fisheries* | 1 | 9 | 1 | 7 | 4 | 0 | 1 | 10 | 2 | 5 | 1 | 10 |
| *dredging* | 1 | 1 | 10 | 10 | 5 | 10 | 1 | 5 | 7 | 5 | 1 | 0 |
| *Flemish government – Coastal defence* | 8 | 7 | 9 | 9 | 1 | 10 | 1 | 1 | 2 | 1 | 1 | 7 |

The above table reflects the impact of the climate change effects on the respective sectors. The ranking of the Flemish government is the outcome of the result of one of the participants, since the other participant did not completed the classification.

The classification shows that the increase of frequency and intensity of storms and waves will have the biggest impact on the majority of the sectors, together with sea level rise and changes in erosion and sedimentation patterns. For fisheries, the changes in fish stocks will have the biggest impact. Legislation and changes in policy as a result of climate change are (very) important for the Flemish government, fisheries, the dredging industry as well as the ports and shipping sector. Changes in seabird population, further acidification and changes in wetlands are less important for the sectors.

## 7. Conclusions

- Raising awareness about the need to adapt (some sectors already take adaptation measures, others not).
- Some climate change effects are already visible but it is not always clear what the cause is of these effects (e.g. more storms; more marine mammals like seals and dolphins; more warm water species like anchovies, Japanese oyster, seahorses, more sludge after a storm, contaminated mussels).
- Some climate change effects are positive, whereas others could be negative depending on the sector (e.g. sea level rise).
- Some sectors will be more affected by climate change effects than others.
  For instance fisheries will be affected by 90% of the climate change effects (changes in fish population, harmful algal bloom, changes in temperature etc.), while the shipping industry will be less affected by climate change effects.
- There is a need for more scientific research and a better cooperation with the scientific community (to have enough information about the impacts of climate change in order to adapt efficiently).
- According to the respective sectors the increase of frequency and intensity of storms and waves will have the biggest impact, followed by sea level rise and changes in erosion and sedimentation patterns.

**2.**

# *Changing World – Changing Climates*
# Workshop Report

May 7th - National Maritime College of Ireland

## Introduction

The workshop was convened to identify the impacts of climate-related issues on Cork Harbour, as well as constraints in dealing with these impacts. The workshop sought participant's views and opinions on issues relevant to adaptation to future coastal change in Cork Harbour - how will climate change influence social, economic and physical changes, how will various sectors of activity be impacted, what are the implications of the various changes facing Cork Harbour? The event marked the beginning of the process to develop a **Local Adaptation Strategy for Cork Harbour**, set to be produced as a result of the Innovative Management for Europe's Changing Coastal Resource (IMCORE) project by 2011.

> ***Adaptation*** refers to any activity that reduces the negative impacts of climate change and / or positions society to take advantage of new opportunities that may be presented. Adaptation is needed to address the challenges of climate change (Lemmen *et al*., 2008).

## Workshop Audience and Structure

The workshop audience comprised representatives from local government, the private sector, Harbour community and resident groups, academia, and Harbour interest groups. A total of 32 participants were involved in the workshop; a participant list with affiliations is provided in Table 1 on page 2.

The first part of the workshop was held in plenary; participants were provided with a series of presentations that: **1)** introduced the IMCORE project and the workshop objectives; **2)** described the global drivers for climate change, IPCC scenarios and how Ireland is likely to experience changes in climate; **3)** specifically dealt with climate policy and planning for adaptation in Ireland; and **4)** outlined the structure for the subsequent group sessions, including an explanation of key climate-related issues for Cork Harbour. The workshop agenda is presented in Appendix A.

| | |
|---|---|
| • **Flooding** | Projections indicate increased risk of flooding; linked to precipitation patterns, storm patterns, and sea level rise. |
| • **Sea Temperature** | 0.85°C rise in Irish coastal seas since 1950; 2007 warmest year in Irish coastal record. |
| • **Sea Level Rise** | During the satellite era SLR of 3.5cm per decade has been observed. Projected rise of 60cm to 2100. |
| • **Sea Chemistry** | Atlantic waters freshened from 1960-1990 and are now becoming more saline. |
| • **Extreme Weather** | Observed decrease in the frequency of storms, but the intensity of storms has increased. |
| • **Waves and Surges** | Evidence of significant increase in wave heights (up to 30cm) during winter months. |
| • **Precipitation** | Drier summers in the south east. Winter rainfall in Ireland by the 2050s is projected to increase by approximately 10% while reductions in summer of 12–17% are projected by the same time. By the 2080s, winter rainfall will have increased by 11–17% and summer rainfall will have reduced by 14–25%. |

**Fig. 1.** Examples of climate related issues presented to workshop audience during plenary session.

Following the plenary session, the participants were divided into two groups; each group was tasked with identifying and discussing the impacts (economic, social and biophysical) of climate-related issues (Figure 1.) for different sectors of activity in Cork Harbour. The key sectors of activity identified for Cork Harbour were:

**Group 1**

- Tourism and Recreation
- Coastal Defence
- Agriculture
- Transport
- Energy
- Biodiversity

**Group 2**

- Settlement and Land-use
- Industry and Commerce
- Built Heritage
- Port and Shipping
- Human Health
- Fisheries

**Table 1.** Composition of groups for session on identification of impacts and constraints; and affiliations of workshop participants:

| **Group 1** | **Group 2** |
|---|---|
| Jeremy Gault (CMRC – UCC) - *Facilitator*<br>Darragh O' Suileabhain (Cork County Council)<br>Eliz Hipwell (Cork County Council)<br>Sharon Casey (Cork County Council)<br>Robert Devoy (Department of Geography – UCC)<br>Brendan Kelleher (Harbour Resident)<br>Romina King (Department of Geography – UCC)<br>Evanna Lyons (Royal Cork Yacht Club)<br>Patrick Treacy (Cork Environmental Forum)<br>Nicholas Mansergh (Cork County Council)<br>Mark Mellett (Irish Naval Service)<br>Kathrin Kopke (CMRC – UCC)<br>Stefan Gray (CMRC – UCC)<br>Norcott Roberts (Harbour Resident)<br>Sarah Iremonger (Sirius Arts Centre) | Cathal O'Mahony (CMRC – UCC) - *Facilitator*<br>Maria Falaleeva (CMRC – UCC)<br>Lorraine Kennedy (Cork County Council)<br>Bob McLaughlin (Harbour Resident)<br>Kevin O'Callaghan (Port of Cork)<br>Rosie O'Donnell (Cork County Council)<br>Pat Ruane (Meitheal Mara)<br>Andy Scollick (CMRC – UCC)<br>Niamh Twomey (Cork City Council)<br>Mike Fitzpatrick (CMRC – UCC)<br>Eddie Desmond (Harbour Resident)<br>Tim Twomey (Cork County Council)<br>Patricia Goulding (Cork County Council)<br>Billy Flynn (Harbour Resident)<br>Anne Marie O'Hagan (HMRC – UCC)<br>Jerry Browne (Electricity Supply Board)<br>Margaret Desmond (Environmental Protection Agency) |

As well as considering **impacts** in economic, social and biophysical terms, participants within each group were also requested to identify both **positive** (i.e. opportunities) and **negative** impacts associated with climate change issues (Table 2).

Over the course of the issue identification exercise, comments relating to **constraints** that individual sectors may face when dealing with future changes were also recorded. Workshop participants were also asked to give opinion on **preparedness** for climate change in Cork Harbour; remarks relating to constraints and preparedness are summarised on page 10.

## Identification of Impacts

**Table 2.** The range of impacts, identified by group participants, related to climate change issues for key sectors of activity in Cork Harbour.

| **Drivers:** Human activity, natural variation, atmospheric concentrations of greenhouse gases, radiative forcing, fossil fuel consumption, seasonal changes…. | |
|---|---|
| | **Sectors and Impacts** |
| | **Settlement and Land-use** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | **Impacts:**<br><br>•Human behaviour is linked to settlement in terms of where we live and work, how we travel and commute – thus a range of impacts can arise from our patterns of behaviour which is in turn driven by our location.<br>•The impacts of climate change on settlement and land-use are influenced by the gap that exists between terrestrial and marine planning.<br>•What level of sea-level rise can we assume into the next fifty years?<br>•What message can be sent to planners in terms of rising sea level and facilitating future development?<br>•The process of planning – zoning, interaction with landowners, opinions and influence of public representatives – can make it difficult to negotiate an appropriate response.<br>•Language surrounding timelines and projections used to deliver the sense of climate change impact has different meanings to planners, scientists and other relevant groups.<br>•Is setback an appropriate solution to adapt to impacts? Each coastal area (and sector) will have differing levels of sensitivity; it is not as simple as drawing a line on a map.<br>•Tools, e.g. visualisation, development of various scenarios to convey impacts would be useful – clearly demonstrate what climate change will mean for Cork Harbour.<br>•Do we know what critical infrastructure is at risk – this is an important step in estimating impact.<br>•Zoning can be undertaken, but quite often this is agreed on the basis of unrealistic stipulations, e.g. increasing ground level by 2m<br>•The costs of engineering a solution will be an impact.<br>•Working in the absence of a baseline is an impact; in terms of vulnerability do we have the information?<br>•The fact that the Harbour is not considered as a single entity, in terms of planning or otherwise, will influence our awareness of impacts. Need to make clear that Cork and its hinterland is a coastal city. There is a need to promote the concept of Cork Harbour.<br>•Need to make people aware that the impact of flooding is not limited to the coastal area in Cork – there appears to be no recognition of the impact of flooding from land and the sea. Problem is that flooding in Cork is influenced by a number of variables: easterly winds; high tides; and the need to release water from the dam – when these occur in unison there can be significant impact.<br>•Is a barrage an option to reduce impacts; this would provoke an immediate reaction and allow planning for the future, to what extent can existing weirs accommodate increased sea levels?<br>•The production of flood maps will give a greater indication of impact and will influence planning, as well as land values and development patterns. |

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| | • Two trains of thought are needed for assessing impacts – how will climate change affect me, and how will it effect future generations? The latter is a challenge for planners – can be difficult to factor in long-term strategic outlook, and it is no common for us to think in terms of 30-40 years ahead.<br>• Insurance costs will be an impact.<br>• Accelerated Low Water Corrosion (ALWC) can damage infrastructure (i.e. steel corrosion), thought that changing water temperatures will make bacteria that cause condition more prevalent in Irish waters. |
| | **Industry and Commerce** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | **Impacts:**<br><br>• Most industry in the State is port concentrated, originally designed with eye-level impact in mind, and built on low ground/ setting. For these reasons, much of industry is vulnerable to flooding.<br>• High levels of investment may be required to climate proof our industrial sites.<br>• There is a need for planning guidance for development within this sector to future proof new developments.<br>• It will be a new departure for climate change to be factored into planning in the context of this sector. Absence of information has hindered planning in this regard.<br>• Many commercial units will be prone to flooding. Altering (floor) elevations may be a solution but this will cost.<br>• Even recent development, e.g. extension of Mercy Hospital, does not appear to take the potential impact of climate change into account; it is built on a lower elevation and was any thought given to the location of the switch rooms and fire pumps?<br>• There is a design dilemma to consider – shop fronts and streetscapes might not be aesthetically pleasing when flood proofed.<br>• A range of issues, e.g. accessibility, are likely to arise when climate proofing planning.<br>• Integrating climate change impact into all stages of planning, design and development is a challenge.<br>• There will also be difficulties in moving from policy to implementation.<br>• Difficult to know where to start – LeeCFRAMS will aid local planning for commercial and residential purposes, and may also act as a base for further research.<br>• There is potential for a forum to address some of the aforementioned impacts, could comprise architects, planners and interior designers. By bringing these different groups together it might be possible to draft some form of national guidelines.<br>• The lack of databases to inform planning is an issue.<br>• Sites that historically flooded would have been identified during the planning process.<br>• There is a challenge in bringing about long-term planning informed by science – there is a need for better monitoring data.<br>• Governance structures for necessary decision-making are inadequate – too short-term in their outlook.<br>• If you have an existing industrial setting, do you allow it to intensify if it means more jobs? How do you weigh employment against impacts of climate change?<br>• Do we know the effects and risks facing critical infrastructure, e.g. Lee Tunnel? What level of relocation of key industry is required, are there reasons for focusing strategic defences?<br>• How do we decide prioritisation of resources in the context of protecting industry versus individual households? |

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| | • In many cases, existing industry is a buffer to flooding of residential areas, e.g. Ringaskiddy.<br>• Industry is now subject to better environmental controls; EC acts as a watchdog and the potential for fines acts as a deterrent. The advent of BER is also a positive.<br>• What are the cost implications of taking the steps necessary to protect industrial sites, what are the amounts involved, who pays – has any analysis of the cost been undertaken? This appears to be a gap area in research/analysis; maybe research could be financed by some of the revenue generated from emissions trading? There should be a Europe wide focus on researching the costs involved; that way everyone is using the same formulae / models.<br>• In many cases the savings made will justify the costs of action, e.g. switching to more energy efficient production, etc. |
| | **Built Heritage** |
| **Issues (e.g.):**<br><br>Flooding<br>Sea Temperature<br>Sea Level Rise<br>Sea Chemistry<br>Extreme Weather<br>Waves and Surges<br>Precipitation<br>Temperature<br>Water run-off<br>+ *Others* | **Impacts:**<br><br>• Level of impact may be dictated by how much do we protect / lose – and how do we make this decision, what criteria to use?<br>• Difficult to make any assessment without impact maps.<br>• Need to consider what is being protected – a building, or the cartilage of a settlement where a building is located?<br>• What is covered by the definition of heritage, e.g. bund near Tivoli that is old but still contributes to port operations – remediation costs will be significant.<br>• Given the naval maritime heritage etc of the harbour, is a world heritage designation status warranted?<br>• The Bund in Cork Harbour adjoining Blackrock Castle has broken up meaning that silt will discharge into the harbour. The channel and enclosed area need to be protected.<br>• Property rights – do individuals have the right to defend their site? How effective would individual protection actions be?<br>• Mechanisms for protection might end up having a greater impact than those brought about by climate change.<br>• How many examples of built heritage are threatened due to their coastal location?<br>• Older buildings were built to last – may be more resilient than a lot of modern structures.<br>• The former rail lines at Passage and Carrigaline will be impacted; also impact on rail causeways and viaducts.<br>• What will the public prioritise in the future?<br>• Harbour heritage as a brand to raise awareness of what might be lost.<br>• Socio-economic scenarios may change people's outlook on heritage – values and priorities may change – built heritage might lose out, what is more important a heritage site or an allotment site to grow food.<br>• Impact on industrial archaeology.<br>• There is a role for vulnerability assessment.<br>• Less traffic in future scenarios may reduce impact on heritage.<br>• Technological advances may benefit (e.g. dredging in port now takes place less often and less material is needed to remove).<br>• Changes are unforeseeable – will happen in ways we don't expect (e.g. effect of the arrival of the PC); need to build in resilience as we go along. |

| | **Human Health** |
|---|---|
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | **Impacts:**<br><br>• For something like disease(s) the range of impact is so wide it can be difficult to pinpoint.<br>• Respiratory disease, e.g. asthma, will increase.<br>• Impacts on drinking water. Also, water pollution may become more of a problem due to increased run-off and discharges – will the main drainage scheme be able to offset this increase, can (water) infrastructure cope?<br>• Food security – climate change will impact where food can be grown and the range of fish that can be caught.<br>• Increase in Harmful Algal Blooms (HABs), heat waves and skin cancers.<br>• Different types of insect borne diseases to emerge.<br>• (Re)acclimatisation – marketing Ireland as a comfortable place to work / live / holiday.<br>• Housing stock, particularly local authority housing – impact of cold, damp and mould effects, influence on health, potential for deterioration.<br>• Elevated stress on local health services, strain on resources – will systems be able to cope with increases?<br>• With climate change in mind – will influence future design of housing stock.<br>• Vulnerable elements of society may bear the brunt of impact, e.g. the elderly and heat related deaths.<br>• Fear factor linked to climate change message may lead to stress and related impacts to increase, different reactions to change.<br>• Everyday well being is influenced by weather. |
| | **Port and Shipping** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise | **Impacts:**<br><br>• If, and when, and where we build a barrage/barrier will have huge implications for port operations and residents in the Harbour. Barrage/barrier is one option contained in the LeeCFRAMS.<br>• Some change can be positive – use of a barrier/barrage to generate electricity. In terms of tidal energy we should maximise the potential of the Harbour. Also potential for use of wind turbines to maximise the energy potential of the Harbour.<br>• It takes 400ls of oil to go from Ringaskiddy to the city quays, if Port operations move to the lower Harbour, this would be the fuel saved for each trip by each ship, with a resultant reduction in $CO_2$ emissions. |

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| Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | • Better weather could see an increase in boat trips and water sports – potential impact of interaction with shipping.<br>• The closure of the Harbour to shipping due to adverse weather conditions may become a more frequent occurrence. Access to port could be delayed by more frequent instances of adverse weather – Whitegate is an option for holding vessels if this becomes a problem.<br>• Changes in weather could cause a greater demand for Inner Harbour anchorages during storm events.<br>• New types of ships (and new routes) may be developed to offset travel and transport by road.<br>• Sustainable shipping to become a means of offsetting carbon footprint of the sector – may be many opportunities in this area (for Cork Harbour).<br>• The trend in shipping and port services is to increase everything in size to improve resilience to adverse weather.<br>• The opportunity / need to relocate coastal industrial infrastructure provides a clean slate in terms of coastal planning and development – could impact on how the Harbour will look years from now.<br>• Future port development would take climate change onboard – future proofing.<br>• There is a need for risk assessment, e.g. LeeCFRAMS.<br>• Identification of key infrastructure is required.<br>• An expansion in shipping will imply new ships and new handling facilities – these need consideration when planning for climate change.<br>• Could climate change impact motivate the development of a new freight line network to port locations? In the case of Cork Harbour this is limited by the existing infrastructure and the level of investment required. In any case, the need for road transport to distribute will not be removed.<br>• Emission control in shipping is getting increasingly regulated – but not sure if impacts of climate change on dust/emissions have been considered.<br>• Increased risk of maritime accidents due to anticipated increase of shipping – what is the influence of climate change on accident risk?<br>• Emergency planning/plans need to climate proofed; what is the likelihood of climate change to influence accidents?<br>• Different settlement patterns may give rise to different transport options, e.g. harbour ferry. Whitegate is no longer considered near Cobh – because you cannot easily drive between the two locations.<br>• Opportunities for transport and recreation. |
| | **Fisheries** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise | **Impacts:**<br><br>• Climate change will impact the type of fish found in our waters – we will see changes. Species like cod and haddock will occur less in warmer waters.<br>• Climate Change will have an economic impact.<br>• There will be changes in jellyfish distribution – increased volumes (blooms).<br>• Structural changes will be required in order to make the fishing fleet more capable of withstanding stormier weather, particularly smaller vessels; this will have cost implications.<br>• Competiveness for new and dwindling species stocks will arise. |

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|---|---|
| Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | • Opportunity to market new species.<br>• Cork Harbour is an important nursery ground for cod.<br>• What effect will a barrier/barrage have on stocks (will it impede access to nursery grounds)?<br>• Creation of artificial reefs to offset the impacts of maintenance dredging is an example of one action that can be taken to reduce impact.<br>• Cork Harbour was historically a productive area for aquaculture; remaining aquaculture (if any) will by negatively impacted by increased run-offs and sediment loads.<br>• Changes in pH will negatively impact shellfish.<br>• There are opportunities linked to the arrival of new species in the Harbour, e.g. bream.<br>• The Inniscarra dam does have influence on fish stocks; the ESB and SWRFB have initiated a plan to return fish stocks to pre-dam construction levels. |
| | **Tourism and Recreation** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off | **Impacts:**<br><br>• The association with continuous flooding incidences will/could lead to a negative perception of the Cork Harbour Area. This could lead to a legacy of people not wishing to travel to Cork.<br>• It was noted that it is very difficult to get an overall grasp on the impact of climate change on tourism and recreation. Ireland's tourism industry is very much dependent on human movement. The concept of overseas travel could change dramatically. There could be a social swing away from overseas travel. Global Travel, as we currently know it, could end.<br>• Investment in water based tourism and recreation could be negatively hit due to increased social and financial risk e.g. insurance costs will rise, access to the water could become more difficult due to increased flooding and rough waters.<br>• Many existing tourist attractions in Cork Harbour (e.g. Fota, Cobh) are already under threat by sea level rise. There is also an increased risk to the existing infrastructure (local access to existing attractions).<br>• Changes in seasonality could have both negative and positive effects i.e. warmer temperatures could make Ireland more attractive to tourists but at the same time could increase pressure on the existing infrastructure.<br>• Existing opportunities in Cork Harbour, such as Spike Island could be under treat by sea level rise i.e. access to and from the island could become very difficult especially with rougher waters and increased insurance costs.<br>• Need to identify the broader boundaries of Climate Change.<br>• The natural change in the chemistry of the water could have a positive or negative effect on the recreational fishing industry.<br>• Increased pollution, flooding, industrial pollution, agricultural pollution etc.<br>• Government finance or the lack of will have a major effect on how Ireland tackles climate change. The lack of finance could result in the loss of |

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|---|---|
| + *Others* | state control in combating climate change. Ireland could very well depend upon a (primarily) privately run response to climate change. |
| | **Coastal Defence** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | **Impacts:**<br><br>• The lack of government funding to defend against climate change is a major worry. It is suggested that it will be private investment, which will fund future coastal defence.<br>• Cork Harbour has the potential to raise expenditure if it is protected therefore it is much more beneficial to protect Cork Harbour from flooding (both river and sea) than to protect other more difficult areas in the country. Strategic thinking is required we need to "sell the harbour". We need to conserve what we actually have. We need to promote the idea that Cork Harbour is worth protecting.<br>• Insurance – with continued flooding in certain areas, how long is it before insurance companies refuse to insure people/companies/businesses located in certain areas e.g. the UK problem. |
| | **Agriculture** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature | **Impacts:**<br><br>• The change in weather conditions could effect crop production. In the future different crop types maybe required. Other crops maybe suited to a different climate. This could be seen as an opportunity rather than just a threat.<br>• More extreme weather could result in damage in existing crop types.<br>• Impact on existing species of flora and fauna. New species could lead to increased risk of disease in existing species. (e.g. the native bee population |

| | |
|---|---|
| Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | is already under threat).<br>•Changes in seasonality could lead to a change in farming activity from cattle to arable farming.<br>•Low-lying lands, which are liable to flooding, may become expendable.<br>•There could be a change in land-use values, more emphasis maybe placed on food production rather than the construction of houses.<br>•Impacts on water especially drinking water. Water security and quality is essential for future population. Increased disease in our waters.<br>•High risk to aquifers from increased pollution.<br>•Self-sufficiency could become more prominent in the future. Locally produced food will need to improve in terms of quality and quantity. Local Authorities may need to cater for increased numbers of allotment spaces.<br>••Aquaculture: warmer waters will lead to new fish species in Irish waters. This will have both negative and positive effects on Irish fisheries (e.g. increased jelly fish numbers could have a detrimental effect on Irish salmon stock).<br>•Adaptation is the key. Ireland will need to adapt to its new environment and will need to monitor any changes. In order for this to happen a change in culture is required, as presently Ireland ***reacts*** not ***monitors***. |
| | **Transport** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature | **Impacts:**<br><br>•Extreme weather will have major financial consequences on the operational costs of running the harbour, (e.g. port operation and repairing infrastructural damage etc.)<br>•Shipping under threat, tighter shipping berths, rougher waters will affect shipping traffic. In the future, the tourist Liners trade maybe unable to dock in Cork Harbour.<br>•The increased threat of flooding will lead to problems for docking, container storage, berth size etc. Existing facilities are all under threat from sea level rise and increased flooding.<br>•We need to identify the critical infrastructure, which is under threat form sea level rise and flooding (e.g. Cork to Cobh rail line and road).<br>•The uncertainty of the impacts of climate change is an enormous challenge for infrastructure planning. It is very difficult to cost and engineer a solution based on uncertainty.<br>•There is a need to put in place a strategic plan for climate change. We need to take the long-term view and start developing long-term solutions. |

| | |
|---|---|
| Water run-off<br><br>+ *Others* | |
| | **Energy** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature<br><br>Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | **Impacts:**<br><br>• Energy requirements and costs will increase. There will be more demand for water pumping, air conditioning etc.<br>• Ireland will need to make a concerted shift to renewable energy. It is necessary to consider our potential to become an energy generator. There needs to be real investment from both public and private bodies into renewable energy including wind, tidal and small hydro.<br>• Cork Harbour could establish itself as a hub for renewable energy. The knowledge and business base already exists within the harbour to design a renewable energy strategy. Cork Harbour could be a test bed for renewable energy solutions; the harbour already has more potential for renewable energy than a lot of other locations in the country.<br>• Energy security is going to be key to Ireland's future economic base.<br>• Overseas companies and inward investment will be attracted to Ireland if we have in place a "Green Infrastructure" - "Companies want to become Green or at least to be seen as Green".<br>• Require a policy change at both European and national level with regards to the National Grid connection costs. |
| | **Biodiversity** |
| **Issues (e.g.):**<br><br>Flooding<br><br>Sea Temperature | **Impacts:**<br><br>• Green energy infrastructure e.g. wind farms have the potential to effect the biodiversity of Cork Harbour.<br>• Eco –system change could lead to new species destroying existing habitats but at the same time creating new habitats.<br>• The conservation status of certain habitats will change as a result of the change in climate. However, this threat of loss of habitats could lead to an |

| | |
|---|---|
| Sea Level Rise<br><br>Sea Chemistry<br><br>Extreme Weather<br><br>Waves and Surges<br><br>Precipitation<br><br>Temperature<br><br>Water run-off<br><br>+ *Others* | opportunity to create these habitats elsewhere e.g. there is potential to replace habitats form Cork Harbour in the North Channel.<br>• The National Parks and Wildlife monitor biodiversity. See recent report.<br>• The perception of the harbour is very important and needs to be improved. We need to place a value on what biodiversity means to the harbour. The good quality of life, which can be appreciated by those living in the Harbour area, should be promoted. |

## Identification of Constraints

A number of key constraints, common to most of the sectors were identified during the group discussions; these can be summarised as:

- Lack of strong leadership;
- Role of national and local politics;
- Regional problems, e.g. European Directives;
- Economic costs of change, and financial restraints;
- Lack of information /education;
- Absence of a baseline, particularly in relation to vulnerability;
- Denial of timescales; and,
- The overwhelming size of the challenge that lay ahead.

## Comments on Preparedness

- General feeling is that we are not as yet at an advanced level of preparedness; and there is a requirement for leadership;
- The international community will have a role in this context;
- However in some instances, progress on preparedness has been achieved through measures such as: the Lee Catchment Flood Risk Assessment and Management Study (Lee CFRAMS); the Maritime and Energy Cluster (MERC) Ireland initiative, which is set to be located in the Harbour area; the work of certain voluntary groups; and,

- Certain sectors will be well positioned to exploit opportunities due to varying levels of preparedness.

## Appendix A (Workshop Programme)

9:00 Arrival and Refreshments

9:30 Welcome and Introduction to Workshop

**Val Cummins – Coastal and Marine Resources Centre**

9:40 Role of Cork County Council in Development of Adaptation Strategy for Cork Harbour

**Padraig Moore – Planning Policy Unit, Cork County Council**

9:50 Global Drivers and Current Climate Scenarios

**Prof. Robert Devoy - Department of Geography, UCC**

10:10 Ireland's Response to Climate Change

**Dr. Margaret Desmond – Environmental Protection Agency**

10:30 Instructions for Group Session

**Jeremy Gault – Coastal and Marine Resources Centre**

10:35 Refreshment Break

10:55 Facilitated Group Discussions

Following the presentations, workshop participants will break into two groups to discuss their thoughts and opinions on how a range of sectors in Cork Harbour will be impacted by issues related to climate change – impacts can be **social**, **economic**, or **environmental**. We will

also examine how prepared we are to tackle these issues, and what are the obstacles to meeting the challenges ahead. The sectors of activity to be examined are:

1. Tourism and Recreation
2. Coastal Defence
3. Agriculture
4. Transport
5. Energy
6. Biodiversity
7. Settlement and Land-use
8. Industry and Commerce
9. Built Heritage
10. Port and Shipping
11. Human Health
12. Fisheries

12:45 Lunch (Optional)

**IMCORE WP 2.3 Donegal County Council Lough Swilly: Driver and Issue Identification Workshop**

| | | Sector/Issue | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Timeframe** | **In General** | **Storms/ Storm Drainage** | **Sea Defences/Erosion** | **Harbour/infrastructure Developments** | **Marine Leisure Investment** | **Flooding** | **Pollution** | **Building Design** | **Development of County Development Plan/Local Area Plans/Forward planning** | **River Basin Management Plans** | **Biodiversity** | **Tourism** |
| Short-term | | yes | yes under public pressure to use hard engineering approaches | yes, safety access for rescue boat difficult at Buncrana pier due to siltation caused by bridge/marina development at Inch and Fahan | yes, investors wasting money doing preparatory work for proposals in desiganted areas or areas at risk of flooding /erosion when they have no chance of attaining statutory permissions. | yes, low lying roads, and coastal areas around the lough, broken embankments, private property flooding in storm conditions | yes, caused by flooding of low lying areas e.g. inch island SAC below sea level vs septic tanks in the area. | | yes, size of problem needs to be determined also need to think in terms of 50 -60 years with the normal 3-6 year planning cycle encompassed withthis lng term plan | yes should work closely wihthis initiative | yes areas such as Inch and the numerous SAC's SPA's in Lough swilly unerthreat form pollution, flooding and inappropriate use. | yes, Tourism industry relies on sustainable management of the coast and resource. Also need to manage pressure on environment with increasing tourism - need for environmental sustainablility |
| Medium-term | | | yes | Management and maintenance of piers | yes, as above | yes, as above | yes, as above | | yes, as above | yes should work closely wihthis initiative | yes, as above | yes, as above |
| Long-term | | yes | yes | yes as above | yes, as above | yes, as above | yes, as above | Need to think long term for planning design e.g. design of floor level to account for increased risk of flooding. | yes, as above | yes should work closely wihthis initiative | yes, as above | yes, as above |

| **Equipped to deal with impacts?** | **In General** | **Storms/ Storm Drainage** | **Sea Defences/Erosion** | **Harbour/infrastructure Developments** | **Marine Leisure Investment** | **Flooding** | **Pollution** | **Building Design** | **Development of County Development Plan/Local Area Plans/Forward planning** | **River Basin Management Plans** | **Biodiversity** | **Tourism** |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Poor | | Need to look at the cumulative affects rather than development by development assessment | Need long term policy backing (what to use where and when) also need DCC policy for soft engineering | Information was probably there but was not easily accessed by planners | Information is available but there is a lack of integrated guidence for developers | Need more proative approach and forward planning to ensure planning permission is not given in areas of risk. Tools such as the Regulatory tools developed by MI could be used. | Cumulitive impacts of one off housing not being assessed e.g. numerous septic tanks in an area at risk of flooding adjacent to SAC/SPA at Inch island | | Very little consideration given to Climate change at this level. | Difficult to break them down to a local level such as L. Swilly | | Tourism relies on the scenery, clean environment, managed facilities etc. Industry itself not equipped to deal with infrastructural climate change impacts e.g. roads on west coast (Ramelton - Rathmullan)of L. Swilly at risk of flooding; heavily reliant on |
| Medium | A lot of theoretical background but little or no practical appliaction on a day to day basis e.g. for planning assessment due to lack of filtration of extrtise and data within the council | | WFD and Irish Marine Institute have developed tools - a regulatory tool to determine the impact and morphological significance of impacts and thersholds | | | | | | | | | Increased temperatures will increase visitor numbers and in turn will increase the impact visitors have on the environment- e.g. dune management, beach access, basic beach services, toilets etc, litter, conflicting activities, staffing for extended season |
| Good | | | | DCC have all the information but it is not used or shared properly resulting in a disjointed approach to development and management.<br><br>Costs of raising a pier not onerous | | | | Designs will take on a new form having car parking etc on the lower levels and accommodation at higher levels. | | Considerable overlap with IMCORE and complementary research, expertise, and regulatory tools have been developed. | | |

**Contraints**

| |
|---|
| Funding |
| Need to change council structure; there is a lack of coordination between divisions, a lot of information knowledge and expertise within the council which is not being used or shared. Certain issues need to be addressed from the top down rathre than from |
| No local or county wide policy |
| Resources: loss of specialist skills from DCC staff (Very little response to Climate Change in DCC) |
| Political buy in & understanding: elected members need to be better informed and recognise the significance of climate hcange - need to look beyond their time in office. |
| Communication |
| Education of the wider public to increase an understanding of Climate Change and the necessary management of the coastline. |

## 4.

# Impacts of Climate Change on the Severn Estuary
# Inaugural Meeting of the Research Advisory Group

***Monday 29th January 2007,***
***Create Centre, Bristol***

**REPORT COMPILED BY THE MARINE AND COASTAL ENVIRONMENT RESEARCH GROUP, CARDIFF UNIVERISTY AND THE SEVERN ESTUARY PARTNERSHIP**

**CONTENTS**

**GOALS OF WORKSHOP:**
To raise awareness, network scientists & professionals, improve climate change planning

**AIMS OF WORKSHOP:**
- To identify research priorities for the marine impacts of climate change on the Severn Estuary.
- To explore how research activity on the estuary could be better integrated and related to the needs of government and public, and disseminated as part of an ongoing Research Advisory Group.
- To be an opportunity for networking, getting better informed and obtaining input of views from both scientists and professionals.

**Table 1 Workshop programme**

| Time | Event | Person |
|---|---|---|
| 1030-1045 | **Welcome** | Dr Hance Smith<br>Dr Rhoda Ballinger,<br>Natasha Barker, SEP |
| 1045-1115 | **Impacts of Climate Change on the Severn Estuary** | Dr Tim Stojanovic, Cardiff University |
| 1115-1130 | **Refreshment Break** | |
| 1130-1145 | **Thames Estuary Partnership Research Forum** | Tim Reader Environment Agency |
| 1145-1215 | **Planning and Management Perspective** | Laurie Newton, UKCIP<br>Roger Wade, EA |
| 1215-1245 | **The Science Perspective** | Dr Ted Bryant, University of Woolagong<br>Prof. Simon Haslett, Bath Spa University |
| 1245-1345 | **Lunch** | |
| 1330-1345 | **Briefing** | Dr Rhoda Ballinger |
| 1345-1445 | **Parallel Meetings:**<br>**A. Applied Science**<br>**B. Evidence Based-Policymaking** | A. Drs Hance Smith / Tim Stojanovic<br>B. Dr Rhoda Ballinger / Natasha Barker |
| 1445-1500 | **Coffee Break** | |
| 1500-1600 | **Plenary**<br>**Linking Research with Strategic Planning Goals** | Rhoda |
| 1600-1615 | **Interactive Session**<br>**Running the Advisory Group and the Way Forward** | Dr Rhoda Ballinger/<br>Natasha Barker, SEP |

## SUMMARY OF MEETING

*WELCOME*
**Dr Hance Smith (Cardiff University)** chaired the morning session.

**Dr Rhoda Ballinger (Cardiff University)** introduced the aims of the workshop in the context of the Interreg COREPOINT COastal REsearch and POlicy INTegration) project. This project is promoting best practice in Integrated Coastal Zone Management across North West Europe and is focusing on the interface between research and policy for coastal zone decision-making.

**Natasha Barker (Severn Estuary Partnership)** provided a short background to the value of the Severn Estuary, role of the Severn Estuary Partnership and importance of addressing climate change impacts and adaptation options: the Severn Estuary is one of the largest low-lying catchments with the largest tidal range in Europe. It has approximately 3 million people living around it, where 80% of the shoreline is artificially defended.

## IMPACTS OF CLIMATE CHANGE ON THE SEVERN ESTUARY

***Dr Tim Stojanovic, Cardiff University***
*(See Appendix 3 for pdf of presentation)*

Tim gave a detailed presentation on climate change issues and a vision for a Severn Estuary Climate Change Advisory Group.
The aims of a potential Research Advisory Group were outlined in the context of national actions (e.g. Stern Review, Nottingham Declaration).
Climate Change impacts (6), adaptation and mitigation issues were detailed and delegates asked to rank them on a feedback form:

1. Regional climate change around the estuary
2. Sea level change
3. Storminess and sediments
4. Impacts of coastal ecology and ecosystems
5. Impacts on environmental systems
6. Vulnerability assessment
7. Adaptation
8. Mitigation
9. Integrated assessments.

Tim drew delegates' attention to the database of over 450 citations on climate change and Severn Estuary related research papers which Cardiff University has prepared, to be available free to the workshop delegates. A contacts list of >250 (potentially) interested parties has also been drawn up.
The advantages of forming an Advisory Group (AG) were outlined for scientists, planners & managers and the Severn Estuary.
The possible structure of an AG was illustrated, noting that there are 12 universities, 14 local authorities and 3 Environment Agency regions around the estuary.

*PRESENTATIONS*

## THAMES ESTUARY PARTNERSHIP RESEARCH FORUM

***Tim Reader, Environment agency & Chairman of the Thames Estuary Partnership Research Forum***

*(See Appendix 3 for pdf of presentation)*

Tim described the work of the Thames Estuary Research Forum and its associated research network. As the network had not focused on a specific theme/research topic, he explained that it had experienced difficulties in momentum since the end of the European funding stream, which had enabled the setting up of the forum. However, it had produced useful outputs including:

- State of the Estuary report
- Research database
- Research agenda
- Supported the Thames Estuary Forum – the 'lifeblood' of the Thames Estuary Partnership.

His experience led to the following recommendations for the Severn Estuary:

- Ongoing momentum of an Research Advisory Group requires staff co-ordination
- The new Thames Estuary Partnership 'Friends Group' was designed to provide supporting funding
- Don't raise expectations beyond means
- Good to take the climate change angle – this theme could help to re-energise the Thames Research Forum.

## PLANNING AND MANAGEMENT PERSPECTIVES

***Laurie Newton, UK Climate Impacts Partnership (UKCIP)***

*(See Appendix 3 for pdf of presentation)*

UKCIP was founded in 1997 at the University of Oxford to look at the impacts of climate change. Capacity building is at the core of its work. Laurie outlined how local authorities in England are responding to the climate change challenge in practical and policy terms. Many local authorities (in England) have signed up to the Nottingham Declaration, a voluntary pledge to exhibit their concern. A 2$^{nd}$ version of the Declaration was prepared in 2005 with greater emphasis on adaptation and commitment with action plans on a 2-year voluntary basis. The UKCIP target is for 200 Councils to be signed up by the end of 2006; there are 187 at the moment. Local Authorities are seen to be important due to:

- Managing their estates
- Service providers
- Community leaders

The Nottingham Declaration supports authority-wide action, but the local authorities are driven by comprehensive performance assessments in which climate change is not a major driver. It is therefore difficult for them to obtain funding for climate change work. The Energy Saving Trust host the Nottingham Declaration partnership website at the moment. UKCIP provide training to local authority staff. Laurie indicated how local authorities operate on relatively short planning horizons whilst some of the climate change impacts require longer-term pre-emptive action. Information about climate change needs to be or more local relevance e.g. through qualitative risk assessments.

The Local Government Association (for England) is soon to launch a Climate Change Commission. The drivers for local authority actions may change with the Local Government White Paper 'Strong and Prosperous Communities' at the end of 2006 leading to 200 national indicators from which they can chose 35 locally to achieve national targets. Defra are lobbying for climate change indicators.

## THE SEVERN ESTUARY AND CLIMATE CHANGE: MANAGEMENT ISSUES

***Roger Wade, Environment Agency***

*(See Appendix 3 for pdf of presentation)*

Roger, who had been involved in the early stages of the development of the Strategy for the Severn Estuary and formation of the Severn Estuary Partnership, illustrated the likely direct and indirect impacts of climate change on the Severn Estuary.

Direct impacts:

- Flood risk management and coastal erosion with a 20-80cm increase in sea level.
- Habitat management
- Water resources

Indirect impacts:

- Renewable energy
- Aggregates (new build and knock-on effects)
- Leisure

Within this context he made the following points:

- Have we got enough local data and ground truth?
- The flooding costs could be huge e.g. from £1 billion to £20 billion national cost by 2080 which will put the 'flood defence' industry at the same level as education and defence.
- Information was quoted from the *Foresight* report
- We need a strategy for the whole of the Severn, being progressed through the *Coastal Habitat Management Plan (CHAMP)* and *Shoreline Management Plan* processes.
- The EA have a 100 year strategy for flood risk between Newport & Chepstow
- The EA have 10 year trends for birds but need local figures
- Low summer flow could decrease by a further 50% leading to saline intrusion in fresh water supplies (e.g. major abstraction for Bristol above Gloucester).
- Renewable energy needs may demand compromised habitat protection
- Health issues and tourism.

Next steps were recommended, including the need to:

- Develop indicators to really monitor what is happening
- Scope potential impacts e.g. at Avonmouth
- Map structures and assets at risk
- Develop and implement strategic planning
- Ensure consultation and working in partnership.

## SCIENCE PERSPECTIVE

***Professor Simon Haslett, Bath Spa University***

*(See Appendix 3 for pdf of presentation)*

Simon described the circumstances around the 1607 storm surge/tsunami that caused significant flooding around the Severn Estuary on 30th January 1607. He felt that a Research Advisory Group would help scientists make links with the government agencies and NGOs to help drive research forwards. He indicated that many academics are field scientists instead of modellers. Evidence surrounding the 1607 flood includes:

- Configuration of the shoreline – the natural shoreline would be different
- Salt marshes and peat bogs would have surrounded the estuary 400 years ago
- Norman churches built in the 'Medieval warm period' were covered by sand dunes.
- The Levels are below high tide…we have a 'fossil surface'
- Scientists have cored 30m into the bedrock to expose the sub-surface sediments in the Levels to reveal shoreline evolution
- Salt marsh has accreted vertically due to vegetation and horizontally due to sediment. In the inner estuary (upstream) there is high sediment therefore as sea level increases sedimentation will too. In the outer estuary (downstream) around Clevedon and Weston-Super-Mare less sediment means salt marsh areas are more likely to drown.

**Dr Ted Bryant, University of Woolagong (Australia)** indicated that 2200 people drowned in the 1607 flood and presented evidence of why it could have been a tsunami:

- There were less storms then than now
- There was no other storm damage reported
- It has been estimated (Horsborough, 2007) that a tide of 7.86m OD ½ hour after high tide could flood 520km coast and 200km2 around the outer Bristol Channel & Severn Estuary.
- The inclination of boulders (e.g. at Dunraven Bay, S Wales and at Sudbrook) and large boulders near Severn Bridge indicate large waves; storm surges are higher out to sea so one would expect larger floods out to sea. A 25m storm surge, 7 times bigger than the 50 year return period would have been required for this, but a 3-4m tsunami could have had the same impact as it increases in height upstream.
- The sluice gate keepers were probably wiped out by the storm therefore it was several days before they were opened e.g. Kingston Seymour flooding stayed 5ft high for 5 days.

The implications of this research provide an insight to the potential impact of climate change impacts with increased storminess and sea level rise. Our existing defences would be overtopped if there were a similar event. It has been estimated by Robert Muir-Wood that based on a 5ft-water ponding (that was initially higher) there would be a £30 billion cost to society. Climate warming is likely to bring more storms. Sea level was 1m lower in 1607.

*PARALLEL DISCUSSIONS*

Rhoda Ballinger chaired the afternoon session and introduced the purpose of the afternoon and the two parallel sessions. In particular, the afternoon was to provide an opportunity for detailed discussion of:

- The research community's needs & aspirations on coastal climate change
- Policy makers needs for climate change implications
- Synergies between priorities for coastal climate research from researchers & policy makers
- The development of a Severn Climate Change Advisory Group

The break-out sessions aimed to focus on specific topics relating to coastal climate change and the Severn Estuary, relevant to the two cohorts. The scientists and policy makers separately addressed their activities and needs for climate change information & co-operation. The researchers and scientists focused on the research community's needs and aspirations and, in particular, the priorities for climate change research around the Severn Estuary. The policy-makers, in contrast, focused on the needs of evidence-based policy and, in particular, policy-makers needs for climate change information.

# A EVIDENCE-BASED POLICY-MAKING

***Convenors: Dr Rhoda Ballinger and Natasha Barker***

The following section is a summary of points taken from flip-charts and additional notes based on the discussions within the break-out session involving policy-makers and practitioners:

**Who is interested in climate change information?**

The following list is compiled from those organisations which were represented in this break-out session:

- Welsh Assembly Government – what research exists, gaps, funding needs, what can WAG do
- CCW & NE – habitat response, impact of climate change on habitats and species over next 100 years, strategic overview of the estuary,
- SWCIP – adaptation & mitigation, input to regional spatial strategy & other key policies
- WWF (NGOs) – energy, strategy, action plans, development control, local service provision, mitigation, how will climate change affect Development Strategies
- Local Authorities – catchment plans, flood risk plans, asset management, energy, adaptation and mitigation, data and information specific to Severn to inform planning, access to non-technical information
- Environment Agency – scientific communication, science to influence Defra, flood risk management, data not modelling, monitoring and observation

There is a need for more monitoring to secure evidence to raise public engagement. More government funding is needed to spur action.

**Why do we need coastal climate change information?**

The following needs for coastal climate change information were highlighted by the participants:

- Local data & monitoring, particularly to assess cumulative effects and provide local interpretation for EA flood risk assessments
- Policy development e.g. development in flood risk areas (PPS25 & TAN15)
- Development control advise from the experts – issue awareness
- Raise public awareness
- Manage risk and define levels
- Sea defences maintenance/other options
- Renewable energy options and impacts e.g. wind turbines and bird surveys
- Space for essential needs e.g. crematoriums in low lying land
- Sustainable and appropriate building design
- Communication of information, accessibility & interpretation (e.g. 'Making Space for Water')
- Longer planning timeframes (SMP 0-20, 20-50, 50-100 but political 5 years)
- SPA designation need for bird monitoring not just of numbers but the scale of change/impact on bird movements.
- Transferring data into information, knowledge and capacity.

**Information Needs**

The following information requirements were raised by participants:

- Sea level change – clear information and level of defence needed
- Temperature – land use policy
- Water chemistry & geomorphology – coastal squeeze
- Local data, easy to access and understand
- Welsh and English specific references – balanced for Severn Estuary
- Understanding *how* the estuary is going to change, assessing against now and looking at future scenarios including the detailed implications
- Studies by consultants to be made more widely available as they are often the mechanism used by government agencies to link with scientists.
- Visualisation of how the estuary is going to change
- How will climate change affect Development Strategies

# B APPLIED SCIENCE

***Convenors: Dr Hance Smith & Dr Tim Stojanovic, Cardiff University***

**A. Review of Current Research Activity relating to the Estuary**

The following table summarises the current research activity outlined in the break-out session.

**Table 2 Current Research Activity relating to the Severn Estuary**

| Initiative or University/Department | Research Area | Contact | Comments |
|---|---|---|---|
| Severn Estuary Levels Research Committee | Archaeology | Richard Brunning | |
| Glamorgan, Environmental Research Unit | ICZM | Dr Simon Jones | ICZM, Conservation and Coastal Management on the Severn Estuary |
| | Coastal and Marine Palynology | Dr Anthony J Harris | |
| | Science Communication | Dr Rob Morgan | |
| | Coastal Geomorphology | Dr Alan Williams | |
| Cardiff, Marine and Coastal Environment Research Group | Coastal Surveys including hydrographic surveying | Dr Chris Wooldridge<br>Dr Rupert Perkins<br>Mr Ian Fryett | |
| | Science Policy Integration | Dr Rhoda Ballinger<br>Dr Hance Smith | COREPOINT Project<br>SPICOSA Project<br>(Major EU projects on coastal science and policy) |
| | Marine & coastal ecology | Dr Rupert Perkins | |
| Bath Spa | Coastal Geomorphology | Prof. Simon Haslett | |
| | Long Term Environmental Change | | |
| Reading | Coastal Geomorphology/ Geoarcheology | Prof. John Allen | |
| Bristol | Global Climate Change | | |
| Cardiff University | Grab Samples | Dr Chris Metham | |
| National Museum of Wales | Historical and Cultural Studies on the Estuary | | Ports, Shipping, archaeology |
| Met Office, Hadley Centre | Climate | David Griggs | |
| Bristol Port Company | Bathymetry | | 3 monthly Bathymetric data |
| Associated British Ports, South Wales | Bathymetry | | |
| University of West of England, Severn Estuary Research Group | Fish Populations | Dr David Bird | Need for more funding for ongoing monitoring |
| | Biomonitoring of Pollutants | Dr David Bird | In particular invertebrates |
| Cardiff University, Institute of Sustainability, Energy and Environmental Management | Modelling of Sediment Transport | Prof. Roger Falconer | |
| | Bacteria-Sediment interactions | Prof. Roger Falconer | |
| National Oceanographic Centre (Southampton), Centre for Coastal Processes Engineering and Management | Erodibility of fine grain sediments | Carl Ames | |
| | Morphology/Evolution of Sandbanks | Paul Carling<br>D. Jones | |
| | Vulnerability of Coastal Systems | Dr Daffyd Lloyd Jones<br>Prof. Rob Nicholls | |
| | Response of Coastal Systems to Climate Change | Dr Daffyd Lloyd Jones<br>Prof. Rob Nicholls | |
| University of West of England, Geography Department | Long term environmental Change | Dr Chris Spencer | Ground truthing with present day, implications for measuring climate change |
| | Monitoring<br>Sediments<br>Plankton | Dr Chris Spencer | |

*Table 2 contd.*

| Initiative or University/Department | Research Area | Contact | Comments |
|---|---|---|---|
| University of Bristol | Climate Change Impacts and Coastal Flooding | Prof. Paul Bates | |
| | Flood Inundation Models Scenario Models | Prof. Paul Bates | 3 year postdoctoral research post focusing on Severn Estuary Sponsored by |
| UKCIP | Climate Change Scenarios Precipitation, Storm Surge, Sea Surface Temperature | Richard Westaway | Models from Hadley Centre in 2008 will be<br>1. Ensemble Models<br>2. Risk Based<br>3. Marine Scenario with 25km grid |
| South West Climate Change Impact Partnership | | | |
| Marine Climate Change Impact Partnership | Report Card | | |
| Swansea Institute | Morphological Change<br>1. Linear Shoreline Evolution<br>2. Beach Evolution<br>Risk Analysis | Dr Mike Phillips | Linear models of Shoreline Evolution<br><br>Case Study data on beaches in Penarth, Gower and Tenby |

**Other current research activity/resources:**
Reference was made to the following key resources:

- Severn Barrage Studies, 1977
- Bristol Channel Marine Aggregates and Constraints Study (Welsh Assembly Government, 2005)

In addition the work of Bob Kirby, R. Uncles and Prof. Allan T Williams over a number of years has built up a considerable knowledge base on the Severn Estuary.

**B. Research Priorities**

At present, little integrated data collection is conducted for the estuary in comparison with other UK estuaries:
e.g. NERC project on the Humber
e.g. Environment Agency Project on the Mersey

Where the data does exist it is difficult to access for research institutions
e.g. National Flood and Coastal Defence Database

Prof. Falconer used the example of data requirements to run deterministic models for the estuary. This is not currently possible for the most dynamic estuary in the UK due to data limitations

Sediments are one key unifying issue on the estuary (and their re-entrainment in the system through developments such as the barrage or renewables)

Legacy of contamination
Benthic species
Major cadmium pollution (amongst the most significant in EU estuaries)

The respondents felt that there were five key areas requiring urgent work

- Downscaling of climate change assessment for the estuary
- Assessments of the state of the whole estuary
- Social and economic assessment of climate change impacts
- Impacts on tourism around the estuary (linked with priorities for Welsh Assembly Government)
- Mapping of assets at risk from climate change

In addition the noted the role of Applied research in Impact Assessment, including:

Remote Sensing
GIS of monitoring activities
Development of time-series and better use of established monitoring information
Offshore Habitat Mapping
In order to form a baseline for impact assessments c/f recreation, renewables, aggregates.

A number of climate change assessment tools have been developed or are in place (e.g. Thames 21 Project) but need to be applied to the Severn Estuary. Therefore Knowledge Transfer bids may form an appropriate source of funding to develop this kind of work

**C. Developing Research Bids and Current Funding**

It was stressed that any bid to the research councils (NERC/ESRC) will have to focus on the unique aspects of the estuary in order to be successful. Amongst these are:

Physical Geography
Size and dynamic range of the estuary
Short, steep catchments, e.g. Ebbw Vale

High percentage Intertidal area
This is linked with estuaries' ecological importance
Wading birds and other biota such as fish and plankton

Human Geography
Aggregates resource
A big resource in terms of its significance to South Wales and W.England and close into the shore
Three Nuclear Power Stations (each with good sea temperature records)
Renewable Energy
Significant potential resource in terms of Tidal Barrage proposal and other small-scale renewable energy projects

Any bid will also have to justify how the Severn Estuary Research Advisory Group on Climate Change is a distinctive contribution.

It was recommended that funding for Climate Change research based on commercial or industrial resources could be targeted from a number of priority areas:

- Aggregates
- Renewable Energy
- Severn Barrage
- Sustainable Development
- Tourism

The group suggested that interaction between Scientists and Practitioners is required for:

1. Co-ordination and Better Availability of Monitoring Data
2. Data Management to enable the above (Metadata, Data Access, Copyright)
3. Involvement of Scientific Research in Integrated Assessment of Risks
4. Various Human Uses of the Estuary acting as drivers for the funding and undertaking of research

*DISCUSSION*

The following notes provide an overview of the afternoon's plenary discussion.

**Data issues:**
The participants stressed the need for there to be:

- improvements with regard to data access – Reference was made to the Freedom of Information Act with government information and commercial (e.g. LIDAR data)
- more monitoring needed e.g. gaps in bird surveys and the cumulative impacts in areas such as energy proposals and development

**Information needs, access and availability:**

- Needs to be easily digestible & quickly accessible & specific to the Severn
- Room to explore knowledge transfer between the data held by private companies and business (example cited – ABP's reluctance to provide data on the Severn)
- Privately held data is not forthcoming
- CCW noted that under the Freedom of Information Act they have large amounts of information available; for example, when they receive consultations or scoping documents, this information that is submitted by consultants is then available to the public (there are exceptions to this and other data that they hold, e.g. LIDAR data has to be bought)
- Those managing nature conservation sites need to know scale of climate change and impacts on sites and species
- Need processes to smooth transfer of data and information
- Consultants, with vast amounts of Severn-related data and information need to be engaged

**Local Authority issues:**

- Local authorities need to pose questions to highlight research needs
- Local Authority needs are wider than just development planning, need to consider Community Planning process, Community Strategies. Climate change should be worked into the priorities of community strategies.
- Differences and similarities between Welsh and English LA approach to climate change e.g. Nottingham Declaration
- Mitigation focus of elected member group in Wales
- How will climate change affect LA services or areas
- Need to consider the range of Local Authority technical officers that could/should be involved in the Research Advisory Group, for example, Policy Officers, Flood Engineers, Drainage Engineers, emergency planners.
- Many of these need to be need to be involved in the community planning process INCLUDING Councillors.
- Mismatch of information needs and interests of technical officers and elected members
- Development control – need climate change facts and figures relevant to the estuary– accessible clear and quickly- stronger evidence needed

**Funding issues:**

- Tourism, renewables, aggregates
- Major industrial areas e.g. Avonmouth
- Potential of Crown Estate funding (remarketing of bids e.g. climate change branding of projects)
- COREPOINT 2 possibilities
- EU Framework 7 funds for the period 2007 – 2013
- EU SPICOSA project possibilities for the Severn
- Future collaborative estuary project was suggested by Prof. Faulkner, e.g. possibility of linking 2 or 3 Local Authorities and at least 3 estuaries, e.g. Med. or Baltic
- Defra Climate Challenge / Communicating Climate Change (England) – Natasha Barker to keep the group updated with developments with regard to this funding pot
- Strong need to convey the uniqueness of the estuary when seeking scientific funding was reiterated (stated by scientist)
- Research Councils want projects that meet their needs and some of the elements being looked at by the research advisory group wouldn't be compatible

**Other points:**

- many of the tools and datasets already exist, identified within the 2100 Thames project
- CFMPS, SMPs, Community Plans, River Basin Management Plans – different policy timescales, and need different scientific/research inputs
- It is important to note when looking at policy makers needs, who's asking and why they are asking
- Public awareness and risk needs to be explored, helpful if people defined levels of risk, risk scenarios to be produced for the Severn
- Emphasis that the designations that the Severn has e.g. SAC, are estuary wide
- Tools for assessing policy – key output
- Posing the policy /practitioner questions – including in bids
- Use of right terminology
- Accept varying science / practitioners drivers and rewards - innovate
- Note that the Welsh Assembly Government have established a climate change cross-sector group
- Need to deal with increasing policy divergence between England and Wales
- Other plans being developed that need inputs:-
    - Severn Estuary CHaMP 2008
    - Severn Estuary SMP2 2010
    - River Basin Management Plans (WFD) 2012
    - Catchment Flood Management Plans

*RUNNING THE ADVISORY GROUP & THE WAY FORWARD*

Natasha Barker emphasised how the Severn Estuary would be at the frontline of receiving the impacts of climate change. She sought confirmation from participants that an estuary-wide approach to the problems was valuable and asked for completion of the feedback forms to guide the way forward.

It was pointed out that establishing an advisory group would involve consideration of:

- Purpose
- Representation/membership
- Modus operandi (frequency of meetings, terms of reference, reporting, leadership etc)
- Funding (Knowledge-Transfer partnerships, Defra, EC Framework 7 & Interreg etc)
- Links to other groups

Hance Smith summed up the day, emphasising that the resources that science offers are needed to ensure that human use & the environment are compatible.

## APPENDIX I CLIMATE CHANGE ISSUES: FEEDBACK FORM ANALYSIS

16 forms from workshop delegates were received and analysed. The table below (Table 3) summarises the respondents' views in relation to their top climate change-related priorities. Although the topics are highly inter-related and, therefore, somewhat difficult to isolate and rank, it is clear that the respondents were concerned with most of the topics listed. In particular, there were most votes for 'vulnerability assessment' (9), followed closely by the priorities for physical climate change topics, notably topics 1, 2 and 3 (storminess, sea level change and climate change itself).

**Table 3 Delegates climate change priorities**

| Topic no. | Topic | Score rating[1] | | | | Comments |
|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | Summary (total no. votes) | |
| 1 | Climate change | 2 | 2 | 2 | 6 | Key factors that can be used in predictive models<br>Rainfall intensity values (range); wind (speed & direction) to generate waves and cause/exacerbate erosion.<br>The Severn Estuary is particularly vulnerable to climate change and extreme weather events. |
| 2 | Sea level change | 4 | 2 | 1 | 7 | The key challenge facing all coastal areas in future.<br>Driver for increasing flood risk and storm surges.<br>Much defended land around the estuary with high value assets<br>What impacts will there be in terms of flooding and coastal damage and how we adapt to this.<br>Information currently provided by Defra (see PPS25/TAN 15 Wales). We must ensure that we are aware of the latest publications. |
| 3 | Storminess & sediments | 2 | 3 | 2 | 7 | Possibilities of massive economic impacts<br>Need increased information on risk – what is the increased storm risk and what does this mean for stability?<br>Sea level change/rise will increase flood risk as will the projected increase in storminess and foreshore erosion.<br>This automatically impacts on 4, 5 and to some extent 1 and 2.<br>Particular interest in sediment transport and flooding and computer modelling of these processes. There are huge assets vulnerable to flooding along the Severn. |
| 4 | Ecological impacts | 1 | 1 | 2 | 4 | What are we loosing and gaining in the Severn?<br>Which species are expected to move?<br>How does this affect the use of resources?<br>How well can species adapt?<br>What mitigation issues can be implemented?<br>What happens when a habitat or biodiversity is fundamentally altered?<br>Underpins biodiversity and conservation.<br>Medium to long-term monitoring required. |

[1] Delegates were requested to rank their top three issues in order of importance and to provide additional comments.

*Table 3 contd.*

| Topic no. | Topic | Score rating | | | | Comments |
|---|---|---|---|---|---|---|
| 5 | Environmental systems | | 2 | | 2 | Changing species compositions will alter ecosystems and their management.<br>How does this relate to the Water Framework Directive? |
| 6 | Vulnerability assessment | 2 | 5 | 2 | 9 | This considers 4 & 5 and leads to 7.<br>Such include coverage of issues 1 – 3 above<br>Linked to 2 & 3 above – what are the impacts given SLR and increased storminess and how do we assess vulnerability?<br>Including impact on tourism (important in Severn)<br>Impact on vulnerable communities<br>What is the expected economic loss?<br>How many people will be affected?<br>Where are the extra resources to come from?<br>Which amenities/ industries are going to be lost?<br>Future planning issues?<br>Communication of risk (as probability x impact) is not always easy to do |
| 7 | Adaptation | | 1 | 4 | 5 | This relies on information on all topics to be able to plan ahead and for policy-making across wide areas of the levels.<br>This enables appropriate response and management and includes 8 and 9.<br>CBA most pressing need, followed by institutional capacity and then strategic policy. CBA is crucial.<br>Stern's report looks at this internationally, but local councils and businesses need to understand if before they will adapt.<br>Will this require more energy?<br>How do we respond to these changes at various levels (national, regional, local, organisation etc.)? |
| 8 | Mitigation | 5 | | 1 | 6 | What resources are available to Wales and which ones are most effective for energy generation? Which ones are most detrimental?<br>Cumulative effects?<br>To include climate change and non-climate changes<br>How can we provide 'green energy'?<br>Pressure for a barrage might come from Central Govt (in view of depletion of North Sea oil & gas) – this would cause an immediate large impact on the estuary environment.<br>This topic is highly important as many large companies are planning to invest in this field. |
| 9 | Integrated assessments | 3 | | | 3 | Integrated approach needed to ensure balanced consideration of issues, including environmental impact.<br>Need to integrated English and Welsh assessments. |

**Additional issues:**

The table below (Table 4) lists additional issues highlighted by the respondents. These include additional areas for study and specific practitioner needs as well as recommendations for improved data and information management, communication, education and awareness. Within the comments there was a clear view that better communication between all users, including academics, consultants and policy-makers is required, with better access to the key information in digestible form (and using non-technical language) for decision-makers. In this context, the need for the RAG process to engage with a wider range of local authority personnel was mentioned. Additionally, the need to disseminate information to the general public was seen as a priority in order to facilitate suitable mitigation and adaptation.

**Table 4 Additional issues highlighted within respondents' comments[2]**

*Further study:*
- Collection of field data is vital and this needs to be funded. Therefor, importance of credible evidence collection needs to be communicated to decision-makers (without unreasonable time constraints)
- Increased local biotic and abiotic monitoring
- On and offshore energy production
- Tide locking on tidal tributaries (particularly if barrage changes the tidal regime)
- What is projected reality for Severn (as opposed to other places) in view of its geography, aspects etc.

*Skills and knowledge requirements*
- Skills and knowledge in order to adapt existing infrastructure and buildings. Do we have the skills and knowledge in the region?

*Practitioner needs:*
- How does information feed into SEA?
- Links between scientific information and development control decisions
- There are substantial consented areas and areas for redevelopment in the Levels – are these threatened?

*Data & information management*
- Identify what information is required an who has the interested and for what purpose
- Access and analysis of long-term data sets
- Collation of all data sources – metadata.

*Communication*
- Communication between all 'users', including consultants, academics and practitioners.
- Communication of science to practitioners (knowledge-transfer) as there is a noticeable divide between science and decision-making.
- Provide access to relevant non-technical information for non-scientists, including planners
- Ensure clarity of the conclusions & recommendations

*Education and public awareness*
- Education and public awareness – people need to be informed and educated into the potential effects of climate change so they move to hopefully make the outcome less detrimental
- Communication to the public of uncertainty
- There is a need to set issues in their historical context

*Finance*
- Need for financial incentives to facilitate proactive (not reactive) adaptation

*Approach required*
- There is a need to take the precautionary approach
- When considering what types of information is needed you need to get the right people in local authorities (e.g. flood drainage people, development control, emergency management etc.) – there is a need for a broader range of people.

[2] Headings in italics added by report's author.

### How can Scientific Research be better linked to regional and local plans, regulation and policy?

The following table (Table 5) summarises the respondents' suggestions for linking science, planning and policy. Many of the themes highlighted in the previous table are reiterated and developed. The comments relating to improved communication and information management are particularly noteworthy. In this context, several respondents mentioned the workshop itself and the role of a future Research Advisory Group.

**Table 5 Respondents suggestions for achieving a better link between scientific research, planning and policy[3]**

*Future research*
- Involvement of stakeholders and end-users is essential to direct research.
- Research needs to be area-specific, but with co-ordination so that all areas are sufficiently covered.
- Research must have a purpose

*Suggested links to explore*
- Link to community planning
- Scientific and policy communities need to work very closely together to ensure that research is relevant and timely for local / regional strategies (through SEP and SWCCIP).

*Information management*
- Different organisations seem to have different bits of information – this needs to be assembled in ONE place and be updated regularly.

*General communication*
- Better communication at all levels and between agencies and at transnational scales.
- Better communication between both sides and realistic targets set and adhered to.

*Communication of research & knowledge*
- What research is taking place needs to be communicated better.
- Need to 'advertise' what research, data and information is currently available.
- Need to produce concise, locally relevant, policy-relevant summary of the problems, risks, scenarios and feasible options.

*Format of research / knowledge communication*
- Research needs to be in an easily understood language and in an accessible format.
- How can planners find Severn geographically specific and mapped information?
- Make sure any advice uses the right terminology for Welsh (all) authorities
- Through dissemination of knowledge at appropriate levels, not just academic journals or specific consultancy reports, but through an appropriate forum (SEP) to wider users.

*RAG*
- The RAG could have an important role in highlighting research needs and linking researchers to make joint funding applications.
- By setting up a small group of academics, regulatory authorities and local authorities to plan integrated studies.
- The day was good in terms of scientists sharing their work with policy makers. It would be good to have a session the other way round (e.g. development control, flood drainage etc. people) sharing their work/needs with the scientists.

*Other comments*
- All new developments in North Somerset must use 15% of all energy from local, sustainable sources.

[3] Headings in italics added by report's author.

**How can practitioner needs for climate change information match with scientific progress?**
**This would hopefully, be achieved through wider dissemination of knowledge at appropriate levels and through communication between all users.**

Further data, information and communication needs were stated by respondents (Table 6). Additionally, several delegates highlighted issues associated with the science of climate change. These included the issue associated with the funding of non-innovative science which is essential to inform policy and decision-making. Further issues associated with the uncertainty, probabilistic and rapidly changing nature of the science were also stressed.

**Table 6 Respondents suggestions**[4]

*Data and information needs*
- Data needs to be widely available
- Planners do not know what specific information relating to the Severn there is.
- What is available to practitioners needs to be clear so that data gaps still outstanding can be identified and funding distribution evenly.

*Science issues*
- It was noted that funding of projects by the National Research Councils needs to be innovative science. However, much of the data required by agencies does not fit this. How can this be tackled and is there a possibility of agency funding?
- Some practitioners seem to want exact figures of sea level rise etc. – which is NOT available.
- Uncertainties seem to be increasing with more research (e.g. Greenland melting)/
- Practitioners need to recognise that only probabilistic estimate can be given and these will be subject to change.

*Communication*
- Need better ongoing dialogue in this fast-changing arena between policy and scientific community.
- Knowledge – transfer partnerships
- Communication is a key issue. More scientists need to engage with use communication and undertake applied science that is actually useful on the ground (but which is not necessarily 'ground-breaking' science)
- Practitioners need to discuss with academics and agree what needs to be done, over what time scales, who should be responsible for what and identify where budgets (monies) may be available.

*Communication and dissemination*
- Through this type of workshop
- Clearer visual representation using a range of scenarios. Scientific studies represented by GIS mapping, for example.
- Better communication through newsletters and funding proposals.

*RAG*
- Hold a decision-maker only session to tease out needs (local authority; Defra, WAG etc.)

[4] Headings in italics added by report's author.

### Further Comments

Additional comments relating to decision-making, policy and research needs as well as to the potential future operation of the RAG were provided by respondents (Table 7). These and earlier comments provide considerable direction for the future development of the RAG.

### Table 7 Respondents further comments[5]

*Decision-making and policy needs*

- Acknowledge that we are not going to get all hard answers and will probably need to take a risk-based approach, supported by evidence / projections.
- From the discussion, there seems to be a lot of focus on planning decisions, but this is not the only extent of LA decision-making. May be focus on community planning processes rather than land use planning processes?
- Many local authorities are only at the start of looking at how they adapt to climate change so a more detailed exercise could be undertaken with them to look at data needs across departments.
- To what extent are climate change issues feeding into and influencing SEA and development decision-making?
- There is a need to turn the general information on climate change into specifics for decision-making on the Severn and if these are to constrain development/activities there is a need for robust, detailed information that will stand up to scrutiny/opposing views (e.g., at inquiry).

*Research needs*

- Environment Agency is heavy tied in to Defra / WAG policy. There is a need to be sure that research is taken on board by these bodies.
- Are we monitoring key impacts in the Severn specifically?

*RAG*

- This type of event is extremely useful and should be an evolutionary process.
- The next meeting should be held in Wales.
- Need to consider what work can be accomplished via email correspondence.
- RAG is a useful partnership for the Severn Estuary and one, which may help with the above issues.
- Any outcomes of the SEP RAG / eventual projects need to be communicated to wider region and to the public. There is a need to use existing channels to do this (e.g. SWCCIP) to help to do this effectively.
- Suggest that all attendees be emailed with a copy of the meeting notes.

*Other comments*

- As time passes, we have to maximise sustainable, locally produced energy.

[5] Headings in italics added by report's author.

## APPENDIX II WORKSHOP PARTICIPANTS

Laurie Newton, UKCIP
Richard Westaway, UKCIP
Victoria Paris, Welsh Assembly Government
Sarah Hendel-Blackford, South West Climate Change Impacts Partnership
Bill Donovan, Environment Agency
Tim Reeder, Environment Agency
Peter Coxhill, Environment Agency Midlands
Alan Rafaelt, Environment Agency South West
Rhys Morgan, Environment Agency Wales
Roger Wade, Environment Agency Wales
Adrian Philpott, Environment Agency Wales
Nicola Rimmington, Countryside Council for Wales
Adrian Jowitt, Natural England
Lorraine Hudson, Bristol City Council
Liz Lambert, Cardiff City Council
Carl Touhig, Newport City Council
Sian Davies, Monmouthshire County Council
Rob Niblett, Gloucestershire County Council
Gillian Ellis-King, South Gloucestershire Council
Steve Hodges, North Somerset Council
Natasha Barker, Severn Estuary Partnership
Dr Daffydd Lloyd-Jones, National Oceanographic Centre
Prof. Simon Haslett, Bath Spa University
Prof. Paul Bates, University of Bristol
Dr. David Bird, University of the West of England
Dr. Chris Spencer, University of the West of England
Dr. John Hunt, University of Gloucestershire
Prof. Roger Falconer, Cardiff University
Dr. Robert Morgan, University of Glamorgan
Dr. Mike Philips, Swansea Institute of Higher Education
Prof. Ted Bryant, University of Woolagong
Nicky Starkey, WWF Cymru

**Apologies:**
Prof John Allen, University of Reading
Nigel Gibbons, Forest of Dea
David Griggs, Hadley Centre
Prof Colin Taylor, University of Bristol
Prof John Shepherd, Southampton Oceanography Centre
Prof Mike Hulme, Tyndall Centre
Charles Green, Crown Estate
Alistair Chapman, Forest of Dean
Dave Jennings, Coastal Manager, Vale of Glamorgan
Prof. Alan Williams, University of Glamorgan
Prof. Geoff Hammond, University of Bath

# Seven Estuary and Climate Change:

# State of the Science

## SECCRAG meeting, Wednesday 6th May, 2009

## Brunel Boardroom, Empire Museum, Bristol

**Contents**

**Attendance:**

Chris Spencer, UWE
Gethin While, Glamorgan University *(GW)*
Guy Schuman, Bristol University *(GS)*
Hance Smith, Cardiff University *(HS)*
Jonathan Mullard, Severn Estuary Partnership *(JM)*
Ken Tatem, Environment Agency (South West) *(KT)*
Nick Rodgers, Cardiff University *(NR)*
Peter Henderson, PISCES Conservation Ltd and University of Oxford *(PH)*
Peter Jones, RSPB *(PJ)*
Rhoda Ballinger, Cardiff University *(RCB)*
Richard Brunning, Somerset Council *(RB)*
Roger Faulkner, Cardiff University *(RF)*
Roger Wade, Environment Agency Wales *(RW)*
Ros Smith, Bristol University *(RS)*
Tim Stojanovic, Cardiff University *(TS)*
Wendy Dodds, Cardiff University *(WD)*

**Apologies:**
Mike Phillips, Swansea Metropolitan University
Vanessa Straker, English Heritage
Steven Stanbridge, Environment Agency
Anne Hayes, Bristol Port Company

## *WORKSHOP OBJECTIVES*

The main purpose of the workshop was to review the current state of the science on the estuary, relevant to the issue of climate change impact assessment and adaptation.

The meeting is one of a series of three, sponsored under the IMCORE EU Interreg 4B project http://www.imcore.eu/ in collaboration with the Severn Estuary Partnership. It will enable the further progression of a *Severn Estuary Climate Change Advisory Group* which has been convened to bring scientists and policymakers together around the estuary.

By convening a relatively small group of 20 delegates the workshop aimed to encourage structured discussion of the key issues surrounding (a) how an assessment can be made of climate change impacts and options for adaptation on the Severn Estuary and (b) communication between scientists and policymakers and practitioners.

## INTRODUCTION TO THE IMCORE PROJECT

RCB introduced the IMCORE INTERREG 4B North West Europe research project. Promoting a transnational, innovative & sustainable approach to climate change adaptation along the coasts of North West Europe, this project will run until 31/10/2011. Project partners include Cardiff University, Glamorgan University, Severn Estuary Partnership, University of Aberdeen, Sefton Borough Council, University College Cork, Cork County Council and Donegal County Council. It has five major work strands including: identifying drivers for climate change, developing adaptive management strategies and future scenarios building. More detailed information is available at: http://imcore.ue.

On the Severn Estuary, the IMCORE project is aiming to facilitate better informed climate change. Specific work areas on the Severn concern the following five areas:

1. Improving the science/evidence base
    - Through the Severn Estuary Climate Change Research Advisory Group (SECCRAG)
2. Planning review & stocktake
    - Climate change considerations / synergies in the planning system
3. Futures research
    - Investigating ‘coastal futures’ for the Estuary
4. Education and awareness on coastal climate change
    - Education schools pack
5. Climate change adaptation assessment
    - Based on 1, 2 and 3

WD presented an overview of the Planning Review and Stocktake being conducted by Cardiff University as part of IMCORE project. This work is auditing and reviewing existing and emerging climate change-related policy making by planning bodies around the Severn Estuary, and the supporting evidence base. This assessment will examine cohesion around the estuary on the issue of climate change mitigation and adaptation.

## SEVERN ESTUARY CLIMATE CHANGE RESEARCH ADVISORY GROUP

RCB reported on previous SECCRAG workshops held in 2007, funded under the INTERREG COREPOINT IIIB project.

Previous SECCRAG workshop identified the following key research priorities:

- Downscaling of climate change assessments
- Assessing state of the estuary
- Social & economic assessment of impacts
- Mapping assets at risk
- Implications for coastal risk management
- Identification of research inputs for estuary-wide, local authority and other plans.

With the following issues identified for the Severn Estuary:

- Monitoring of baseline indicators for future climate change
- Signposting of existing & future research
- Bridging between strategic & tactical research
- Increased accessibility of & trust in existing research (& research community).

## *Session 1: CLIMATE CHANGE AND THE SEVERN ESTUARY: REVIEW OF THE CITATIONS DATABASE*

Aim / Content of Session:

This session sought to gain feedback from participants concerning the Citations Database. The first point made was that most of the references do not actually relate to climate change assessments, but rather the baseline information which is needed to make these kinds of assessment. TS presented Version 4 (May 2009) which currently stands at over 950 citations concerning the Severn Estuary. The floor was opened for feedback, including suggestions on possible improvements, suitability of the format of the database (e.g. EndNote software), the index / keyword system currently used and the management of the database in the future.

Feedback from the group concerning the database, included:

- Objectives of database need to be refreshed due to its current breadth
    - e.g. is it to inform policy making, or is it to be tailored to support focused scientific investigations
    - if aimed at local government, the size and time required would be off-putting for policy makers who ideally would prefer abstracts or even better, a simple prioritisation of issues (e.g. 6 key issues)
- Academic bias / historic focus
- There needs to be translation of content:-
    - Right format for audiences
    - Right organisation of topics
- It was noted that there is a strong perception that the Severn has been extensively researched BUT when compared to other estuaries/areas such as the Humber and Liverpool Bay, it is not the case with respect to both monitoring and understanding
    - There is a good case to compare of state of science of Severn Vs. another estuary such as the Humber (potential ESRC/NERC proposal)
- Data gaps on the Severn include:
    - Sediment / morphology /water quality /hydrology (RF)
- Examination of chronology of the citations contained in the database would be valuable e.g. “History of the science of the Severn Estuary”.

## *Session 2: REVIEW OF STATE OF THE SCIENCE*

Aim / Content of Session:

This session sought to develop understanding of climate change on the estuary. To achieve this, presentations were given by representatives from key topic areas delivering perspectives on the current state of science on the estuary within their respective fields. Each presentation, approx 5-10 minutes in length, addressed, where possible, the following questions:

1. **What are the key messages coming through?**
2. **What evidence is there of climate change trends?**
3. **Does the science / research cover key questions required for climate change assessments?**
4. **What are the uncertainties or contentious issues on the science?**

**Or**

**What needs to be done to provide an assessment?**

The following presentations were given during this session:

*Marine Renewables, Roger Falconer, Cardiff University*
*Meteorology and Climate, Nick Rodgers, Cardiff University*
*Physical Environment, Chris Spencer, UWE and Guy Schmann, University of Bristol*
*Fisheries, Peter Henderson, PISCES Conservation Ltd. and University of Oxford*
*Water Quality, Roger Wade, Environment Agency*
*Built Environment, Rhoda Ballinger, Cardiff University*
*Cultural Heritage and Archaeology, Richard Brunning, Somerset Council*

Individual presentations were followed by informal short group discussions, allowing feedback from the floor to identify synergies with other disciplines, additional professional perspectives and key considerations. Brief summaries of the presentations follow:

### MARINE RENEWABLES, Roger Falconer, Cardiff University

**Key Messages coming through:**

*Climate Change.*
Climate change is being taken seriously amongst public and professionals on a day to day basis. Sea Level Rise Scenarios for the next IPPC assessment report are likely to be revised upward. The consensus is that whatever we do about mitigation, we have already altered the biogeophysical system. There is a rowing awareness of the importance of rainforests within this system. In some parts of the world, the damaged caused by increasing storminess and hurricanes are a major concern.

*Renewable Energy Solutions in the Severn Estuary.*

A major consideration in the development of UK renewable energy is the 2020 target 15% of energy generation from renewable sources. However, a more long term focus on mitigation using 2050 as a horizon, might lead to the maximisation of different factors. On the Severn Estuary this could lead to more favourable consideration of the Minhead-Aberthaw Tidal Energy Scheme with its potential for two way energy generation which would have less impact on intertidal habitats, as well as greater energy production.

As far as offshore lagoon solutions for tidal energy in the Estuary, there is a need for greater research and understanding about proposed schemes. Recent calculations have suggested that these would provide <25% of the 14TW energy proposed from a tidal barrage.

**What evidence is there of climate change?**

- Changes in rainfall patters across Wales
- Changes in shoreline erosion
- Changes in storm activity
- Changes in bird numbers along the Severn
- Changes in fish species

**Uncertainties**

Major questions surround the assessment of climate change impacts on the estuary, include:

- Changing rainfall- how this will vary in patterns and intensity? There are likely to be big local variations. There are knock on effects downstream. This needs to be assessed holistically on a catchment scale, treating the whole water cycle rather than just considering the estuary or river.
- Sea level rise
- Storminess at sea and storm surges
- Shoreline erosion and estuary morphology
- Flood elevation, inundation extent
- Interaction of hydraulics / hydrology with ecology
- Changes in bird numbers and fish migrations, linked to changes in habitat and climate.
- Water quality implications of changing biological, geomorphological or chemical processes

Recent research by Cardiff University has looked at how increased storminess might have a knock on effect on re-suspension of sediments, and how this will combine with land-based sources of P and N to give increased nutrient loads in the estuary. The research focused on T90 values. However, the modelling of microbiological processes is a field in need of greater research. (This modelling is in its infancy compared to hydraulic modelling, with a constant being used for the decay rates of faecal coliforms).

*Engineering uncertainties*

These relate to the operational efficiency of a range of tidal power options, or groups of options. There are related questions linked to efficiency of tidal stream energy devices. There have been major improvements in the technology since earlier proposals, so there remains much to be explored concerning optimum design configurations.

- Operation and efficiency of tidal stream turbines
- Operation and response of tidal lagoons
- Opportunities of tidal stream and wave energy devices
- Fish mortality rates with barrages, lagoons, turbines…

**GROUP DISCUSSION**

(RW) –supported most of the above points. Added:
The Environment Agency are currently setting up a research project over the next 2 months to look at impacts of climate change on the estuary. Some key questions to be considered include:

- Changes in migratory bird patterns (linked with bird numbers around the estuary)
- Changes fish migration due to temperature changes.

Whatever the changes in patterns, it remains highly likely that the estuary will continue to be important as a habitat.

Concerning the question of renewables, there is a dearth of evidenced-based and data led information on the impacts of tidal energy. Relating to water quality- many of the key papers date from research done in 1970s and 1980s. Some useful work has been done more recently but only on local or site scale. Furthermore, the original specifications for tidal energy developments were concerned to maximise energy output, and the turbine technology concerned has moved on since 1980s proposals. This requires reconsideration.

(PJ) Contrasted two approaches to decision-making: the government intends that assessments should proceed on the basis of 'evidence-based policy' but the political and cultural realities mean that were are more often working to 'policy-based evidence'. PJ noted the urgent requirement of policy makers for evidence that will assist them in dealing with the current policy issues they are facing. Policy responses are being formed, and many bodies are taking up public policy positions on issues such as climate change. Policy staff work with the evidence that they can glean together, and are in need of mechanisms that can assist them to get a good handle on the state of the science.

## METEOROLOGY and CLIMATE, Nick Rogers, Cardiff University

**Key Messages coming through:**

The last major paper on storminess referenced by the citations database dates to the 1981 storm surge. There are therefore more papers and datasets concerning climate which need to be captured in for the Severn Estuary Citations Database. A long term data record is required specifically for the Severn Estuary. There may be adjuncts which can be used from other places to help generate a good understanding of the processes occurring. The Marine Climate Change Impacts Partnership's Ecological Linkages Assessment (2009) provides useful and improved summaries to support assessments. This document has been reviewed by paleo-oceanographers and climate experts within the School of Earth and Oceans, Cardiff University and gives an overview of current state of the science within the UK. UK Climate Change Projections (UKCP09) will be launched by Ministers later in the year (within this parliamentary session).

**What needs to be done to provide an assessment?**

In terms of climate, a key question concerns the prevalence of Easterly winds in spring, and data on storm tracks. These have knock on implications for flood risk which requires an assessment of storm intensity and directions to calculate the likelihood of overtopping sea defences. In general,

an assessment of change on the estuary requires better baseline information and monitoring, to complement relatively limited network of existing weather stations at data bouys around the estuary, which are taking oceanographic and climate measurements for a range of national agencies and laboratories.

**GROUP DISCUSSION**

(TS) on the social side, there are implications of climate change for activities such as tourism and recreation around the estuary, with warmer summers possibly leading to increased trips to the coast, and implications for resorts such as Penarth and Weston.

## PHYSICAL ENVIRONMENT, Chris Spencer, UWE

**Key Messages coming through:**

Long term sea level changes at a large scale are relatively well understood for the estuary. Changes in the relatively recent past (*i.e.* 2000yrs before present) are less well understood, with respect to both the evolution of landforms and sea level rise. For example, there are big gaps in data and knowledge about changes in sedimentology on the estuary and how landforms will react to these. In assessing climate change impacts in response to sea level change, there is a need to draw on the multiple site based studies and synthesise and scale up this evidence to the estuary level.

**Citations database**:
The current SECCRAG citations database provides a good baseline of research on the estuary and shows the detailed site studies which have taken place around the estuary on sedimentology and hydrodynamics. There is an opportunity to further draw together broad scale research such hydrographic surveys which have been conducted on the estuary.

**What needs to be done to provide an assessment?**

- There is a requirement to synthesise present research to understand how coastal landforms have reacted in the past, and use this knowledge of behaviour to project changes for the future.
- This requires a clear understanding of how sea level has been a driver of change in the past in order to project likely future changes.
- The major human modifications of the estuary will have to be factored into this understanding of how the estuary will change.

**GROUP DISCUSSION**

(RB) The development around the coastline, including the constraints caused the sea walls, is an important factor in the modern day evolution of the estuary. There remains uncertainty about the relative importance of anthropogenic/natural drivers.

## PHYSICAL ENVIRONMENT, Guy Schumann, Bristol University

The Hydrology research group at Bristol (drawing on a current GWR research fellowship) is presently conducting a probabilistic assessment of sea level rise, incorporating consideration of global sea ice melt. The UKCIP07 assessment predictions are based on increased storminess, but do not calculate sea level rise due to ice melt. UKCP09 will give an ensemble of model simulations, more probabilistic in nature- so perhaps show potential futures and levels of uncertainty better. The monetary losses associated and economic impacts associated with sea level rise are an area of research that is potentially difficult to establish but warrant further research consideration/effort. Ros Smith is developing models which consider past storm surges and flood risk on the estuary. The Hydrology Group will be using the same calibrated hydrodynamic model to simulate flood risk under future sea level rise scenarios.

- **Citations database:**

There are gaps in data and understanding concerning issues such as sediment transport pathways. Much of the database concerning sediment transport is largely outdated, dating back to >20 years ago. There are more datasets to be mined. The SECCRAG citation database could usefully be developed into an online wiki-style database, which would allow researchers remotely up load their relevant references and findings.

## FISHERIES, Peter Henderson, PICES

The citations database captures most of the significant publications concerning fisheries, but is weak on the industry sponsored ecological studies that have been conducted around the estuary (understandably, as these data are difficult to access). This type of research is sponsored by some of the major coastal industries, including: nuclear power plants (including proposals for new builds at Oldbury and Hinkley), the Bristol Port Company (for their capital dredging and port expansion schemes), and six or seven studies relevant to EIAs for Aggregate Dredging. Also private companies such as Brixham Labs who are major industrial landowners along the shoreline. Some relevant data has been collected with respect to managed retreat schemes in the Bridgewater Bay area. Altogether, access to these data are problematic and could be better organised. A related consideration is the amount of data held by consultancies who have been regularly working on the estuary, such as HR Wallingford.

**Key Messages coming through:**

*A. Summary of Aquatic life.*

The general picture is of an estuary rich in fish, with a diversity of 80+ species, (120 if rare and occasional visitors to the estuary are included). Larger crustaceans are the key invertebrates, especially *Crangon crangon* (Shrimp) which provide a big standing stock. A key aspect of the estuary is the highly mobile fauna which lives on the sea bed (the benthos is relatively poor but the epibenthos is rich, due to the fact that the estuary is a very dynamic environment). Species can be divided into those that go up river for breeding, such as Lamphrey, Shad and Salmon, and those which go further out to sea, such as Flounder and other species.

*B. Key Trends*
PISCES holds 30 years of monthly data on species in the estuary. This is one of the best long-term datasets in the world of its type. Long-term research has enabled the identification of three major variables influencing species behaviour

- Temperature (e.g. Shrimp retreat to upper estuary when it is cold)
- North Atlantic Oscillation (NAO)
- Salinity and river flow

**What evidence is there of climate change?**

*C. Specific interactions*
Fish- Dover Sole *Solea solea*- there has been an explosion of numbers in the last 20 years linked to changes in temperature, probably due to warmer springs which mean that the species is able to get through its reproductive period faster. The NAO affects sole growth and the presence of other species sin the estuary. Salmon (considered the most culturally significant species) is in long-term decline, linked to recruitment patterns and possibly also due to higher temperatures and anthropogenic modification of rivers. Shad has become rare in the estuary, in comparison to the 19$^{th}$ century when it was reported to be very abundant. This may be due to changes in temperature and climate. Lamprey used to be abundant, but has also declined. Changes in temperature have been observed to change the local abundance of bass, dab, prawns and rockling in addition to sole. There is evidence of a sudden and abrupt change in fish community structure during the early 1990s. There is also a steady rise in total species richness which can be related in part to the gradual arrival of warm water tourist species.

*D. Global and Local Changes*
PISCES is involved in research to conduct a comparative analysis of change in the Wadden Sea, Hudson Estuary and Severn Estuary ecosystems. This will reveal the scale of change which is being experienced in marine ecosystems. For example:
1. The Common Eel is experiencing catastrophic decline worldwide caused by global change and probably linked to increased diseases and anthropogenic pressures (c.£120 can be fetched for a kilogram of eel).
2. Explosion of biomass. Species abundance may have increased by up to 50%. The theory is that with reduced pollution, productivity is stepping up. In addition, greater mixing and rise in water temperature might give rise to the release of stored organic carbon which is consumed by bacteria at the bottom of the food chain. This increase supports greater populations of throughout the food web and greater fish abundance.

Future trends related to global warming, might give rise to a more Mediterranean kind of environment which is species rich but denuded of certain current fauna.

**GROUP DISCUSSION:**

**(RW)**. There is an ongoing debate about the decline of Salmon and whether they are actually in long term decline due to physical or anthropogenic factors. There is also an argument concerning the impacts of turbines on fish species from renewable energy options. This does not only concern fish kills on bigger sized fish, but also losses due greater predation from bass and seabirds on fish (as they are constrained by the fish pass) and the sub lethal stresses caused for fish by the pressure differential and using their swim bladders. It should be noted that the direct cooling systems of power stations around the estuary kill millions of fish per year.

**(HS)** are there also issue of the Salmon fish stock at sea and changes in marine biology in the North Atlantic
**(PH)** There needs to be greater sharing of data- there might be an incentive to share data between industries in order to reduce costs.
**(HS)** The offshore industry provides good examples of agreements to share data (e.g. oil and gas industry- all drill cores are sent to BGS). Archaeology and geology sectors provide good examples of data sharing on the estuary. For archaeology, a lot the data provision is development driven. Access to data from government departments by industry is also problematic. In a public enquiry all data should be publicly accessible, but with planning applications, access to source data it is less clear.

## WATER QUALITY / POLLUTION, Roger Wade, Environment Agency Wales

**Key Messages coming through:**

There have been significant improvements in water quality on the estuary over the last 20 yrs in response to legislation (urban waste water treatment / EU Legislation) and better treatment of sewage and industrial discharges into the estuary

**The citations database:**
This contains the majority of references on the topic, but many are related to the appraisal of tidal energy and predominantly date from the 1980s. Another 50% of papers are grey literature and reports. Some of the detailed studies done by agencies are missing from the database. The most interesting observation from the citation database is the research gaps and areas where data is needed for more detailed or up-to-date assessments (i..e. post 1980s overall inputs into the estuary). The key areas covered in current research include:

- Trace Metals, in water, biota and sediments - the dominant topic for water quality research
- Organics are well covered
- Air quality has reasonable coverage
- Litter surveys are well covered, but necessarily Severn Estuary specific assessments
- There is some research on nutrients and dissolved oxygen

**What evidence is there of climate change? What are the related uncertainties**

It is likely that the main climate change impacts affecting water quality will be socio-economically driven, and human impacts will be significant as well as direct physical influences. Some of the key inputs are from coal fired power stations. Therefore a key question relates to whether Aberthaw will be active on the estuary in the future, and also whether it or replacements will operate with carbon capture mechanisms. This will have an impact on direct/indirect inputs. It is likely that two new nuclear power stations will be developed on the estuary. Major influences on water quality will be driven by changes in the catchment, especially the potential for changes in landuse related to biocrops. It is unclear if this will increase or reduce, fertilizer input. Concerning trace metals, current water quality issues and exceedance of ecological quality standards mainly relate to copper and organics. As far as Local Authority stakeholders are concerned, Bathing Water Quality is an important issue. More rainfall and greater storm run-off has the potential to lead to higher levels of bacteriological contamination. Restrictions on planning developments (discharges to the estuary) may be required due to the less disbursive environment of an estuary in

the scenario of a tidal barrage. In addition there are potential water quality issues related to anoxia, increased water temperatures and suspended sediments.

In terms of physical changes, there is a well established linked between changes in toxicity and pH, for example a rise of 0.1ph is likely to increase the toxicity of ammonia, and change the amount of absorption of metals substantially. A key question concerns the relation between accelerated sea level rise and increased tidal range. Increased tidal range would be likely to lead to (1) sediment re-suspension, (2) saline intrusion (3) change in the saltwater boundary (which has knock on affect on biota and water extraction, particularly at the Gloucester/Sharpness canal). Less flow in the summer would also affect migration, there being less freshwater dilution this would affect the signal for migratory cues. Reduced flows would also giver rise to an decrease in dissolved oxygen. Water temperature is also linked with levels of dissolved oxygen and in combination with other changes, could put significant stress on certain migratory fish species.

**GROUP DISCUSSION**

(PH) Changes in seasonal patters of water flow, with less flow in summer, is likely to have a significant impact on fish migration, along with potential slight increases in water temperature (higher temperatures leading to less dissolved oxygen).

## BUILT ENVIRONMENT, Rhoda Ballinger, Cardiff University

**Key Messages coming through:**

There has not been any systematic research or overview on the characteristics and trends associated with the built environment around the Severn Estuary. However, there been a considerable amount of research, particularly consultancy-lead projects on specific sectors around the estuary, notably recreation and tourism, tidal power, aggregates and landscape. These, however, have been guided by sectoral management objectives and have examined issues at a variety of scales (for example, the South West of England and South Wales, the Bristol Channel, Severn Estuary as well as site specific studies). Overall it has not been an academic priority to conduct regional research on land use change around the Severn Estuary, although there may be related references within academic, human geography text books on British land use change .

In addition to the grey literature which makes a significant contribution, there are active groups in S.W. England (Climate Change Partnership) and S.E. Wales (Strategic Planning Group) which are considering the need for adaptation and looking at the built environment both as a driver of, and receptor of, climate change impacts.

Local Development Documents provide an indication of current and future levels of development, although it should be noted that development allocations do not always translate into developed land. The ‘Futures’ approach being proposed as part of the Interreg IVb IMCORE project for the Severn Estuary, however, holds some interesting possibilities for considering how key trends might evolve under different climate change scenarios. Some related work has been done along other parts of UK coast such as the Humber. The latter used a Futures approach to consider linkages between landuse and water quality under different scenarios.

In terms of adaptation, the Severn Estuary Partnership Management Group recently undertook a brief overview of potential climate change issues. The findings highlighted the potential issue associated with 'planning' blight in areas adjoining the estuary, as a result of identification of perceived flood and erosion risk areas. This potentially could result in knock on problems for other, adjoining areas, perceived to be less at risk. One key element in all these considerations is that it is *communities* which are at risk not just development. Consequently, there is an urgent need to consider this as well as the form of proposed and new developments in coastal areas and the retrofitting of existing developments. In this context, it is important to consider how adaptation issues are presented and communicated to target audiences.

**What needs to be done to provide an assessment?**

In order to understand the current responses, there is a requirement for a stocktake of planning policies around the estuary, including high level targets for flood and coastal erosion risk management as well as engagement with planning officers. To this end, Cardiff University are undertaking a review of planning policy around the estuary and undertaking interviews with the planning community as part of the Interreg IVb IMCORE project.

There is a firm requirement to provide downscaled climate change scenarios for the Severn Estuary. For example, the Strategic Environmental Assessment of Severn Tidal Power options in the estuary only utilises general climate change scenarios.

It is important to recognise that planning and management frameworks and approaches will have to evolve as the implications and needs for adaptation become clearer. Plans must be co-ordinated and work together at a range of scales. The strategic nature of spatial plans makes them particularly important in this context, however there are questions about the level to which they encourage practical delivery of outcomes. There are also issues associated with the administrative complexity of the planning framework for the estuary and the offshore planning regime proposed under the Marine and Coastal Access Bill may further divide the estuary between England and Wales.

**GROUP DISCUSSION:**

(HDS): What role might insurance companies play in providing these kinds of assessments?
(RW): Insurance companies already tend to act independently and have their own flood risk assessment databases separate from the Environment Agency.

(KT) – Appropriate developments need to be undertaken using a risk based approach. Integration of SMP2 policies into local development plans.
(JM) -Marine spatial planning in the estuary may result in 2 plans for estuary (Northern & Southern). SEP & RTPI are arranging a meeting of planners from around the estuary (Autumn '09: tbc)

It was reported that WAG's 'TAN 8 Planning for Renewable Energy' is currently being revised.
The group suggested that WAG's 'TAN 14 Coastal Planning' should be similarly revised. As it stands this planning guidance is not suitable for estuary wide planning issues. Also, it should be revised to bring it inline with PPS20 Coastal Planning, due shortly from DEFRA.

## CULTURAL HERITAGE AND ARCHAEOLOGY, Richard Brunning, Somerset County Council

**Key Messages coming through:**

Quite a lot of research has been done concerning the archaeology of the estuary, especially on the coastal wetlands forming the Gwent and Somerset Levels. The Severn Estuary Levels Research Committee has been established since 1985 to coordinate this research effort. Local Authorities, Developers, Archaeological Trusts and Welsh and English administrations collaborate well to advance this knowledge. The Rapid Coastal Zone Assessment (RCZA) should provide a good baseline overview of coastal heritage for the English side of the Estuary. The phase one desktop has been completed and the pilot for the stage 2 fieldwork has begun.

In Somerset, a considerable amount of work has been done on sea level change since 10 000BP. However, much of this is based on widely spaced data points, and there are big gaps in evidence. Certainly, in comparison to former ages, conditions on the estuary are very different, due to the constraining factor of sea defences established since the Roman period. This is likely to affect the future behaviour of the estuary in response to sea level rise, and the inherently unstable nature of the coast is something that comes as a surprise to some coastal residents. There is therefore a requirement for better communication of science there is a need to explain this historical perspective to communities.

**What evidence is there of climate change?**

*Climate Change Impacts*
Erosion has been an important factor in the loss of heritage assets along the coast(e.g. sites around Blue Anchor) including historic buildings, historic sea defences and ancient settlements. In the sub-tidal area, there are threats to archaeological resources such as wrecks, which are being damaged due to species invasion (more aggressive species of burrowing worms due to climate change) and also potentially to increased rates of chemical decay due to increased acidification. Other fragile remains in the intertidal zone, such as fish traps and prehistoric buildings, are also under pressure from erosion. The wooden remains of such structures are usually buried at a shallow depth and subject to point erosion. The peat layers containing archaeology are also subject to periodic substantial loss.

Whilst the intertidal archaeology is relatively well known due to its exposure, we often don't understand the changes in hydrodynamics of erosion and deposition and how this affects the resource. . These losses include some of the most significant archaeological sites in the UK. The relative lack of Scheduled monuments in the inter-tidal zone is not a true reflection of the importance of the resource there.

The impacts of different adaptation measures have knock-on implications for archaeology. For example a policy of 'hold the line' will have negative impacts on the resource in front of the defence as it will increase erosion of the inter-tidal area. A recent project to undertake LIDAR mapping around the English side of the estuary should provide a baseline for measuring change and establishing long term trends (note: does this cover the Welsh side too?). Managed realignments, such as those proposed at Steart will have a massive impact on individual heritage assets and historic landscape character. Because realignment is only possible on particular types of coastline the cumulative impact could eventually involve the potential loss of a whole type of medieval reclaimed coastal landscape. In coastal marshes and wetlands, reduced summer rainfall could cause increased peat wastage (thereby releasing$CO_2$ to the atmosphere) and associated

destruction of nationally important waterlogged archaeology. Furthermore, altering the economics of agriculture could have significant knock on effects (diary farming and permanent pasture are less damaging to archaeology than arable, but climate change could lead to an increase in the latter). Water shortages have implications for the continuation of waterlogged burial environments in coastal wetlands- these are a nationally important and vulnerable resource.

**Uncertainties**

*Gaps in Understanding*
Most of the potential impacts are known, but the rates of change are less well understood. This applies to coastal and inter-tidal erosion. Very little is known about the sub-tidal heritage resource in the Estuary. The baseline resource dataset created as part of the EH Rapid Coastal Zone Assessment is now at stage 2. CADW have undertaken a similar assessment which complements the database of resources built up by Reading University, who have conducted considerable long term research and monitoring on the Gwent levels.

There are still large gaps in our understanding of the Holocene history of coastal change in the estuary. The importance of much of the sub-itdal and inter-tidal heritage resource is not known because of a lack of investigation, especially dating.

The potential effects of sea level rise and managed realignment upon the inland freshwater hydrology are uncertain. The effects of managed realignment upon buried archaeological remains are unknown (eg. change from fresh to salt water burial environment).

*Potential for Adaptation*
This is difficult to assess. Managed realignment might avoid the loss of intertidal resources due to coastal squeeze, whilst the subtidal resource could potentially continue to decay. There may be some options for water storage to protect wetlands and waterlogged areas. There is a continued need to improve the database concerning the resource.

(KT) The recent series of low tide LIDAR surveys being conducted by the Plymouth Coastal Observatory (Channel Coastal Observatory) could provide some useful data.

## *Session 3: STATE OF THE SCIENCE SUMMARY*

Aim / Content of Session:

This session sought to summarise key emerging issues from the presentations outlined above and to provide participants with an opportunity to reflect strategically upon the state of the Severn Estuary science. HS highlighted issues such as the potential for improved data collection and information management, and better coordination of the science on the estuary. An overview of these is presented below. An open discussion amongst the participants followed.

### State of the Science Summary, Hance Smith, Cardiff University:

*1) Citations Database*

- This is the beginning of a useful tool with wide application
- There are a lot of gaps and some of the more comprehensive assessments date from the 1980s

*2) Data and research*

- valuable projects are beginning which will provide useful information and synthesis e.g. EA research project on climate change in 2009, and the Severn Estuary Partnerships' State of the Estuary assessment
- There is a need to develop the conceptual basis in order to provide a synthesis
- Socio-economic data will have a significant role in any assessments

*3) Management of the science*

- Local government have a key role in managing the estuary– what science do they need and how can they be provided with more rapid access to it?
- We need a system that will facilitate science-policy interaction
- The science must be set in its social context
- It should not be forgotten that industry and economic development has been a major source of funding for investigations of the estuary
- Anthropogenic drivers from the watershed and potential renewable energy development will have a significant influence on the evolution of the estuary, arguably outweighing physical drivers.
- There is a need to integrate land and sea in assessments (The development of a marine spatial planning system for UK waters should consider this issue)
- The Archaeological research committee (SELRG) provides an exemplar of disciplinary collaboration and good practice

## GROUP DISCUSSION

A summary of the main delegates discussion points following HS's overview are contained below:

- The group felt that there is a need for "where we are now" assessment to be undertaken (assimilation and analysis of the science, particularly oceanographic)
- KT reported that the SMP2 for the Severn was being currently being prepared to be in line with Defra targets. Using differing assumptions on Wales / English sections of the coast. Where gaps in the knowledge have been identified, the plan will document these. The SMP will be reviewed in 6yrs time, presenting opportunities for new areas of knowledge and understanding to be integrated into the revised plan.
- The group raised concerns that there may be two marine spatial plans prepared for the estuary. JM indicated that the SEP will be meeting with WAG & GOSW to promote a coordinated approach, and indeed, one plan for the Severn.

Monitoring- related points:

- It was reported that good examples / models of best practice that should be considered for the Severn e.g. Liverpool Bay and the work of the Plymouth Coastal Observatory.
- The group referred to the Wales Coastal Monitoring Centre, with the group being uncertain as to its current operations.
  It was agreed that Peter Jones, WAG, should be approached regarding the role of the centre and its current and future activities.
- There was a general agreement for the requirement for a Severn Estuary-wide, network of oceanographic monitoring. It was suggested that there was scope for the extension of the monitoring work of Plymouth Coastal Observatory as part of this. Additionally, it was recommended that the Breaksea Spar Buoy (Trinity House), due its location in the middle of the estuary, could feasibly be utilised as a monitoring point; this would be low-cost starting point for Severn Estuary-wide monitoring efforts.

## *Session 4: DISCUSSION ON THE APPLICATION OF SCIENCE*

Aim / Content of Session:

This session was designed to gather delegate's perspectives and encourage discussion as a group, concerning the application of the science, including the future direction of the database and the work / focus of SECCRAG. Drawing on comments from the floor and using a flip chart, TS mapped out a process for the 'Way Forward' including two further IMCORE funded workshops in 2009/10.

### Way Forward

A. Provide a **Gap Analysis of current research** (including assessments made in this workshop) and circulate for comment and feedback

↓

B. Develop a **rationale** which will justify the effort needed to **develop monitoring and ground-truthing** of climate change modelling.

↓

C. Establish a series of **key questions from planners and managers** which require answers

↓

D. Provide a **synthesis** of this information to be presented at the **Winter 2009 IMCORE Workshop**

↓

E. Use the comprehensive list of questions as a basis for **prioritising climate related issues**

↓

F. Consider these issues relevant to the **key drivers** (perhaps draw on the approach taken on the Humber Estuary to do this kind of work)

↓

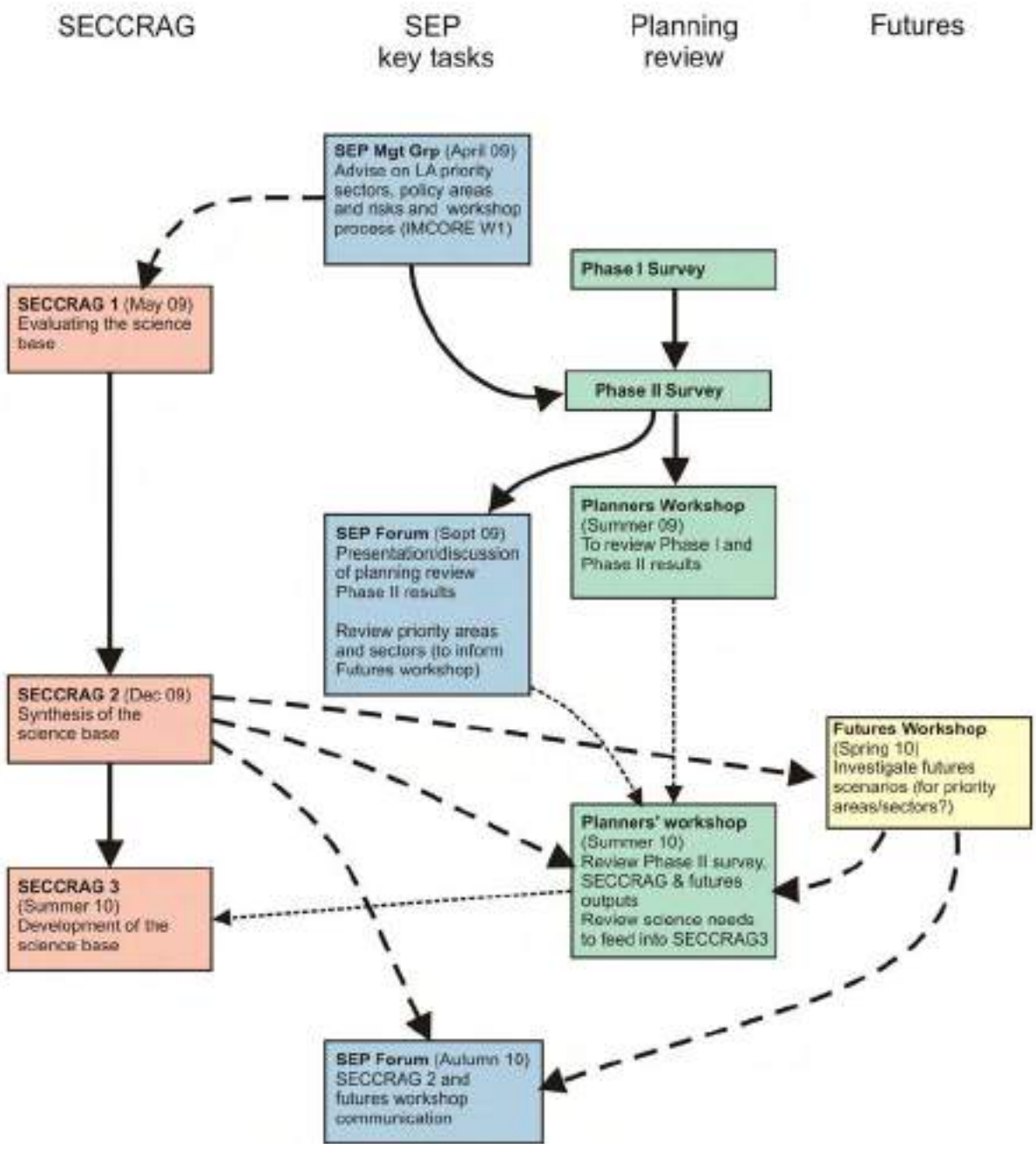
G. Identify key issues for which you can begin to **map and model change on the estuary**, to form the basis of a **Summer 2010 IMCORE workshop** and potentially subsequent bids by a consortium of scientists and technical officers.

↓

At ALL stages above consider how to provide incentives that will encourage the engagement of scientists and professionals

The work of the Severn Estuary Climate Change Research Advisory group will dovetail with other meetings being hosted as part of the IMCORE project, including a Futures workshop and a workshop for planning professionals:

## IMCORE WORKSHOPS & ACTIVITIES ON THE SEVERN - *Draft*



A number of key discussion points were raised during this session.

*Actions*

It was agreed that the next step for SECCGRAG would be to draw on the findings of the current workshop and database, to conduct a gap analysis, which would then be circulated around the group. There is a real need for a synthesis of research and to move beyond current consideration of research gaps. This will require asking the right questions, which is dependent upon good interaction between science and policymakers to formulate relevant questions. There are precedents for taking this approach, and it was reported that a similar exercise was conducted on the Humber Estuary[1], and JM highlighted a journal paper entitled 'Top 100 ecological questions of policy relevance.'[2] A major issue is the need to understand feedback linkages between social and ecological systems, and this kind of approach might form an incentive for a wide variety of scientists to become involved.

Issues concerning the utilisation of the UKCIP02 scenarios by decision makers were discussed. It was felt that these figures can often be taken at face value, with simplistic interpretations being made my decision makers. There is a need to understand whether UKCP09 data will be sufficient for assessments, or whether in certain areas more Severn specific assessments are required- what would be the implications of using too simplistic data at certain scales? There was a suggestion that certain policymakers do not know what assessments they want made, possibly is due to the high pressure case work/workload on policymakers, and so are looking for scientists to provide examples of the possibilities. There was also a suggestion that certain 'policymakers' may not be aware of the significance of their role- elected members form a key part of the decision-making process but may not see themselves in this light- in other words there is the need for good communication of science to this target group.

In general, there is a strong scientific case for considering the climate change issue from the estuary perspective, not least because the uniqueness of the estuary and its extent and size. The modelling going on concerning climate change needs ground-truthing, and this is a major justification for the existence of SECGRAG. For a number of sectors and scientific disciplines, a relatively good knowledge exists concerning the estuary, but there is no 'neat summary' of this understanding, so SECCRAG can play are role in undertaking this.

*Engagement and Linkages*

It was highlighted that there were overlapping timeframes between the work of SECCRAG and phase 2 of the Department of Energy and Climate Change Severn Tidal Power SEA. There are opportunities for SECCRAG to input into this. There is also a need to consider the complementarity with the work that will be required for Nuclear Energy schemes around the estuary. South West Climate Change Impacts Partnership's 'Warming to the idea' research and report outputs are applicable to the work of SECCRAG.

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2 Sutherland, W.J., Armstrong-Brown, S., Armsworth, P.R., Brereton, T., Brickland, J., Campbell, C.D., Chamberlain, D.E., Cooke, A.I., Dulvy, N.K., Dusic, N.R., Fitton, M., Freckleton, R.P., Godfray, H.C.J., Grout, N., Harvey, H.J., Hedley, C., Hopkins, J.J., Kift, N.B., Kirby, J., Kunin, W.E., Macdonald, D.W., Marker, B., Naura, M., Neale, A.R., Oliver, T., Osborn, D., Pullin, A.S., Shardlow, M.E.A., Showler, D.A., Smith, P.L., Smithers, R.J., Solandt, J.-L., Spencer, J., Spray, C.J., Thomas, C.D., Thompson, J., Webb, S.E., Yalden, D.W., Watkinson, A.R. **The identification of 100 ecological questions of high policy relevance in the UK.** (2006) *Journal of Applied Ecology,* 43 (4), pp. 617-627

The failure to sufficiently engage ecologists for the workshop was noted, and a review of the 54 scientists invited to the workshop was circulated to highlight potential contacts which had been identified, with a further 2-300 identified to be 'kept informed'. Delegates suggested the importance of clear lead times and the use of incentives to involve key stakeholders, including scientists from national organisations such as CEFAS, and research and consultancy sponsored by industry. Finally, in terms of engaging relevant decision-makers, SECCRAG needed to consider writing up results and a language which is accessible to Local Authority officers, and also specifically consider the approach to engage elected members.

## A State of the Severn Estuary Report

JM indicated that Severn Estuary Partnership (SEP) will be supporting a review high level strategic policies on and around the Estuary, in preference to updating the 2001 Strategy for the Severn Estuary. There is an urgent need for informed decision-making and JM reported that the SEP are therefore intending to develop a State of the Severn Estuary report, with SEP stewarding this process, and welcomed input or ideas for partnership from delegates present.

## Any Other Business

**Guy Schumann, University of Bristol, 'Flood Risk Modelling'**
GS presented a brief overview of his current research being at the University of Bristol, funded by the Great Western Research fellowship programme. This flood risk modelling work is coupling the IPCC's Fourth Assessment Report scenarios with sea ice collapse data, to develop more accurate representation of sea level rise scenarios and clearly presenting uncertainties. Other research outputs include:

- extreme scenarios e.g. storm events;
- modelling flood risk (2D)

This research is linked with other initiatives at the University of Bristol, including the work of Ros Smith who is examining past storm and flood events on the estuary. GS also indicated that he has a number of flood risk citations that can be inputted into the citations database.

**Tim Stojanovic, Cardiff University, 'The COMPASS Project'**
TS presented the ongoing COMPASS project. led by EDINA at Edinburgh University, as a potential technological approach to information management. Whilst traditional approaches to searching the internet involve the use of key words; COMPASS enables more intelligent web searching by using 'semantic webs'. The use of semantic webs and innovative visual presentations of search results are considered as being powerful ways of accessing vast volumes of information existing on the web.

**5.**

Atelier enjeux changements climatiques - préparation

19 décembre 2008 – atelier avec les élus du territoire du projet de Parc Naturel Régional du golfe du Morbihan

8h30 – 11h00

Salle du conseil, Saint Nolff

Invités :

25 personnes invitées, toutes élues :

- 10 maires
- 6 conseillers généraux
- 9 conseillers régionaux (excusés pour cause de réunion programmée tardivement à la même date)

Déroulement :

1. Présentation IMCORE 5 minutes (MP)

Voir présentation ppt :

Présentation du projet et de la façon dont on va travailler. Dire que l'on va interroger d'autres personnes lors d'atelier de travail (personnes qui ont autorité sur la mer et la côte).

2. Présentation contexte enjeux CC 10 minutes (MC)

Voir présentation ppt :

- Quelles sont les certitudes scientifiques ? « ce n'est pas pour les générations futures, c'est pour maintenant ».
- Quelles incertitudes en termes d'impacts ? Quelles conséquences potentielles ?
- Présenter notre vision des choses des enjeux et impacts
- Phénomènes lents (variation du niveau de la mer) vs phénomènes exceptionnels brutaux (tempêtes)

## 3. Débat

### RISQUES / IMPACTS

**Comment ressentez vous la nature des risques et le niveau d'impact auquel est exposée votre territoire (commune, canton, département) ? Quelles sont les atouts locaux et les faiblesses locales qui peuvent avoir une influence sur les impacts des CC (altimétrie très faible, etc).**

Quels sont de votre point de vue les secteurs potentiellement impactés ? (tourisme balnéaire, agriculture, pêche, aquaculture…)

Prise en compte des impacts sur la biodiversité et sur les habitats sensibles (zones humides) ?

Prise en compte de l'impact sur la santé humaine ?

**Comment anticipez-vous les coûts induits par les impacts des CC ?**

### STRATEGIES

**Comment gérer l'incertitude (est ce que la température va monter ou baisser au niveau local ?) ?**

Réversibilité des choix.

**Qui doivent être les institutions/partenaires qui doivent travailler ensemble pour faire face ? Quels sont les points de blocage ?**

**A quelles échéances/sur quelles échelles de temps faut il travailler ?**

**Sur les zones à risque habitées, quelle stratégie ?**

Recul, mise en place de systèmes de protection, habitations légères moins cher à reconstruire… ?

**En fonction de quels critères faut-il adapter la réponse aux CC ?**

(selon la densité de population, potentiel économique d'une zone, potentiel naturel d'une zone…)

### MOYENS d'ADAPTATION

**De quels outils disposent les élus pour lutter contre les effets des cc ?**

**Pensez vous que les moyens de lutte sont**

- physiques (digues, écluses, restauration et protection des dunes…),
- juridiques (interdiction de construire sur des zones à risque…),
- organisationnels (systèmes d'alertes ; maitrise de la consommation énergétique),

- assurances (pour couvrir les risques),
- pédagogiques (inciter les citoyens à modifier leurs comportements pour limiter les CC…) ?

**Comment voyez vous le rôle/la responsabilité de l'élu en cas d'impacts sur les infrastructures publiques (systèmes d'assainissement) ou privées (atteinte de propriété privées) ?**

## 4. Conclusions

Proposer de réfléchir aux grands axes d'une stratégie adaptative pour le territoire. Faire un groupe de travail restreint pour traiter de ces questions. Qui veut participer ?

6.

## RESULTS FROM IMCORE WORKSHOPS (5 NO. TOTAL)

## EVENT IN COUNTY HALL, DURHAM

Code: S = social, C = economic, N = environmental, I = institutional

| ISSUES AND CONCERNS | TIMESCALE | Code |
|---|---|---|
| GROUP 1 | | |
| Many measures to date have been too short term | Long | I |
| Need adaptation of informal systems | Short | I |
| Need better information about climate change impacts on communities | Short | S,C, N |
| How do we protect economic assets? i.e. TV estuary | Short | N |
| More power needed at a regional policy level to influence planning decisions | Short | I |
| Regional prioritisation of high risk sites i.e. landfill breaches; large scale industry | Short | N |
| Effects on offshore wind farms? | Medium | C,N |
| What are the important thresholds in the north east and how do we influence or act on them? | Short | N |
| GROUP 2 | | |
| Coastal erosion link to loss of designated wildlife<br>- problems for birds nesting<br>- grazing project | | N |
| Marine life – suffers from pollution etc | | N |
| Coastal pollution | | N, C |
| Economic development – effect on fishing | | C,N |
| Displacement of people | | S |

| | | |
|---|---|---|
| Working with other organisations<br><br>- NWL problems with waste water - sewage<br>- Problem effect on issues listed above | | I |
| General awareness of the public<br><br>- How they travel to the coast, what effects does that have? | | S |
| Transport links may suffer | | C |
| GROUP 3 | | |
| Too many messages that contradict | | I |
| Lack of clarity | | I |
| Mixture of opinions | | I, S |
| Understanding the facts – causes of greenhouse gases and where they come from | | S, I |
| What can they do about it? | | S, I |
| More clarity on possible solutions | | I |
| Is wind realistic or is it a token and what are the alternatives? | | N, C |
| Difficult for the single person if large organisations don't do what they preach | | I |
| Real policy needed from Government | | I |
| What are Durham's advantages from it's natural resources and how can they be used? | | C, S |
| Building on flood plains and flood risk areas | | I, N |
| Access of emergency services | | I |
| Negative messages are what is reported e.g. "what about China?" "America won't sign" etc | | I, S |
| Facts need to be in plain English – what can be done, what can I do and what is happening? | | I |
| Culture of blame | | I |

| | | |
|---|---|---|
| Effects of run-off from land use in upland areas impact on lowland and coastal areas | | N |
| Messages – give the facts, the arguments, what is happening, use all media inc. press | | I |
| Understand the facts – what is in the information? | | I, S |
| GROUP 4 | | |
| Act now | | I, S |
| Go back to Environment Agency consultation on flooding in the north east (Blyth and Redcar) needs to be looked at again | | N. I |
| Coastal Flooding<br><br>- top down, should go from local upwards, important to get the correct information locally<br>- communicating back to communities | | I |
| Importance of climate change is not yet known! | | I |
| Raising awareness of businessmen | | I |
| Get the right information across | | I, S |
| Damage to cliffs from coastal erosion (Limestone project)<br><br>- defences can destroy beauty | | N |
| Innovating ways for defences<br><br>- work with local communities – they need opportunity to have their say and become involved | | N, S |
| Lots of wrong information | | I |
| Do we have the data? Implications are unknown, but data is available | | I, N |
| Exchange of information between "stakeholder organisations" | | I |
| Press relations between project and media – should be involved right from the start | | I |

| | | |
|---|---|---|
| Adapt in a way so it does not have a negative effect on the natural beauty | | N |
| Long term solution to projects and work with the natural environment | | I |
| GROUP 5 | | |
| Communication means. Who is targeted? – All levels<br><br>- businesses<br>- communities<br>- schools<br>- individuals<br>- users of the coast<br>Skype could be used as a communication tool.<br><br>Lack of joined up thinking or coordination | | I |
| Underused NGO sector as NGO has strong communication links to communities..<br><br>Develop, harness and education the community – 'community will' | | I |
| Activating behavioural challenge | | S. I |
| Champions – the correct champion who people will trust and continue to listen to | | I |
| Present information spread within the contact of "what's in it for me? my community? my business?" | | S |
| Visual results – how the community sees the results of our/their work. | | S |
| The message "it's going to happen anyway but we can lessen its impacts" isn't working. People seem to think "why should I bother" | | I, S |

Code: T = technical improvement, L = improved communication links, A = the approach to coastal issues, P = collation and presentation of materials.

| INFORMATION NEEDS | |
|---|---|

| | |
|---|---|
| GROUP 1 | |
| Promotion of issues through popular media | L |
| Clarity of purpose in advice in planning for the future | A |
| Greater dissemination of useful information i.e. magic maps | T, L |
| Develop ONE organisation with statutory powers with regard to the coast | A |
| Much complex information needs pulling together into understandable list of actions and priorities | P |
| Clear communication of new realities around adaptation and mitigation | P, L |
| Better information about cause and effect | T |
| GROUP 2 | |
| What percentage cause has the combustion engine had on climate change? | T |
| Key personnel providing information to community<br>- use LAP<br>- explain to individual the effect on them | L |
| Seeing is believing<br>- provide an idea on time and then options on how they can alter pattern<br>- change perceptions and tackle consumer power | P |
| Direction needs to come from National Government or EU | A |
| GROUP 4 | |
| Have information and raise awareness in local communities and make sure they understand why | P, L |
| Specific information about our natural area – needs to come from local community | L |
| Get accessible information – communities | L |
| IM-CORE to collate the information from all organisations involved with climate change | P |
| Putting information together that is relevant | P |

| | |
|---|---|
| Story telling, DVD's using different techniques for different audiences – music, drama etc. | P |
| GROUP 5 | |
| Time scaled distinct impact of climate change – this should change the way we communicate | T |
| Simplify graphs | P |
| Cartoons as an effective simple method | P |
| Single source information point – can IM-CORE provide this? | A |
| Climate change impact along the coast explained – how specific areas will be affected; will tidal reaches encroach further inland? | T, P |
| Different communication forms for different target audiences. Priority must be to engage the hard to reach groups – those previously not actively engaged or refused to participate | L |
| Specify targets and change approach to suit – not a 'one size fits all' | A |

Codes: T = technical, P = people and skills, I = institutional, S = policy & strategy, M = money.

| CONSTRAINTS | TIMESCALE | Code |
|---|---|---|
| GROUP 1 | | |
| We are too complacent in the North East ("I'm all right Jack" attitude) | Short | P |
| Climate change mapping against coastal communities – economic, social, environmental | Short | S |
| Concern about lack of joined up thinking – is everybody doing their own thing? | Short | I, P |
| Only regulations and laws can move this agenda forward | | S |
| It feels like nobody is in control | | I |
| GROUP 2 | | |

| | | |
|---|---|---|
| Change in people and business behaviour | | P |
| Money | | M |
| Directing information at all ages to understand | | P |
| Time – takes a while for change to occur | | I |
| Take action earlier before the problems are there – awareness raising | | I |
| GROUP 3 | | |
| Reliable alternatives e.g. transport (cars to buses) | | T |
| Provision of facilities – bike locks, changing facilities | | I |
| Transport system not integrated | | T, I |
| Lack of investment | | M |
| Good Quality networks – not necessarily joined up | | P |
| Work stops at council boundaries, often won't work together, needs joined up approach | | I |
| Not a joined up approach to roadworks | | I |
| Policy – national and local – carrot and stick approach | | S |
| Financial benefits and penalties – households, business and L.A.'s | | M |
| "Bang head on the wall" policies | | S |
| Waste not being disposed correctly and finishing up in the sea | | T |
| Local produce and suppliers disappearing meaning an increase of travel and packaging, finishing up in the sea if not disposed of correctly | | T, I |
| Concern of the targets that have been set and signed up to and the public and politicians do not understand what these really mean | | P |
| More linked up public transport system | | T |

| | | |
|---|---|---|
| GROUP 4 | | |
| MONEY! Deprivation – skills, training, lack of technology | | M |
| Use existing networks/mechanisms – look at local events and use these to further promote IM-CORE | | I |
| Working with disadvantage | | P |
| How to reach harder to reach people | | P |
| Vested interest/conflicted interest | | I |
| Community capacity – is there enough? | | P |
| Short term thinking | | P |
| Need more local input – take these type of workshops to more local areas | | I |
| Get the correct information from the local community | | I |
| GROUP 5 | | |
| Funding – an unimaginative approach | | M |
| Intense localism – creates conflict and no co-operation | | P |
| Generate optimism – opportunities available – it's not just a disaster | | P |
| Need for understandable targeted communication for each engaged group | | I |
| Generate optimism and opportunity | | P |
| 'Our area is a positive, special place to live in and conserve' | | P |

7.

**Surveys North West and North Wales Coastal Group**

# Cell 11 Shoreline Management Plan SMP2
# North West England and North Wales

## Seaforth to Southport Pier

### Issues and Objectives Tables

# Seaforth to Southport Pier SMP Issues and Objectives Tables

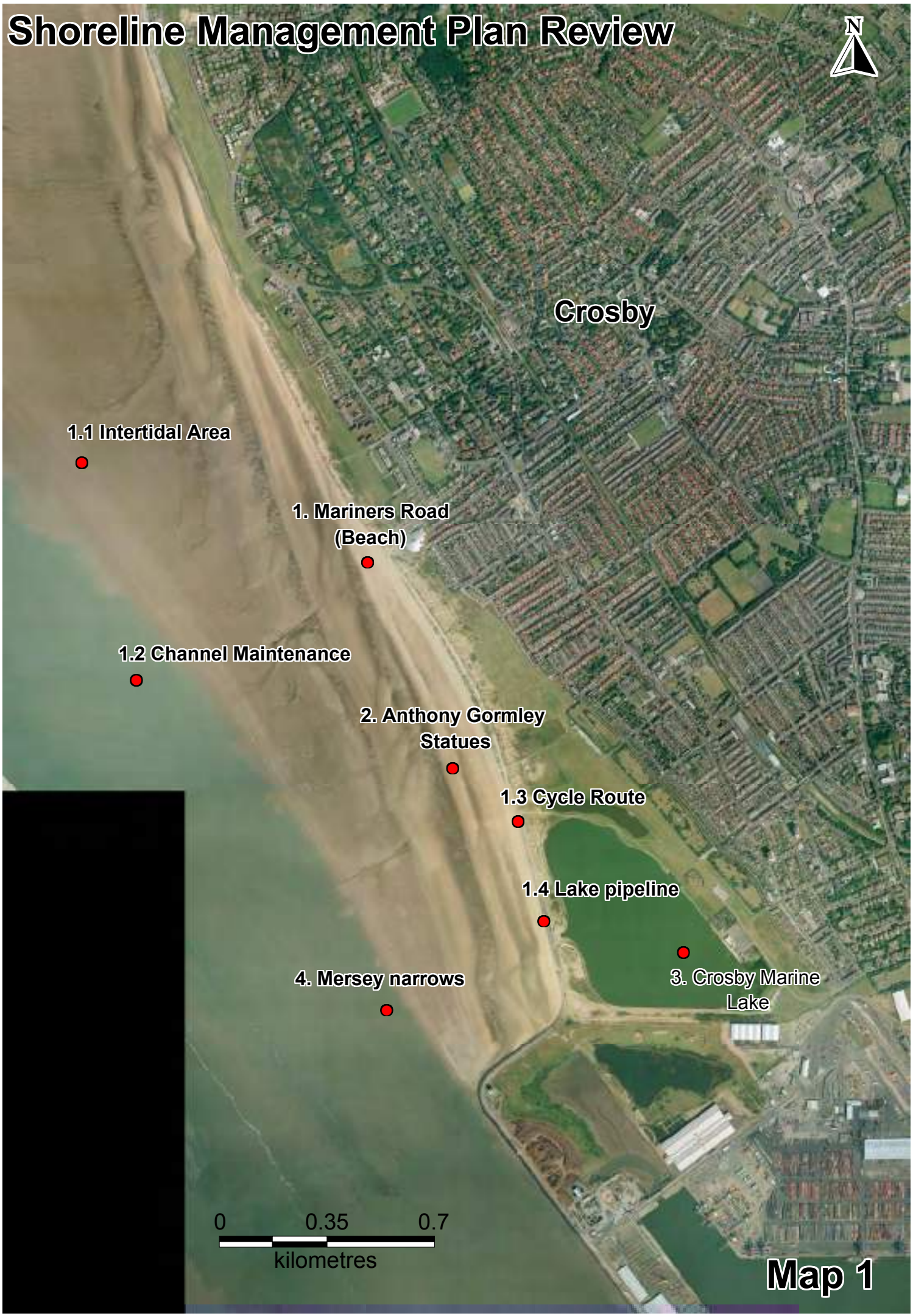
| Location/ feature | Key issues and benefits | Objectives that apply | Key Considerations |
|---|---|---|---|
| Crosby | Crosby is generally regarded as an outlying suburb of Liverpool and therefore the predominant land use is residential. However, Crosby also has several miles of beach, a marina and a number of parks. Popular use for tourism especially with statues. Residential development is located close to the coastline and therefore it is at significant risk from coastal erosion and potentially tidal flooding. | To avoid loss of property due to erosion and/ or manage risk of flooding to people and property<br>To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities | The frontage is characterised by a large undefended dune system which is an important barrier to tidal inundation of the low-lying hinterland.<br>The frontage is significant for nature conservation as it is one of the larger dune systems within the UK. A continuation of natural processes is extremely important for these designations. However as much of this coastline is not artificially defended this should not be an issue.<br>Key areas of potential conflict are the urban areas of Southport and Crosby, the Ainsdale Holiday Centre and the River Alt, which is currently trained by a training wall.<br>The evolution of this transitional coast is heavily influenced by both the Mersey and Ribble Estuaries and therefore is dependant on the management of the Ribble Estuary and activities such as dredging and spoil dumping in the Mersey Estuary. The Mersey training walls also effect processes along this stretch of coastline. |
| Hightown | Hightown is a primarily residential settlement, potentially at risk of coastal erosion and flooding, with risks strongly related to movement of the Alt channel and sea level rise response. | To avoid loss of property due to erosion and/ or manage risk of flooding to people and property<br>To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities | |
| Formby | Formby is largely a residential town, which also attracts large numbers of tourists during the summer months, with day trippers attracted to its beaches, sand dunes and wildlife. There are two main spots along the Formby Coast which are particularly popular, at Lifeboat Road and Victoria Road. | To avoid loss of property due to erosion and/ or manage risk of flooding to people and property<br>To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities | |
| Southport | Southport is a seaside town and popular tourist destination, with a number of tourist attractions and extensive sand dunes. Although generally on slightly higher ground, commercial, recreational and amenity / tourist properties / venues located along the seafront are at risk of coastal erosion and tidal flooding.<br>Sea walls are also amenity structures. | To avoid loss of property due to erosion and/ or manage risk of flooding to people and property<br>To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities | |

# Map 1 SMP Issues and Objectives Tables

| Location/ feature | Key issues and benefits | Objectives that apply |
|---|---|---|
| 1. Mariners Road (Beach) | The beaches are important for tourism, biodiversity and for coastal defence. Where the beach fronts hard defences their loss will result in failure of defence. Where the beach fronts soft defence their loss will result in erosion of the soft defences. | To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities. |
| 2. Anthony Gormley Statues | The Anthony Gormley artwork on Crosby Beach attracts a huge amount of interest in the area with large numbers of people visiting the beach to see the statues. | To avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities and tourism |
| 3. Crosby Marine Lake | Area important for sailing and watersport activities and includes a Sailing Club & Yacht Club. | To minimise the impact of policies on marine operations and activities. |
| 4. Mersey Narrows | Supports International assemblage of Annex 1 birds and regularly occurring migratory birds on intertidal habitats and man-made lagoons.<br>Any changes to coastal evolution could affect this site. | To maintain the integrity of internationally designated sites and the favourable condition of their interest features. |

# Map 1 SMP Issues and Objectives Tables (review)

| Location | Question / Issue |
|---|---|
| 1.1 Intertidal Area | Key to maintenance of this cells international importance for birds is no reduction in intertidal area. |
| 1.2 Channel Maintenance | Channel maintenance for the port: The need to continue working with the stake holders for mutual benefit (also mitigating any predictive change) of Seaforth Development. |
| 1.3 Cycle Route | Cycle route along promenade disappearing. Need to look at alternatives. |
| 1.4 Lake Pipeline | Need to protect and maintain lake pipeline.<br>Issues of wind blown sand. |


Shoreline Management Plan Review
N
Crosby
1.1 Intertidal Area
1. Mariners Road (Beach)
1.2 Channel Maintenance
2. Anthony Gormley Statues
1.3 Cycle Route
1.4 Lake pipeline
3. Crosby Marine Lake
4. Mersey narrows
0
0.35
0.7
kilometres
Map 1

# Map 2 SMP Issues and Objectives Tables



| Location/ feature | Key issues and benefits | Objectives that apply |
|---|---|---|
| 1.Agricultural Land | Along the coast within this coastal section the land is predominately a mix of urban, non agricultural and Grade 5 agricultural land. Further inland there are large areas of Grade 1 and 2 agricultural land which stretches from Litherland north to the River Ribble, between Formby and Ormskirk. | To avoid loss due to erosion of and/or manage risk of flooding to agricultural land |
| 2. Hightown Station | One Scheduled Monument is known for this unit, a cross at Hightown Station. In addition one Registered Park and Garden and 170 listed buildings are recorded. | To avoid loss of scheduled and other nationally, locally and regionally important cultural heritage sites and their setting |
| 3. River Alt | The River Alt is a key feature in local geomorphology. Changing pumping regime can alter river structure. Historically the river has caused erosion across Crosby frontage hence needing to be trained. The United Utilities outfall at Hightown currently fixes the river in position. Removal of this feature would affect local coastal processes.<br>The river is used recreationally (e.g. Blundellsands Sailing Club) to access open water. | To minimise the impact of policies on the River Alt. To manage risk of flooding and erosion to key community, recreational and amenity facilities |
| 4. Historical Trackway and Submerged Forest | Consultation with the appropriate bodies would need to be undertaken to ascertain the level of risk from flooding/ erosion to individual features.<br>Locally important heritage features include the Track way and submerged forest at Hightown | To avoid loss of scheduled and other nationally, locally and regionally important cultural heritage sites and their setting |
| 5. West Lancs Golf Club | One of six golf courses within the coast section. Situated in close proximity to the coastline and is at risk from erosion. Other clubs may become vulnerable to tidal flooding or erosion in the long term. | To avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities and tourism |

# Map 2 SMP Issues and Objectives Tables (review)

| Location | Question / Issue |
|---|---|
| 1.1 Altcar Ranges | Do the MOD intend on keeping the Altcar Ranges? If no then possible re-location for NT |
| 1.2 Hightown Funding | Why are we delaying coastal defence work at Hightown when funding has been in place for years. It doesn't get any cheaper! |
| 1.3 Drainage of the mosses | Make the connection between coastal defence and drainage of the mosses. |
| 1.4 Property Prices | Effects on property prices. Removal of agricultural land. |
| 1.5 Coastal Change | Coastal Archaeology |
| 1.6 Habitat Regs | What will impact be on control, management of visitors to coast? (Habitats Regs/Mitigation issues) |


Shoreline Management Plan Review
N
1.1 Altcar Ranges
1. Agricultural Land
2. Hightown Station
3. River Alt
1.2 Hightown Funding
Hightown
1.3 Drainage
of the mosses
4. Historical Track way
and Submerged Forest
1.4 Property Prices
1.5 Coastal change
5. West Lancs Golf Club
1.6 Habitat Regs
0
0.35
0.7
kilometres
Map 2

# Map 3 SMP Issues and Objectives Tables



| Location/ feature | Key issues and benefits | Objectives that apply |
|---|---|---|
| 1. Victoria Rd and 4. Lifeboat Rd Beach | The beaches are important for tourism, biodiversity and for coastal defence. Where the beach fronts soft defence their loss will result in erosion of the soft defences. | To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities. |
| 2. Historical Footprints | Locally important heritage features include the Footprints at Formby. | To avoid loss of scheduled and other nationally, locally and regionally important cultural heritage sites and their setting |
| 3. Formby Dune System | The Formby dune system is internationally designated and provides an important natural form of coastal defence and protection to the backing low lying areas.<br>Water extraction practises take place from these dunes. | To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities.<br>To Maximise the coast protection value of sand dunes (through active management), whilst recognising the habitat designations. |
| 5. Isolated Coastal Properties | A number of small settlements and isolated properties are located along the coastline in this coastal section and therefore may be prone to coastal erosion and flooding. | To avoid loss of property due to erosion and/or manage risk of flooding to people and property<br>To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities |

# Map 3 SMP Issues and Objectives Tables (review)

| Location | Question / Issue |
|---|---|
| 1.1 Caravan Park | Where and how Caravan Park at Freshfield will move to and life span? Alternative Route or location for NT car park. |
| 1.2 Sediment Deficit | Formby Point: Concerned that the sediment deficit in this area will not permit managed re-alignment as a soft defence. |
| 1.3 Negative public perception of coastal change | Demoralisation of population by shrinking areas of land by coastline affecting communities and general infrastructure. |
| 1.4 Public rights of way | Public rights of way moving within dunes. Divert/redefine? |
| 1.5 Geomorphological processes | Consideration of geomorphological processes and the provision of the necessary space for these to occur needs to be considered. Roll Back. Trees. |
| 1.6 Visitor pressure | Increase visitor offer along coast to ease pressure on certain areas. |
| 1.7 Map historical coastal changes | Map coastal changes since 1400 using known fixed points: i.e. Shorrocks Hill, Kings gap (Wirral), Bootle Shore, Alt, Thornton, Lunt, MT Pleasant, Warren House, Rimrose Valley and Breeze Hill. etc Map next 100years |
| 1.8 Marine conservation | Marine conservation isn’t represented well with sands and dredging. |

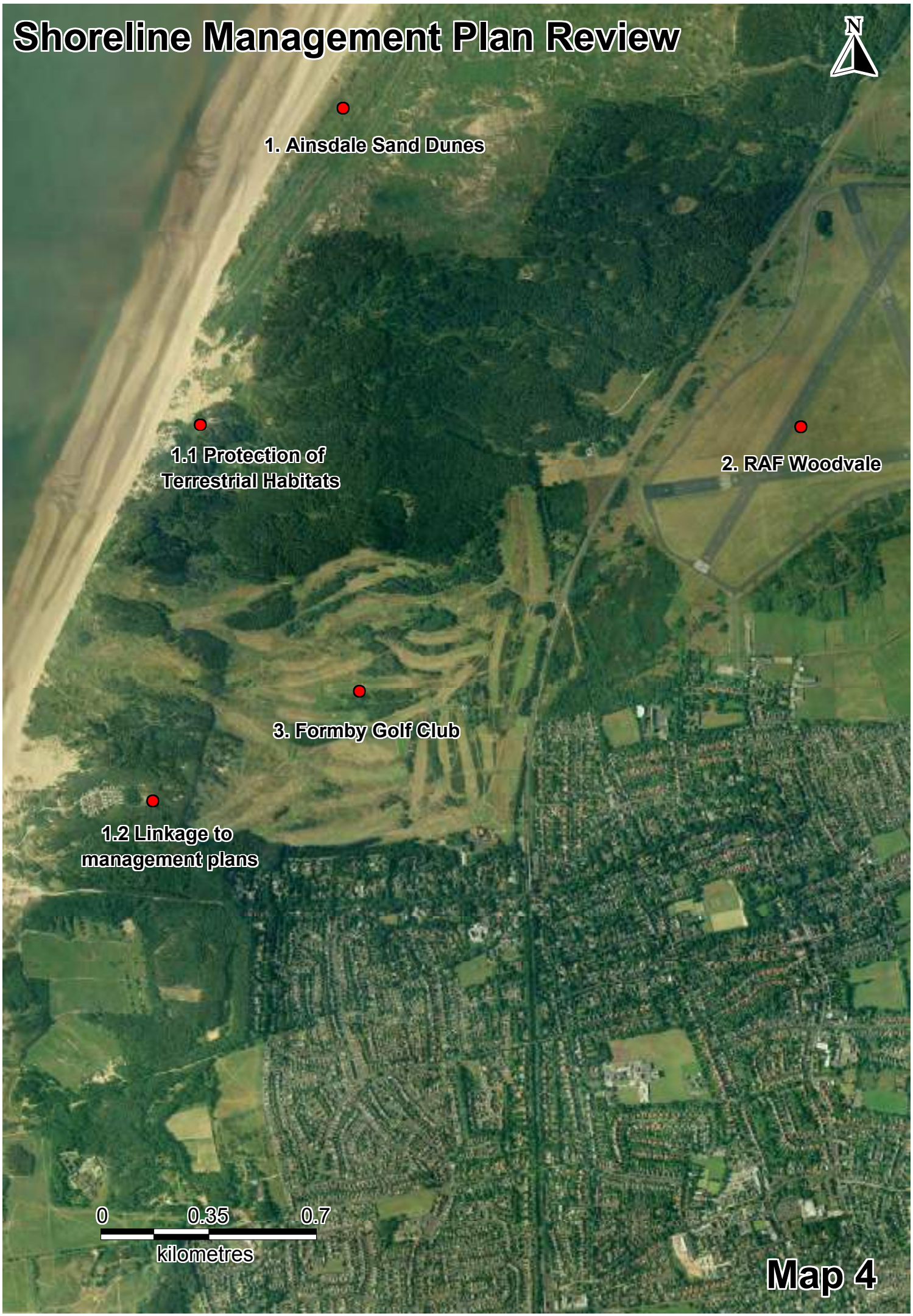

Shoreline Management Plan Review
N
1. Victoria Rd
1.1 Caravan Park
1.2 Sediment Deficit
2. Historical Footprints
1.3 Negative Public Perception of coastal change
3. Formby Dune System
Formby
1.4 Public Rights of Way
1.5 Geomorphological Processes
4. Lifeboat Rd Beach
1.6 Visitor Pressure
5. Isolated coastal properties
1.7 Map historical coastal changes
1.8 Marine Conservation
0
0.35
0.7
kilometres
Map 3

# Map 4 SMP Issues and Objectives Tables

| Location/ feature | Key issues and benefits | Objectives that apply |
|---|---|---|
| 1. Ainsdale Sand Dunes | Noted for its internationally important variety of sand dune types and dune vegetation. | To maintain the integrity of internationally designated sites and the favourable condition of their interest features.<br>To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated conservation sites. |
| 2. RAF Woodvale | RAF Woodvale at Formby is a military airport and classified as a Core MOD site. The site is located in close proximity to the coastline but is currently protected from tidal flooding. | To avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities and tourism |
| 3. Formby Golf Club | One of six golf courses within the coast section. Situated in close proximity to the coastline and is at risk from erosion. Other clubs may become vulnerable to tidal flooding or erosion in the long term. | To avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities and tourism |

# Map 4 SMP Issues and Objectives Tables (review)

| Location | Question / Issue |
|---|---|
| 1.1 Protection of Terrestrial Habitats | Ensure interests of terrestrial protected habitats and species are accounted for e.g. bats and red squirrels |
| 1.2 Linkage to management plans | Ensure appropriate linkage to other documents such as catchment, flood management and river basin management plans under water framework directive. |

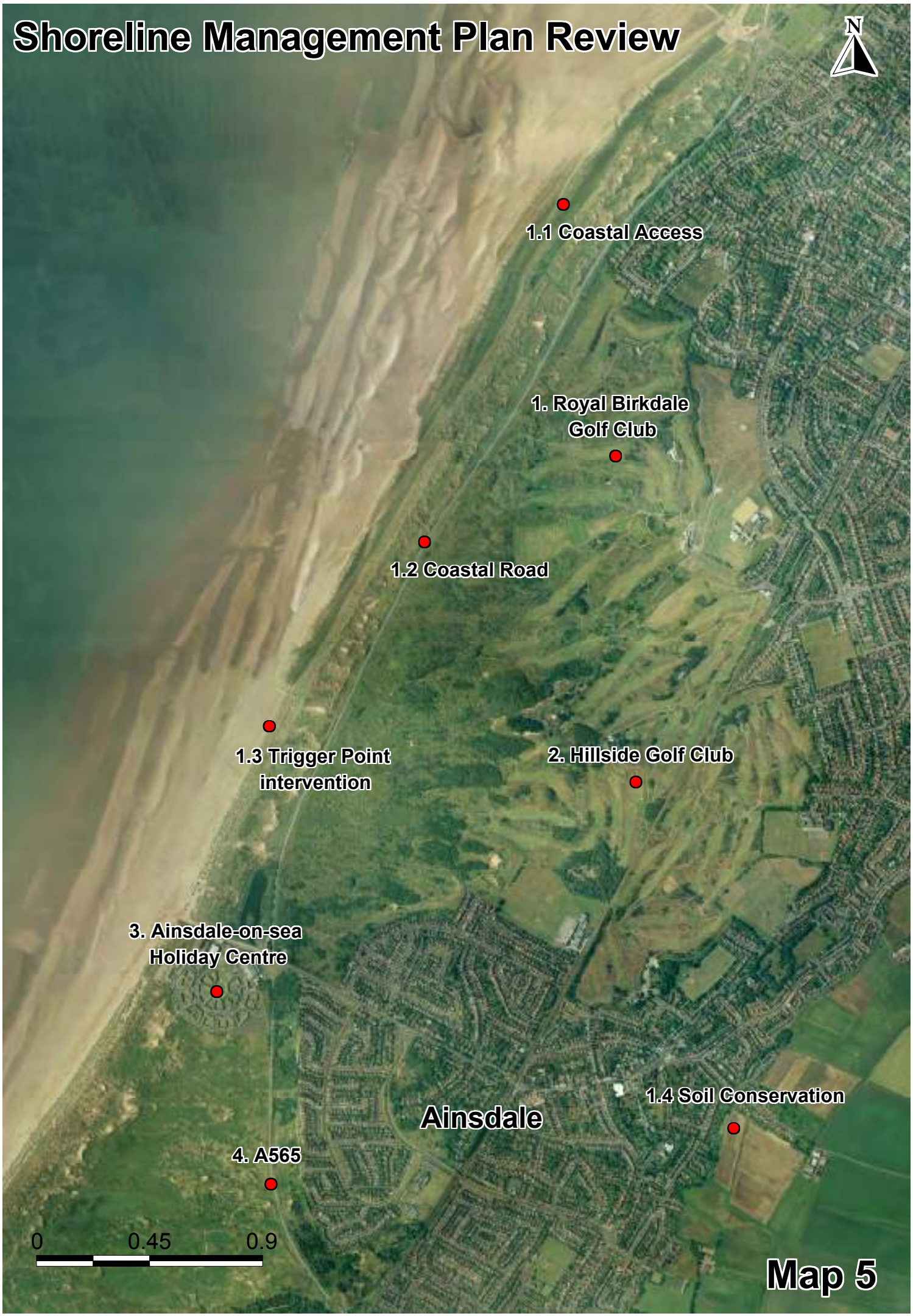

Shoreline Management Plan Review
N
1. Ainsdale Sand Dunes
1.1 Protection of Terrestrial Habitats
2. RAF Woodvale
3. Formby Golf Club
1.2 Linkage to management plans
0
0.35
0.7
kilometres
Map 4

# Map 5 SMP Issues and Objectives Tables

| Location/ feature | Key issues and benefits | Objectives that apply |
|---|---|---|
| 1. Royal Birkdale Golf Club and Hillside Golf Club | Two of six golf courses within the coast section. Situated in close proximity to the coastline and is at risk from erosion. Other clubs may become vulnerable to tidal flooding or erosion in the long term. | To avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities and tourism |
| 3. Ainsdale-on-sea Holiday Centre | The importance of tourism and leisure activity is also reflected in the 'formalised' amenities such as Ainsdale-on-Sea Holiday Centre. | To avoid loss of property due to erosion and/or manage risk of flooding to people and property<br>To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities |
| 4. A565 | The A565 is the main coastal road which connects Southport to Formby. Due to the route it takes along the coast, it is at potential risk from both coastal erosion and flooding, which may prevent the safe operation of this route. | To ensure tidal flooding and erosion risks to critical infrastructure are managed appropriately and that critical services remain operational. |

# Map 5 SMP Issues and Objectives Tables (review)

| Location | Question / Issue |
|---|---|
| 1.1 Coastal Access | Coastal Access new legislation |
| 1.2 Coastal Road | Could we consider closing Coast Road to help with dune processes? |
| 1.3 Trigger point intervention | Who will decide trigger points and when do we get to see and be involved in the decisions about what is to be done? i.e. change from one policy to the next |
| 1.4 Soil Conservation | Soil conservation on the mosses. |


Shoreline Management Plan Review
N
1.1 Coastal Access
1. Royal Birkdale Golf Club
1.2 Coastal Road
1.3 Trigger Point intervention
2. Hillside Golf Club
3. Ainsdale-on-sea Holiday Centre
1.4 Soil Conservation
Ainsdale
4. A565
0
0.45
0.9
Map 5

# Map 6 SMP Issues and Objectives Tables



| Location/ feature | Key issues and benefits | Objectives that apply |
|---|---|---|
| 1. Ribble Estuary | Supports International assemblage of Annex 1 birds and regularly occurring migratory birds on dunes, intertidal flats and saltmarsh.<br>The distribution of habitats is particularly vulnerable to changes in the physical environment (natural or human induced), in particular, coastal squeeze and the effects of climate change. | To maintain the integrity of internationally designated sites and the favourable condition of their Interest features.<br>To avoid adverse impacts on, conserve and where practical enhance the designated interest of nationally designated conservation sites. |
| 2. Southport Beach | The beaches are important for tourism, biodiversity and for coastal defence. Where the beach fronts hard defences their loss will result in failure of defence. Where the beach fronts soft defence their loss will result in erosion of the soft defences. | To avoid loss due to erosion of and manage risk of flooding to key community, recreational and amenity facilities. |
| 3. Marine Lake | Area important for sailing and water sport activities and includes a Sailing Club & Yacht Club | To minimise the impact of policies on marine operations and activities. |
| 4. Southport Pier | Much of the Sefton Coast is renowned for its natural beauty and ecological importance and combined with the leisure use of the beach/dune area, the rural coastal zone is a significant generator of tourist economy in itself.<br>Southport in particular, is a significant tourist destination due to its importance as a ‘high order’ resort and a renowned speciality shopping destination. | To avoid loss due to erosion of and manage risk of flooding to industrial, commercial and economic assets and activities and tourism. |
| 5. Southport Station | The northern rail line and Southport Railway Station, which provides a destination for tourists as well as a key linkage to Manchester, is also located in a flood risk area, which may impact on its operation. | To ensure tidal flooding and erosion risks to critical infrastructure are managed appropriately and that critical services remain operational. |

# Map 6 SMP Issues and Objectives Tables (review)

| Location | Question / Issue |
|---|---|
| 1.1 Loss of Saltmarsh | During the presentation the potential threat of climate change to the saltmarsh was flagged up. |
| 1.2 Promotion of Saltmarsh | Promotion of Saltmarsh as an excellent sea defence |
| 1.3 Communication with Lancashire/ West Lancs | Communication and or Discussion with Lancashire/West Lancs as the sea does not recognise boundaries! |
| 1.4 Energy Development | Regional Energy Development |
| 1.5 Coastal Trails | Development/protection/diversion of English/NW Coastal trails |
| 1.6 Local Issues | 1. Seawall at Southport can be heightened if needs be!- can it also be extended should it be required to marshside.<br>2. Effluent still spewing on to beach near Weld Rd from river Nile.<br>3. Marine life and flora to be maintained on Birkdale beach i.e. Orchids, Natterjack toads, lizards etc.<br>4. Beach in front of Pleasureland to be maintained for tourism |
| 1.7 Freshwater Habitat | Plan for potential loss of unique freshwater habitat at marshide now. |
| 1.8 Accretion and Erosion of Coastline | Stress difference accretion v's erosion on the various stretches of coastline |
| 1.9 Protection of Seafront | Is greater protection needed for seafront and its development sites? |


Shoreline Management Plan Review
N
1. Ribble Estuary
1.1 Loss of Saltmarsh
1.2 Promotion of Saltmarsh
1.3 Communication with Lancashire/West Lancs
1.5 Coastal Trails
1.4 Energy Development
1.6 Local Issues
2. Southport Beach
1.7 Freshwater Habitat
1.8 Accretion and Erosion of coastline
3. Marine Lake
4. Southport Pier
1.9 Protection of Seafront
Southport
5. Southport Station
0
0.4
0.8
kilometres
Map 6

**8.**

Link to report submitted for East of England.

http://insighteast.org.uk/viewResource.aspx?id=16329