

SEVERN ESTUARY

DRAFT

DRAFT ISSUES REPORT

A joint project
by the
Environment Agency
and the
Severn Estuary Strategy

November 1996

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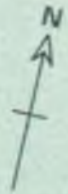
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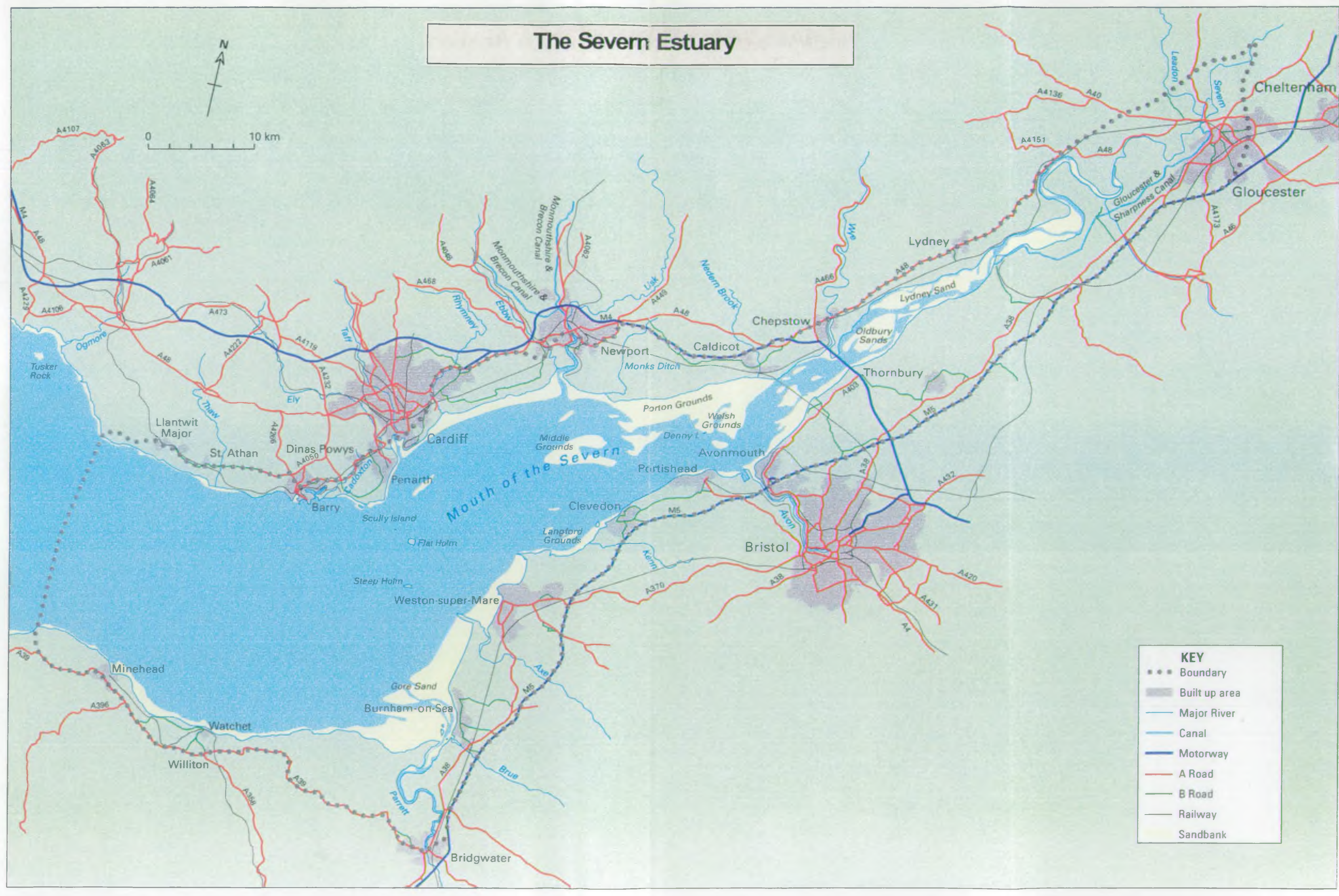
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The Severn Estuary



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KEY

- Boundary
- Built up area
- Major River
- Canal
- Motorway
- A Road
- B Road
- Railway
- Sandbank

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1. Introduction

The Severn Estuary is a unique place. For centuries it has been a focus for man's activities, a location for settlement and a gateway for trading and exploration. Its ports have a great history which, together with modern industrial developments, provide employment and pride to many local people. Yet the estuary still holds a sense of wilderness valued by those who live, work and play around it. The Severn is one of Britain's biggest estuaries. It is also special because it has the second largest tidal range in the world. This gives rise to the Severn Bore and creates extensive sand and mud flats which attract many thousands of wading birds in winter.

The area covered by this report is shown on the inside front cover. The study area runs from just above Gloucester to Minehead on the English Coast and Nash Point (west of Barry) on the Welsh Coast. This is larger than the normal description of the estuary to include areas designated for conservation purposes and areas of the coast not covered by National Park Plans etc. Inland areas covered are approximately bounded by the first major road reached from the estuary. However, because of the inter-related nature of coastal matters, boundaries are perhaps best defined by the issues rather than any physical feature.

There are widespread concerns about the health of the estuary and the impacts of pollution, especially sewage pollution. Equally, the vibrant economy and culture of the area creates a strong pressure for further development. We are still learning how this can be achieved while safeguarding the nature, heritage and landscape of the area. This report seeks to explore ways to find a balance between conservation and development demands. Further issues arise from aggregate extraction, coastal defences, recreational use, regulations on industry and shipping, nature conservation designations, barrages and the potential impact of sea level rise.

More than 50 authorities have direct regulatory control of activities in or near the estuary. Many other organisations, including voluntary bodies such as the Royal Society for the Protection of Birds, and recreational groups such as anglers and wildfowlers value the estuary and are very interested in the way it is managed. Yet most important are the people who live near the estuary, obtain their living from it or enjoy being on it or near it.

Many of these people and organisations have already contributed to this document, which was compiled by the Severn Estuary Strategy and Environment Agency as part of the process to achieve the estuary that we all want. By identifying issues and concerns of all those involved in the estuary we hope to be able to plan together for a future that combines a strong local economy with a healthy estuary environment. We would like to think these are similar goals to those of the local Agenda 21 groups and we want to working with anyone who has similar objectives.

The Severn Estuary Strategy

The Severn Estuary Strategy is an independent group. It was set up by local authorities and other organisations who want a co-ordinated approach to estuary management. Representatives of a range of interests are already involved including ports and harbours, business and industry and conservation, recreation and archaeological groups. The Environment Agency are active participants within the Strategy.

In addition to involvement with this issues report the strategy will:

- Publish a Who's Who of the Severn Estuary.
- Establish groups to examine important topics and to recommend policies to manage the estuary.
- Prepare a plan that draws together the work of these groups into a final management plan.
- Establish a permanent management group to implement agreed actions.

The Environment Agency

The Environment Agency started life on the 1st April 1996 as an environmental regulator of water land and air. It also has flood defence, water resources and Fisheries functions and has duties to promote conservation and recreation. The Agency has many interests in the estuary and is committed to working with others to address the issues. One aspect of this is the production of a Local Environment Agency Plan which details the actions the Agency is committed to over the next 5 years. This issues report is the start of that process. Where feed-back from the report shows that an issue requires action by the Agency this will be carefully considered and entered into the action plan where possible. The Agency hopes that other organisations could produce similar action plans so that a co-ordinated approach to tackling the problems in the estuary can be made.

Identifying the issues

The Severn Estuary Strategy and Environment Agency wanted to hear the views of local people and organisations about the future of the estuary and the issues it faced. To identify locally held concerns we:

- held five public meetings in April and May 1996
- distributed over 400 questionnaires (called Statements of Interest) to organisations and groups
- invited the input of many involved in the management of the estuary such as Environment Agency staff and professionals on the Severn Estuary Strategy Steering Group
- distributed a draft report for comment and suggestion to over 100 organisations and individuals.

Public meetings

A key aim of the Severn Estuary Strategy is to involve the users of the estuary from the beginning of the process. We are looking for a means for people who live, work or play

around the estuary to voice their concerns. The result was a series of five public meetings held in Gloucester, Bristol, Burnham on Sea, Undy near Chepstow and Cardiff.

Over 300 people participated in the public meetings. At each meeting, the people formed into small discussion groups and were asked the following questions:

1. *What do you like and value about the estuary?*
2. *What use do you make of the estuary and do you have any problems or concerns about that use?*
3. *What are the most important issues for the future of the estuary?*

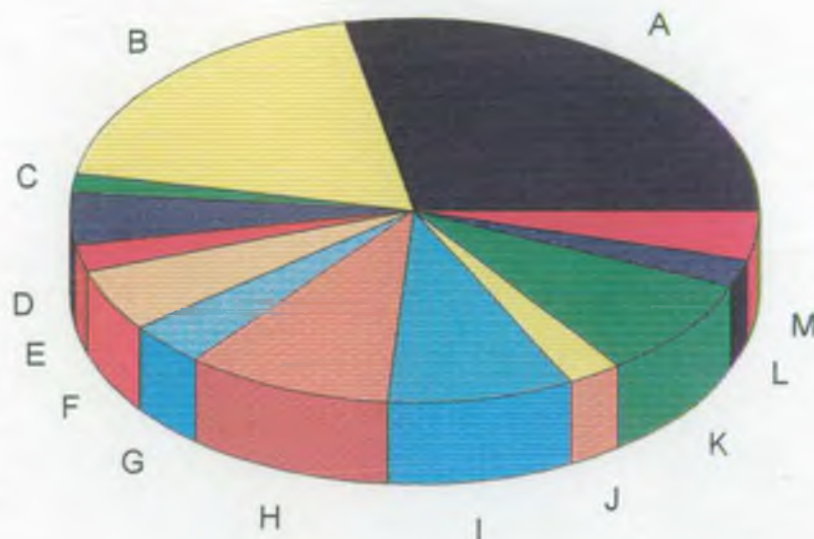
The most frequently expressed value was a sense of wilderness. This is astonishing when one considers that the estuary is bounded by major cities like Bristol and Cardiff and over a million people live close to the Severn Estuary. Other likes included landscape, wildlife, community spirit and local distinctiveness. Perceptions of beauty, a pride in local heritage and the estuary's uniqueness were commonly reported. Discussions of likes and values gave rise to a romantic and poetic charm: sunsets and sunrises, views from one side of the estuary to the other, mudflats, sandy beaches and a history that included pirates!

Why?

The most commonly voiced concern was about sewage and litter pollution of the foreshore. The other very important area of concern was the general management of the estuary, with people being particularly concerned about integration between plans and initiatives, regulation of water based recreation and public involvement. Other concerns included those relating to development, nature conservation, recreation, flood defence, fisheries, and agriculture.

The pie-chart on the following page shows the issues with the most expressed interest

Figure 1.1: Issues raised at Severn Estuary Strategy public meetings



Legend

- A Sewage and litter pollution on the foreshore
- B Integration between estuary initiatives and plans
- C Other forms of pollution
- D Habitat protection and species biodiversity
- E Quality of the environment as a place to live, work and play
- F Erosion of saltings and foreshore and flooding of land and villages
- G Access to the estuary and provision of facilities for recreation
- H Over regulation of water based recreation
- I Cardiff Bay Barrage and any future barrages that might be proposed
- J Perceived conflict between different user groups and a misconception of incompatibility
- K Public involvement in the planning process and early consultation on estuary initiatives
- L Increased understanding of estuary issues and provision of information
- M Impact of port expansion and increasing industrial development

Statements of interest

Organisations and clubs with regulatory or general interest in the estuary have been asked to complete a Statement of Interest form. General information was requested such as area and scope of operations. In addition, questions were asked about the most important issues on the estuary and why the organisation valued the estuary. There were two main reasons for these requests:

- the Severn Estuary Strategy are producing a 'Who's Who' of the estuary which we hope will become an essential information source for all around the estuary.
- information on issues and values has been fed into this document.

Over 200 of these statements of interest have been returned. The Severn Estuary Strategy also produced a flyer in March 1996 with a pre-paid reply slip which also enquired about issues and values in the estuary. Over 100 of these have been returned.

Many of the organisations have sent very interesting replies. The Chepstow Boat Club, for example, when asked 'Why does the Chepstow Boat Club value the estuary?' gave this reply

There would be 43 different answers to this question!-varying from bird watching to fishing from photography to geology. Mostly just the pure joy of being on the river'

Severn Estuary Strategy ^{is} ~~are~~ working to prepare the Who's Who of the Severn Estuary. It will be a very useful document but further funding from industrial and commercial partners is needed for final compilation and printing costs. *

Input from specialist and professional workers

Many specialists and professional workers have contributed their views about issues around the estuary. The input of many involved in the management of the estuary such as Environment Agency staff and professionals on the Severn Estuary Strategy Steering Group has been very valuable in ensuring that the technical and factual input to this document is accurate.

Consultation on draft issues document

A draft of this report was distributed for consultation to over 100 people and groups. Their comments and ideas have been incorporated wherever possible.

2. Overview

Introduction

Man was first attracted to the estuary and the surrounding areas for its wildlife natural resources and access. The estuary provided fish wildfowl and transportation. It also provided sand for building and the surrounding semi-tidal marshes held wild boar, deer and huge prehistoric cattle known as Aurochs. During the industrial revolution and modern era industry and power stations have been sited on the estuary to enable them to use the Ports, cooling water and cheap waste disposal. With the industrial revolution and easier personal transportation also came recreational use of the estuary - witnessed by such Victorian sea-side resorts as Weston Super-Mare and Penarth. This interest in recreation has now expanded to a large group of people who enjoy and appreciate the estuary and wildlife for its own sake. This is reflected in the millions of members of such organisations as the National Trust, County Wildlife Trusts and the Royal Society for the Protection of Birds. The numbers of visitors to the internationally renowned Wildfowl Site at Slimbridge is one of the prime examples of this interest in the estuary. //

The natural environment of the estuary was the basis for the local economy. During the Industrial Revolution the economy was also affected by the exploitation of coal and iron ore in the adjacent South Wales valleys and the Forest of Dean. With increased communications and globalisation of the economy the links have become less obvious but the economy and environment are still intimately related. //

Man's social needs grew alongside the developing economic activity. The provision of other goods, roads, health services, education etc. required social organisation. Social action was also needed on the estuary to prevent the disaster of flooding threatening life and livelihood. The Romans were almost certainly the first to tackle the tides with man-made defences while they occupied the area between the 2nd and 4th centuries.

This chapter follows this structure and is therefore in three main parts:

- **Environment** - a summary of the estuary's physical features and its wildlife;
- **Economy** - a summary of the main economic activities in the estuary and around;
- **Society** - a summary of the social structures we have developed to manage the estuary

Sustainable development

The ultimate aim of management of the Severn Estuary is it should develop in a sustainable way. Sustainable development is a phrase that is used a lot and has important implications for what we do and how we do it, but it is a simple idea. It is:

'Development that enhances the quality of life for all without damaging the environment, or the ability of future generations to meet their own needs.'

(adapted from Vision 21 in Gloucestershire).

This definition includes several important parts:

- **'development'** - sustainable development is not about trying to preserve the world exactly as it is today, but rather about developing it in a positive way;
- **'enhancing the quality of life for all'** - sustainable development must bring positive changes to people's quality of life and these improvements should be felt by everyone, not just the few. Quality of life includes people's financial well being but much more, including their social well being;
- **'without damaging the environment'** - we depend on our environment for our survival so sustainable development must respect the environment;
- **'without damaging the ability of future generations to meet their own needs'** - so whilst we can strive for improvements in our quality of life, we should not do this by destroying the resources which our children and grandchildren will need to continue with that quality of life.

Sustainable development is therefore not just conservation, and its not just about development. It is about everything we do and its effects every part of our world: our environment, our economy and our society.

The principle of sustainable development is particularly relevant to the Severn Estuary. It is rich in natural resources and is very productive. It can help enhance the quality of life of thousands people and contribute to the needs of many future generations. But it is also fragile and needs to be carefully managed if it is to continue to contribute to our quality of life. We need to balance the needs and desires of all current users and future generations.

One of the most important factors for many decision makers is financial cost. Whilst some people believe that this is given too much weight others believe that it will always be important and that we should use it to improve the sustainability of decision making. This means that the financially sound decision would also be environmentally and socially sound. To do this, the costs which decision makers use must to reflect the costs on the environment and society. This task is not easy and there are many people studying so called 'environmental economics'.

An example of the effects of improved environmental pricing can be drawn from the building of the Second Severn Crossing where virgin stone from the Mendips was used instead of china clay waste because of financial costs. It was proposed to supply 6 million tonnes of china clay waste to the roads leading to the new Severn crossing failed because moving waste from Cornwall entailed improving port facilities and would have escalated the cost of materials to £7 per tonne as opposed to £3 per tonne for virgin stone from the Mendips.

ENVIRONMENT

Physical features of the estuary

The Severn Estuary lies on the west coast of Britain at the mouth of four major rivers, the Severn, Wye, Usk and Avon. It is one of the most important British estuaries with the largest tidal range in Europe and the second highest in the world (exceeding 15 metres at Avonmouth during Spring Tides). The shape of the estuary produces the famous Severn Bore in the upstream reaches. It is Britain's biggest coastal plain estuary and has the fourth largest area of intertidal sand and mud flats in Britain.

Boundaries of the estuary

Estuaries are difficult to define because they are transitional areas - from rivers to the sea. The boundaries of the Severn Estuary can be defined in several different ways. We have chosen one particular set of boundaries, as shown on the map on the inside cover, but we are aware that the estuary is part of the wider world and have considered influences outside those boundaries.

There are two lines that could be considered as the estuary's seaward boundary:

1. the most commonly used line joins Lavernock Point to Brean Down (line 1 on Map 1.1). Seawards of this line there is a marked widening and deepening of the estuary.
2. a line between Nash Point and Hurlstone Point (line 2 on Map 1.1). Seaward of this line is a further rapid widening.

West of the second line the coast has the characteristics of an open sea area. East of the line there is mud, turbid water and a rapid change in salt concentration - all characteristics of estuaries. The second line encompasses the whole of the possible Special Area of Conservation suggested by English Nature and the Countryside Council for Wales. It also fits well with new administrative boundaries and abuts other coastal plans such as the Exmoor Plan and Heritage Coast Plans in South Wales. For these reasons the second line has been chosen for this study.

The upstream boundary has been taken as Haw Bridge (10 Km above Gloucester) which is above the limit of salt water penetration and is the furthest point up the estuary where the tide has an effect on the suspended solids concentrations. Figure 1.1 shows the limits of salt, silt tides and marine biological activity in the estuary.

Inland the boundary has been nominally set as the first major road. For some issues a greater boundary is needed. Economic activity and infrastructure, for example, may best be discussed in terms of the administrative authorities. Some information is stored on the basis of Parishes or in kilometre squares and where necessary these boundaries have been used. There is also a good argument for basing the inland boundary on land height because the low lying land which is potentially at risk from tidal flooding could be considered as the estuary zone. In the Severn Estuary this would take in the whole of the

Somerset Levels which would bring in many new issues. The area we have chosen is one of the largest considered for estuary planning and we did not feel we could do justice to this wider area.

At the seaward end the width of the estuary is 19km and the mean depth 25m. From this boundary to Haw Bridge is some 150 Km along the centre line of the estuary. Between the two boundaries there is a surface area of some 1350 Km² at high water.

Depths in the estuary and height of adjacent land

Above the Holm Islands there is only a small channel where the water is deeper than 10 m below mean sea level. The water deepens downstream of the Holm islands but a large area in Bridgwater Bay and along the coast to Minehead is relatively shallow.

The low lying areas of land around the estuary which are most at risk from tidal flooding are parts of the Gwent Levels, Somerset Levels and Vale of Berkely. Map 1.2 shows areas of land less than 10 m above ordnance datum and the depths in the estuary.

Map 1.1: Possible boundaries of the Severn Estuary

Map 1.2: Topography of the estuary and surrounding land

Tides and the Severn Bore

The tidal range in the Severn Estuary is the second the highest in the world. The shape of the estuary produces the famous "Severn Bore" in the upstream reaches. Examples of tidal ranges and levels are given in Table 1.1. The range is greatest in the Cardiff to Avonmouth area and drops off towards the upper estuary and further out to sea. Tide tables for the Bristol Channel and Severn Estuary are published by Arrowsmith. There is significant variation from year to year in height and range of tides - as shown by the variation in number of large bores (Four star bores) predicted by the Environment Agency! The relative times of flood and ebb tide also change further up the estuary and typical water levels over a tidal cycle are shown in Figure 1.2.

(copy) at 0.2
The figure shows that, on spring tides, there is about six hours of flood and six hours of ebb at Avonmouth while at Gloucester there is about two hours of flood and ten hours of ebb. Times of high water are later further up the estuary and predicting the time of flood tide is important for the thousands of Bore watchers. The bore is delayed (and usually disappointing) if there is high pressure or a lot of fresh water in the river but it is usually better if there has been a depression with strong south-westerly winds and low river flows. A leaflet giving predicted bore times and a star rating is published by the Midlands Region of the Environment Agency.

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The bore travels up the estuary at about 10 miles per hour and current speeds in the upper estuary of up to 13 Knots have been recorded. Within the navigable section of the estuary (below Sharpness) current speeds during spring tides reach ** knots.

Another feature of interest to estuary scientists is the 'tidal excursion'. This is a term which refers to how far an object will be carried on a single tide. This is important for the study of pollution and sediments. From the Holm Islands average distances are 26 km for the north side and 37 km for the south side, showing that the currents are not the same on both sides of the estuary.

Table 1.1: Tidal data around the estuary

Location	Mean High Water Spring Tides -range (m)	Mean High Water Spring Tides - level (mAoD*)
Minehead	9.6	5.2
Burnham	11.0	5.8
Cardiff	11.2	5.9
Newport	11.8	6.3
Avonmouth	12.2	6.7
Sharpness	8.7	7.5

Salinity

Salinity is measured in parts per thousand of salt in water. Sea water has a salinity of around 35 parts per thousand and fresh water is usually less than 1. Average salinity taken from helicopter surveys is shown in Figure 1.3 together with the differences noted on neap and spring tides. Although there is some evidence of salinity varying with depth (known as stratification) at the mouths of the rivers Taff and the Usk at certain states of tide, the water is usually well mixed. This shows that in most respects the estuary is dominated by the tide rather than fresh water flow - hardly surprising given the tidal range observed.

Fresh water flow

In the Severn Estuary there are several important sources of fresh water, some of which enter via tributary estuaries, namely the rivers Wye, Bristol Avon, Usk, Rhymney, Taff, Ely and Parrett. The annual variation of some of the more important fresh water flows is shown in Figure 1.4. As a round figure, the average fresh water flow into the estuary is about 300 cubic meters per second (26,500,000 cubic metres per day), about half coming from the rivers Severn and Wye.

Coastal processes - erosion, deposition and flooding

The coastal processes of erosion, deposition and flooding are driven by:

- * tides and currents
- * winds and waves
- * tidal surges
- * flood water flows.

Coastal processes in the seaward area of the Severn Estuary are dominated by tide and waves while those upstream are dominated by river floods and the Severn Bore. The direction of drift, areas of erosion and deposition and nature of the coastline are shown in Map 1.3 together with areas subject to the greatest wave action.

Interpretation and technical appraisal of these processes is part of the Shoreline Management Plan process. The Severn Estuary Strategy and the Environment Agency keep in close contact with these groups and hope they will lead on any topic group discussing tidal flooding or erosion.

Sediments

The high energy associated with the tides in the estuary has a large effect on the distribution of both suspended and bottom sediments. East of the line between Nash Point and Hurlestone Point large areas of the bed-rock are exposed - sometimes covered with a thin layer of unconsolidated sediment while there are areas of settled mud off Avonmouth, in the Newport Deep and Bridgwater Bay.

Upstream of a line joining Barry and Bridgwater Bay large quantities of fine sediment are redistributed according to the tidal state and range. During the full ebb and flood of

spring tides similar levels of suspended solids may be found throughout the water column - and these may be up to 10,000 mg/l. Towards slack water, the suspension settles out to form mobile layers of mud more than three metres or more thick on the bed of the estuary with suspended solids sediment concentrations of more than 50,000 mg/l. It is estimated that the estuary carries up to 10 million tons of suspended sediment. These dynamic conditions have resulted in the formation of characteristic seabed communities. Some of these are of high conservation value.

In the tidal River Severn near Gloucester sediments characteristic of the estuary migrate upstream during periods of low freshwater flow and give rise to concerns for navigation between Gloucester and Tewkesbury and in the Gloucester Sharpness Canal. Figure 1.4 shows the suspended solids concentration over a tidal cycle at Gloucester for two tides of the same range but different fresh water flows. These high levels of suspended solids in this area also cause oxygen depletion when sediments with a high sediment oxygen demand are re-suspended after a quiescent neap tide period.

Map 1.3: Coastal processes

Life in the estuary

The Severn Estuary is famous for its birds. Many thousands of wildfowl and wetland birds use the estuary, either as a permanent home or as winter feeding grounds. The Severn is one of only a handful of British estuaries which regularly support more than 68,000 wading birds in winter.

The estuary is also renowned for its salmon and elvers. The rivers Severn, Wye and Usk account for more than 25% of the salmon caught in England and Wales and the area is the most important in the UK for elvers.

Saltmarsh is a significant and threatened habitat of the estuary's fringes. There are many types with both gradual and stepped transitions from bare mud to upper saltmarsh. Several nationally rare or notable species are present.

One of the less well known but important features of the Severn Estuary is the reef built by *Sabellaria* worms. The reefs in the Severn Estuary are some of the largest examples in the United Kingdom. A variety of other animals such as bristle worms, flat worms, barnacles and sea squirts may also use these reefs for shelter and attachment points.

The following sections briefly describe these four components of the estuary's wildlife.

Birds

Thousands of birds are attracted to the estuary by the millions of tiny animals which thrive in the muds and sands of the estuary. Although there are not many different species living in the mud, they are very productive. Indeed, an acre of the estuary's mud is more productive than an acre of first grade agricultural land. The birds also graze on land around the estuary. ?

Wildfowl

The estuary is home to the world renowned Wildfowl and Wetland Trust reserve at Slimbridge. The New Grounds there support more than half the Russian population of white fronted geese and a flock of over 5000 is regularly seen. Up to 400 Bewick swans (about 5% of the west European population) have also been seen at the New Grounds and flocks occur in many other parts of the estuary.

The more common species such as Mallard, Widgeon and Shelduck are found in many parts of the estuary with major concentrations being at Bridgwater Bay and Slimbridge where there are protected feeding grounds and roosting places.

Waders

Waders are the most common birds feeding on the mud dwelling animals. The most common are Dunlin which stop off in the estuary on migration often in their bright breeding plumage. Other waders include Knots Ring Plovers and Grey Plovers. The lives of all the shore-feeding waders are governed by the tides and they feed both by day and night if the mud is exposed. At high tide they are forced to the top of the shore where

they congregate in large roosts either at the tide edge or in nearby fields. The largest roosts in the Severn Estuary are at Start Island in Bridgwater Bay and at Collister Pill near Newport. The sight of many thousands of wading birds wheeling and turning in flight as they prepare to settle at such roosts is one of the finest wildlife spectacles in the estuarine wilderness.

Breeding birds

Breeding birds have declined in the estuary with increased human disturbance. A few Ringed Plovers and Oystercatchers still breed in scattered locations. The Shelduck is another species which has declined as a result of disturbance but still breeds. Until recent years the coastal levels flanking the estuary were one of the finest breeding areas for wetland birds in the country. The lowering of the water table has unfortunately reduced the numbers of species such as the Common Snipe but others like Redshank Lapwing and Yellow Wagtail still thrive.

Birds of passage

In winter the Wentlooge, Caldicot and Somerset Levels together with the lowlands at Clevedon and the Vale of Berkeley support vast flocks of Redwings, Fieldfares and other visiting thrushes. Another bird which uses the estuary during Spring and Autumn migration is the Whimbrel. Over 2000 birds have been recorded at Start in May represent over 75% of the Whimbrel recorded in Britain at this time of year.

Fish and fisheries

The estuary is also well known for its salmon and elvers. The rivers Severn, Wye and Usk account for more than 25% of the salmon caught in England and Wales and the area is the most important in the UK for elvers.

The presence of salmon in an estuary or river is often taken as a measure of the health of the environment. It does reflect the quality of the water but not the biological diversity or productivity of the estuary as salmon do not feed there. There appears to be a long term decline in numbers of salmon in line with other North Atlantic fisheries. However, at present we are only able to measure this by looking at the number of fish caught - and this depends on reliable returns by fishermen!

Although there is a general interest in salmon and an occasional view of a fish jumping the weirs at Gloucester or Tewkesbury, the fascination with salmon in the estuary is centred on the traditional methods of fishing. The 'fixed engines' are a feature of the inter-tidal area of the estuary. These consist of rows of baskets - traditionally withy but now steel and plastic - which catch salmon swimming near to the shore (normally on an ebb tide). The currents are so strong and the estuary so muddy that the fish are not able to see or avoid these traps. Some individual fishermen near Lydney walk out across the sands at low water and fish with hand held 'Lave Nets'. The fishermen watch for the tell-tale line of the fish's fin and scoop the fish into their nets. This is a very dangerous occupation and even some fishermen who have worked the river all their lives have been caught by the tide. Other traditional methods of fishing have been lost over the last 20 years as the market for Severn Salmon has fallen away with the advent of cheap 'farmed' salmon.

The estuary is the most important in the country for elvers (small eels). High concentrations of these are found swimming with the tide up the banks of the estuaries and tidal rivers on spring tides between March and May. They are mostly caught at night as lights attract them to the hand held nets of the fishermen. The myriad of small lamps on the banks of the estuaries and tidal rivers during these periods is very much a part of the character of Severnside. Elvers used to be a local delicacy or sport (there was an elver eating contest at Frampton until 2 years ago). However, it is now much more a business because one kilo of live elvers for export can fetch over £200. This does lead to problems of trespass and damage to land by the estuary, conflicts between fishermen and poaching.

Over eighty species of fish have been recorded from the estuary. The fish known to depend on the estuary to complete their life cycles include those which migrate between the sea and sub-estuaries. These include the allis and twaite shads, members of the herring family, the sea and river lamprey, which are primitive jawless fish like eels, and of course atlantic salmon and eels. They all pass through the estuary on their way to spawn in the rivers which flow into it. It is not known at present whether the allis shad is still breeding in the rivers though it has been caught in the estuary in recent years.

Salt marsh

Saltmarsh is a significant and threatened habitat of the estuary's fringes. There are many types with both gradual and stepped transitions from bare mud to upper saltmarsh. They are threatened by erosion and their plant communities are significantly affected by the levels of grazing by sheep or cattle. Several nationally rare or notable species are present. Common cord grass is abundant on the seaward fringes of the marshes, where it occurs as dense monocultures.

Apart from the stretch near Burnham on the Southern side of the estuary where sand dunes have been formed, the boundary between the plants of the land and the sea edge is formed either by cliffs or by a man made sea wall. To the seaward side of the sea wall, saltings are often found consisting of stretches of grass leading to low earth cliffs with saltmarsh or mud flats beyond. All plants beyond the sea wall are likely to be covered by the tide at some time so only salt-tolerant species can survive. Most parts of the upper saltings are grazed by sheep or cattle and consist of Bent and Fescue grasses with flowers of Sea Pink, Sea Milkwort and Sea Spurrey. The middle zone of the grass saltings shows the change from the green fescue to the grey-green of the common saltmarsh grass at a lower level.

Below the earth cliffs the native Glasswort and Annual Sea-blite has been replaced in many places by *Spartina* grass. This is a cross between a native British species and an American import and has been deliberately planted in many areas to trap silt, so raising the level of the saltmarsh and protecting against erosion. Eel grasses maintain a hold on some of the more sheltered mud banks but are grazed by geese and other waterfowl and may be declining in the estuary. These are our only truly marine flowering plants and are a nationally scarce species.

The influence of the sea is not entirely checked by the sea walls, salt water may percolate through into the drainage channels on the landward side allowing salt tolerant Sea Sedge, Celery Leaved Crowfoot and Horned Pondweed to replace some of the freshwater plants.

***Sabellaria* reefs and invertebrates**

A particular feature of the Severn Estuary is the reef built by segmented bristle worms (ross worms), mainly *Sabellaria alveolata* and *Sabellaria spinulosa*. The worms normally grow in colonies - each one in a tube made from particles of sand which have been stuck together. They can be so firm that they are like honeycombed porous sandstone. The worms are 2-3cms long and they feed by trapping suspended particles on their feathery tentacles.

A variety of other animals such as bristle worms, flat worms, barnacles and sea squirts may also use these reefs for shelter and attachment points. *Sabellaria* worms are widely distributed, but these reefs in the Severn Estuary are some of the most extensive examples in the United Kingdom, and are unusual because the two species of this type of worm live side by side.

Sub-tidal sandbanks are permanently covered by sea water up to a depth of 20 metres. These large areas of sand and sediment occur in the middle and outer estuary and Bridgwater Bay. Mobile sands such as the Welsh and English Grounds are characterised by communities of bristle worms. Sea woodlice are also found here.

The broad intertidal mudflats and sandflats are exposed at low water and have different species living on them and in them depending on the proportions of mud and sand. Where there is low salinity and a muddy bottom such as at Berrow Flats and the mouth of the River Usk, there are mud snails that feed on the surface and Baltic tellin which burrow in the mud and extend long siphons to suck in food and water from the surface. Other bristle worms such as catworms and ragworms also inhabit these areas. Other areas of sand have communities including lugworms and sandhoppers. The common shrimp is also abundant in the estuary and is a significant part of the diet of many juvenile fish.

Special Area of Conservation

The Severn Estuary is one of nine United Kingdom Estuaries which have been proposed as possible Special Areas of Marine Conservation. The four reasons for nomination were:

- its general importance for nature conservation,
- large areas of intertidal mudflats and sandflats,
- subtidal sandbanks, and
- Atlantic salt meadows (saltmarsh).

The dynamic conditions in the estuary have resulted in the formation of characteristic seabed communities such as the *Sabellaria* reefs which are of high conservation value.

ECONOMY

Additional information is needed on economic matters. At the moment only unemployment is included.

Unemployment

The level of unemployment can give a guide to the general economic welfare of an area. The latest unemployment statistics for the area indicate that around 66,300 persons were unemployed in August 1996, but it is not possible to calculate precisely what percentage of the workforce this number represents. This is because unemployment rates and workforce figures are not available for Local Authority Districts, only for Counties (or Unitary Authorities) and for Travel to Work areas.

Nevertheless, it is possible to calculate the unemployment rate for the nearest equivalent area in terms of selected Unitary Authorities and Travel to Work Areas (see Table 1.3). Using this method it has been calculated that the 'workforce' based unemployment rate in August 1996, for the nearest equivalent to the plan area, was 6.6% - compared to the 7.6% for Great Britain as a whole. However, as can be seen on the following table there was considerable variation in unemployment rates by area.

Table 7.3: Unemployment around the Severn Estuary - August 1996

Severn Estuary Plan area nearest equivalent area to plan area to obtain overall unemployment rate					
Area	Unemployment at 8th August 1996				
	Male	Female	Total	Workforce	% Workforce
Vale of Glamorgan	2,992	1,143	4,135	59,928	6.9
Cardiff UA	10,098	3,144	13,242	178,946	7.4
Newport UA	3,291	939	4,230	47,528	8.9
Monmouthshire UA	1,577	671	2,248	32,580	6.9
Forest of Dean	486	168	654	17,676	3.7
Gloucester City	3,535	1,233	4,768	80,420	5.9
Tewkesbury	3,300	1,221	4,521	90,420	5.0
Stroud	1,799	808	2,607	48,278	5.4
South. Glouc. UA (Northavon.Kingswood)	3,682	1,640	5,322	108,612	4.9
Bristol UA	13,735	4,557	18,292	247,189	7.4
North Somerset UA (Woodspring)	3,573	1,352	4,925	74,621	6.6
West Somerset	1,993	713	2,706	39,794	6.8
Sedgemoor	656	228	884	12,629	7.0
SUB TOTAL	50,717	17,817	68,534	1,039,014	6.6
Great Britain	1,545,800	538,100	2,083,900	27,419,737	7.6

SOCIETY

Additional information is needed on society. Only population data is included in this draft.

Population

There are 13 local authorities in the plan area. Information on the population in these areas is shown in Table 1.2. The population in 1995 totalled 1,966,900 people, compared with 1,924,000 in 1991 and 1,828,900 in 1981. This means that between 1981 and 1995 there were an extra 138 000 people living around the estuary. The average population growth per annum is faster than the national average:

	1981-1991	1991-1995
National average	0.25%	0.33%
Severn Estuary authorities	0.50%	0.55%

Table 1.2: Population in the authorities adjoining the Severn Estuary

SEVERN ESTUARY PLAN AREA POPULATION (000s)									
LA Area (former name)	Year			Change					
				1981-91		1991-95		1981-1995	
	1981	1991	1995	No	%	No	%	No	%
Vale of Glamorgan	113.3	119.2	118.8	5.9	5.2	-0.4	-0.3	5.5	4.9
Cardiff UA	286.8	300.0	309.4	13.2	4.6	9.4	3.1	22.6	7.9
Newport UA	132.4	136.9	137.2	4.5	3.4	0.3	0.2	4.8	3.6
Monmouthshire UA	76.6	80.4	85.6	3.8	5.0	5.2	6.5	9.0	11.7
Forest of Dean	73.2	75.9	75.4	2.7	3.7	-0.5	-0.7	2.2	3.0
Gloucester City	100.2	104.7	105.8	4.5	4.5	1.1	1.1	5.6	5.6
Tewkesbury	63.5	71.1	76.2	7.6	12.	5.1	7.2	12.7	20.0
Stroud	96.1	104.4	107.3	8.3	8.6	2.9	2.8	11.2	11.7
South. Glouc. UA (Northavon/Kingswood)	203.1	223.2	233.2	20.1	9.9	10.0	4.5	30.1	14.8
Bristol UA	401.2	397.0	400.7	-4.2	-1.0	3.7	0.9	-0.5	-0.1
North Somerset UA (Woodspring)	162.9	179.8	183.8	16.9	10.4	4.0	2.2	20.9	12.8
West Somerset	29.5	32.1	32.4	2.6	8.8	0.3	0.9	2.9	9.8
Sedgemoor	90.1	99.3	101.1	9.2	10.2	1.8	1.8	11.0	12.2
SUB TOTAL	1,828.9	1,924.0	1,966.9	95.1	5.2	42.9	2.2	138.0	7.5
Great Britain	54,814.5	56,206.5	56,956.8	1,392.0	3.5	750.3	1.3	2,142.3	3.9
SEVERN AREA AS % OF GB	3.3	3.4	3.5	6.8	204.8	5.7	167.0	6.4	193.1

External issues and factors

There are several issues which could have a significant impact on the Severn Estuary in the next few decades which will need a response but which are not within the power of the local regulatory authorities to control. The major external issues are:

1. Increased general development pressure.

Nationally it is expected that some four million houses will be needed in the next 20 years to meet changes in lifestyle and an ageing population. Many of the development proposals within Structure Plans are already focusing on sites close to the estuary and this trend may continue as the land is flat and is seen by some to have less landscape appeal than more upland areas.

→ Local Perspective?

2. Increased demand and scarcity of natural resources.

With the possibility of large housing programs there will be even more demand on aggregates. There will be more demand for sand from the Severn Estuary.

only this?

3. Global Warming.

The main consequence of Global Warming for the estuary is a rise in sea level. Until recently this was still considered as only a possibility but the major international commission studying the problem now accept that it is likely to happen. This is already being taken into account in the design of new flood defences but obviously has major implications for renewing existing defences. The river run-off is likely to change because of changes in the weather with more floods in winter and lower flows in summer. This could eventually have implications on the ecology of the estuary and surrounding levels. Salt water may penetrate further up the river affecting abstractions for water supply at the tidal limits. Farming round the estuary may change with the changing climate and there could be a resurgence of tourism with warmer summers. This truly is a potential 'wind of change'!

4. External factors affecting migratory fish.

The numbers of salmon caught in commercial traps in the estuary depend on many factors outside the estuary. While the main factor may be the effect of commercial fishing in deepwaters climate change may also affect the feeding grounds in the North Atlantic. Inland effects are also important - acid rain, forestry and other land use changes may severely affect the ability of the fish to spawn

5. Possible Severn Barrage.

While the financial climate does not seem to be favourable to a Severn Barrage at present this may change in the future. As fossil fuels become more scarce and we try to reduce their effects on the climate, the Barrage may become financially viable. The proponents of the scheme claim that it could generate up to 7% of the annual electricity consumption of England and Wales, provide sea defence, create new jobs and protect the water environment. Others consider that much of the area of mud-flats important to birds would be lost and that salmon would be killed while passing through the turbines.

6 International trade and the global economy.

Changes in trade and the global economy will affect pressures on the ports and development opportunities. For example, inward investment to the UK by overseas

companies is a significant issue, providing jobs but putting pressures on the environment. The place of the UK in the European Union will affect investment decisions such as these.

7 Increased recreational pressure

As some people's leisure time, disposable income and personal mobility grows, there is increased pressure from recreation. There are very few 'wilderness' areas in southern England and the estuary is likely to be the focus of much of this pressure.

*I'm a bit unhappy with this section,
it is rather superficial but more sympathy
lacks 'authority' in its statements.*

3

Planning and management in the estuary.

Estuary management

Estuary management: what is it?

World-wide, interest in coastal and estuary management dates back over twenty years. Since then there has been a marked rise in the adoption of coastal/estuary management across the globe with well over fifty nations having implemented such programmes. Estuary management, or integrated estuary management as it sometimes called, may be defined as:

'a process which brings together all those involved in the development, management and use of the estuary within a framework which facilitates the integration of their interest and responsibilities to achieve common objectives'

Through taking an integrated and long-term approach to planning and management, estuary management aims to:

- promote sustainable use of the coast/estuary
- balance demands for estuary resources
- resolve conflicts of use
- promote environmentally sensitive use of estuaries
- promote strategic planning of estuaries and coasts

*Repeats earlier
information*

To achieve the above, it has been recognised that estuary planning and management should:

- take account of guidance, plans or strategies at international, European, national, regional and local levels
- bring together policies and practice from all sectors and taking account of their different characteristics and timescales
- bridge management across the land/sea interface

International dimensions of estuary management

The international community has provided much support and momentum for coastal management, particular through the activities of the United Nations and its programmes, such as the United Nations Environment Programme, as well as the work of international organisations including the International Union for the Conservation of Nature and Natural Resources (IUCN) and the Intergovernmental Panel on Climate Change (IPCC)

However, the most significant international event over the last decade has been the Earth Summit. At this, coastal nations agreed to the following basic principles and needs of ocean, coastal and estuary management in Agenda 21, Chapter 17:

C O-ORDINATION / INTEGRATION

- integrated policy and decision-making processes/ instruments,
- integration of sectoral programmes

O RGANISATION

- full public participation
- education and training programmes

A CTION (COASTAL) PLANNING

- coastal and marine use plans
- contingency planning

S USTAINABILITY

- conservation, restoration of critical habitats
- measure to maintain biodiversity, productivity of marine species / habitats
- preventative and precautionary approaches

T ECHNIQUES

- monitoring
- information on systems and users
- Environmental Impact Assessment

*needs to be
done if this
is to work.*

Estuary management and Europe

Although there is a considerable amount of general European legislation which contributes to the protection of the coastal and estuarine environment, such as the Habitats and Species Directive, there are few measures which specifically concern the coast. The fifth European Community Environmental Action Programme suggests various targets and instruments for coastal policy (Table 3.1), but a European instrument providing for the integrated estuary / coastal management, although requested by various European bodies, has, as yet, not been forthcoming. However, the European Commission has recently acknowledged that attention needs to be focused on fragile coastal (and estuarine) environments which require integrated management approaches. It has agreed to the funding of a demonstration programme which will draw on available experience from within Europe and will inform a decision on possible subsequent European action.

In addition to European regional policy which has made a major contribution to the development of the European coastal environment, the funding programmes of the EU /EC have had a major impact on the redevelopment and protection of the European coastal zone. Of especial note is the financial assistance from the European LIFE programme (Financial Instrument for the Environment) and INTEREG. These have aided projects promoting sustainable development and environmental quality, including some of the work of LES ESTURIALES, described below.

Table 3.1: Fifth European Community Environmental Action Programme: coastal policy

OBJECTIVE	<ul style="list-style-type: none"> Sustainable development of coastal zones and their resources in accordance with the carrying capacity of coastal environments.
COASTAL ZONE	<ul style="list-style-type: none"> Includes the fore-shore, coastal waters and estuaries, together with coastal land up to the limit of marine or coastal influence.
TARGETS (to the year 2000)	<ul style="list-style-type: none"> higher priority to the environmental need of coastal zones through, <i>inter alia</i>, better co-ordination between relevant EC policies at the EC, national and regional level operational framework for integrated planning and management development of criteria for better balance of land use and conservation and use of natural resources raising awareness of the public, competent authorities and economic sectors
INSTRUMENTS	<ul style="list-style-type: none"> framework of integrated management plans at appropriate levels better exchange of knowledge and experience creation and improvement of databases and relevant indicators pilot projects on integrated management of coastal zones information campaigns, education, professional training, financial support for demonstration projects and innovative approaches (LIFE) improvement of criteria to ensure sustainability of projects and programmes (including EIA)

(Source: EU, 1992)

LES ESTURIALES

LES ESTURIALES is a pan-European partnership of municipal and regional authorities responsible for the sustainable management of five of Europe's major estuaries (the Tagus, Clyde, Loire, Wear and the Severn). The LES ESTURIALES Charter of 1992 (Box 3.1) recognises the unique environmental and economic character of estuaries and promotes the sustainable and holistic management and development of these areas through co-operative actions, including exchange of experience, lobbying and technical projects. These include a comparative environmental study in 1993 which provided much basic background material on the state of each estuary and its management as well as a study of the feasibility of a feederling coasting service along the Atlantic Arc for container transport. The current *Cybestuaries* project is developing Good Practice guidelines and training material using multi-media techniques, principally CD-ROM to assist with the sustainable management of Europe's estuaries and is drawing on the emerging experience of LES ESTURIALES. The value of such co-operative work of LES ESTURIALES has been recognised in the European Commission's spatial strategy *Europe 2000+*.

??

This is getting bogged down in political detail to the detriment of the repub

Box 3.1: Aims and actions of LES ESTURIALES

LES ESTURIALES aims:

- assist upgrading of the environment of estuaries in a consistent and sustained manner through Europe
- facilitate estuarine port economies particularly through reconstruction of existing historic ports
- facilitate developments directly relevant to estuarine location
- assist implementation and development of EC directives as specified in environmental programmes, CZM proposal or similar ordinances

LES ESTURIALES actions :

- undertaking and publishing joint studies
- identifying where environmental intervention is required on a European basis to redress problems created by economic activity
- make joint representations on action required to safeguard the environment and
- economic future of estuarine communities

Estuary management in the UK

General

Recent interest and development of coastal and estuary management in the UK has been remarkable. Coastal and estuary planning programmes are under production for much of the English coast and the Scottish firths. Numerous non-statutory coastal fora and engineering-based coastal groups have also been formed to address local and regional coastal issues.

The report by the House of Commons Environment Select Committee into *Coastal Zone Protection and Planning* (1992) was a landmark for UK coastal/estuary management. It raised the profile of coastal issues in the UK, stressing the need for a strategic coastal management system for the British coast and suggesting a number of possible improvements to the organisational, policy and planning framework for coastal areas. In response to this report the government has published a range of documents, clarifying coastal policy and suggesting possible ways forward:

- *Planning Policy Guidance Note 20: Coastal Planning*
- *Development below the Low Water Mark. A review of regulation in England and Wales)*
- *Managing the Coast. A review of coastal management plans in England and Wales and the powers supporting them*
- *Policy Guidelines for the Coast*
- *Coastal zone management: towards best practice*

The Government's aims for the English coast are listed within *Policy Guidelines for the Coast*. Within this document, themes and priorities for the coast, include:

- achieving sustainable use of the coastal resource
- helping reconcile competing needs - recognising the commercial and development importance of the coastal zone; its significance for sport, leisure and recreation; and the need to protect the coastal environment
- promoting integrated management of the coast

At local levels the guidelines suggest that:

- all concerned with proposal affecting the coast should consult widely with relevant local bodies and interests to take full account of their views and expertise

In referring to non-statutory estuary management plans, the guidelines state that such plans:

- 'should reflect a broad and balanced approach. All parties are asked to involve themselves actively in the plan process to the fullest practical (and where relevant, statutory) extent of their respective responsibilities'

The guidelines also note that local, county and regional conferences can help to:

- improve knowledge of coastal processes
- define key issues for coastal planning
- co-ordinate policies for conservation, coastal defence and development in the coastal zone
- advise the Secretary of State that particular issues affecting the coast should be covered in Regional Planning Guidance

English Nature's Estuary Initiative

The UK government has drawn attention to the special significance of British estuaries and expressed its aim to produce plans for key English estuaries within its response to the Earth Summit (*Biodiversity: the UK action plan*). Within this context, EN is encouraging the sustainable use of estuaries through its *Estuaries Initiative*. EN has promoted and facilitated the preparation of non-statutory integrated estuary management plans for each of England's estuaries and has encouraged the establishment of estuary management groups to guide and implement these plans. The plans are intended to 'build on, support and inform the existing planning and management structure operating on estuaries' and involve relevant Local Authorities, Harbour Authorities and others with EN providing the central focus facilitation and partial funding. The Severn Estuary Strategy is supported by English Nature along with other agencies and bodies.

Who does what around the Severn Estuary ?

There are many types of management and planning initiatives covering coastal and estuarine areas. Such programmes and plans have evolved in response to legislative requirements and the sectoral evolution of agencies and other organisations. This patchwork of uncoordinated plans has led to considerable overlap between plans and a complex framework within which integrated estuary management is developing. Figure 3.2 shows the range of plans which are currently operational or in preparation for the Severn Estuary area.

Figure 3.2: Coastal Plans within the Severn Estuary Area (diagram)

Local Environment Agency Plans

Here As referred to in Chapter 1, this Joint Issues Document marks the end of the first phase of the preparation of the Local Environment Agency Plan for the Severn Estuary. In addition to this strategic-level plan, other smaller catchments around the major estuary and the Gwent Levels have had, or are having, Local Environment Agency Plans produced for them (Map 3.1). The Agency's predecessor, the National Rivers Authority, began progress on agency plans (the Severn Estuary and other Catchment Management Plans) several years ago and the new agency has continued with the production of plans, now called Local Environment Agency Plans (LEAPs). These plans, which have been primarily concerned with the strategic planning of the Agency's functions, now have a somewhat wider remit, reflecting the agency's new functions, which include notably flood defence, water resources, navigation, conservation, fisheries and pollution as well as waste, integrated pollution control, contaminated land and air quality issues. As these plans succeed the Catchment Management Plans, they are currently primarily based on catchment/sub-catchment management units. *||*

One of the plans' primary roles lies in assessing problems and opportunities resulting from catchment uses and proposing actions to optimise the future well-being of the environment. However, it is envisaged that they should also aim to:

- assist the development of Environment Agency management programmes
- guide the agency's response to development proposals within individual catchment units
- help promote the agency's vision of sustainable management of the environment
- foster wider support for the agency's management proposals.

|| To some extent the production of the LEAP for the Severn reflects the new agency's greater emphasis on sustainability, flexibility and partnerships, including those with local government and local communities. In addition, the Joint Issues Document's wider consultation and focus on issues is in line with current thinking on LEAPs. It should be noted that the process of agency plan formulation to date has involved an initial Consultation Report (such as the Joint Issues Document) and a final Action Plan being produced. The former generally provides a description of the resources, uses and activities of the environment as well as outlining issues and possible solutions. After a period of public consultation, an agreed Action Plan is produced outlining the long-term vision (10+ years) for the area, setting out clear implementation and responsibilities.

Map 3.1: Local Environment Agency Plans around the Severn Estuary

Shoreline Management Plans

Shoreline Management Plans (SMP) should provide a framework for the strategic planning of sustainable coastal defences (**Chapter 6**) along the coast of England and Wales. The Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office have jointly issued guidance pressing local authorities to produce such plans. The Severn Estuary SMP being produced for the Severn Estuary Coastal Group is one of these such plans.

It is envisaged that these plans should outline a preferred approach to shoreline management following consideration of a range of coastal defence options, including 'soft' and 'do nothing' options. The environmental and human consequences of coastal defence programmes have also to be considered within such plans, which are being produced for defined management units, normally based on coarse sediment cells or sub-cells. The SMP being prepared for the Severn Estuary extends from Brean Down on the English shore, north to Haw Bridge near Tewkesbury, and west to Lavemock Point on the Welsh coast (**Figure 3.2**).

Figure 3.2 The extent of the Severn Shoreline Management Plan

The preparation of the Severn Estuary SMP is being conducted in three separate stages:

- Phase 1 Scoping Study
- Phase 2 SMP Preparation
- Phase 3 SMP Adoption

At present a scoping study has been completed, which has identified, collected and assessed the quality of relevant datasets through on-line searches and consultation with key organisations. It is envisaged that Phase 2 will begin in 1997 by addressing the recommendations of the scoping exercise. Following consultation and analysis, the estuary's shoreline will then be sub-divided into self-contained management units, each of which will have 'clear, strategic guidelines from which operating authorities can develop coastal defence strategies'. The plan will be finalised and adopted in Phase 3 following wide consultation on the draft SMP, which includes details of management units and guidelines.

In the context of integrated estuary management, it should be noted that it is generally intended that SMPs should be integrated with the work of local planning authorities and that statutory development plans should take account of the needs of shoreline management.

Memorandum of Understanding

To reduce overlap, increase efficiency and achieve consistency, a Memorandum of Understanding (MOU) has been drawn up between the Severn Estuary Strategy, the Environment Agency and the local Coastal Cell Groups considering coastal defence and Shoreline Management. This MOU 'acknowledges the importance of working together during the development of the Estuary Management, the Severn Estuary Catchment Management Plan (now LEAP) and the three Shoreline Management Plans.'

The initiative was made possible by the coincident timing of the plans and helps to:

- minimise confusions about the aims of the initiatives
- reduce unnecessary repetition of work
- share expertise and information

To accomplish the above, the partners have agreed to:

- work together
- share expertise and data
- reduce duplication of work
- enable joint reports to be prepared for consultation

SAC Scheme Of Management

Relevant authorities have been given powers to establish management schemes for marine Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) under the EC Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC). Sites designated under these directives contribute to the EU ecological network, *Natura 2000*, which aims to conserve internationally important species and habitats occurring through the European Union.

The Habitats Directive's main aim is:

- To ensure that biodiversity is maintained through conservation of important, rare or threatened habitats and the habitats of certain species. The Directive also aims to make a contribution to sustainable development of the sites

The main aim of the Birds Directive is:

- To protect bird species within the European Union through the conservation of birds and important habitats for birds

The Severn Estuary/Mor Hafren has been recommended as a possible marine Special Area of Conservation (pSAC) because of its high diversity of habitats/species of European importance, notably its subtidal sandbanks, and Atlantic salt meadows, inter-tidal mudflats and sandbanks, and estuarine environment which are considered to be amongst the best in the UK (Figure **?).

After consultation with competent and relevant authorities as well as other groups with interests in the candidate marine SACs, the Government and the European Commission will agree a list of sites to be designated. A final list of sites will be decided by June 1998 and then each Member State will have until 2004 to designate the chosen sites.

The proposed marine SAC for the Severn Estuary along with other such sites will not be subject to legislation until it has gained EC approval, although it is intended that a voluntary management scheme for each site should be set up as soon as conservation objectives and a management group have been established. The latter will consist of those authorities with relevant marine regulatory functions, such as Local Authorities, the Environment Agency, Ports and Harbour Authorities, Sea Fisheries Committees, English Nature and the Countryside Council for Wales. However, the conservation agencies have indicated that it would be preferable for such schemes to involve local people and interest groups in addition to regulators at an early stage, possibly through a local forum. Although both English Nature and the Countryside Council for Wales have a specific duty to advise on the conservation objectives of management schemes and on activities likely to harm SACs, any of the relevant authorities may take the lead in establishing the management scheme. However, the Government has reserve powers which allow appropriate ministers to direct a particular relevant authority to lead the development and delivery of a management scheme through a management group.

It should be noted that the Habitats Directive is only concerned with those activities and actions which are incompatible with the maintenance of the international conservation interest of the site and

cause 'significant' effect(s) on the relevant habitats/species. This includes indirect effects, which may emanate from in or outside the site boundary. It is envisaged that schemes of management will be based on existing management initiatives and that new regulation of activities will only be introduced where these are not delivered by current schemes.

Development Plans

The statutory role of local authorities in controlling the use and development of land and property (Chapter 3) is aided by the preparation of statutory development plans. These contain policies and proposals which guide the location and nature of development and are prepared in the context of regional and national planning guidance. Table 3.2 shows the authorities, and the stage of preparation of their plans as of December 1996.

Table 3.2: Development plan status around the Severn Estuary

To be completed

In areas where county councils still exist strategic policies are contained in Structure Plans whereas detailed policies, which guide individual planning decision and development control, are given in Local Plans produced by district councils. The new unitary authorities around the Severn are producing Unitary Development Plans at as early a date as possible. These plans will contain strategies, overviews and policies in Part I and detailed policies for the authority's area in Part 2. However, South Gloucestershire, Bristol and North Somerset have a direction from the Secretary of State for the Environment to prepare a joint structure plan. A Joint Technical Unit has been established to steer this work. County and unitary authorities also prepare mineral and waste planning policies which are either include in their development plan or in separate documents. In addition, statutory development plans may be supported by additional, non-statutory plans and policy or supplementary guidance prepared by authorities in response to various issues. Although supplementary guidance plays only an advisory role it can have a significant role in influencing development and is a useful reference source for estuary management.

All development plans involve extensive consultation with statutory consultees, non-statutory consultees and the public. If necessary, issues are discussed at Public Local Inquiries/Examinations in Public. Stages in this consultation are generalised below:

draft plan → plan placed on deposit for public scrutiny and comment → public inquiry → modifications proposed by council → plan adopted

It should be noted that authorities with coastlines along the Severn Estuary are at different stages in the preparation of their development plans - some have adopted plans, others are working at various stages on 'emerging' plans (Table 3.2).

*Assessment of policies within development plans in the context of estuary management?
(Section to be completed)*

Local Agenda 21

Agenda 21, the agenda agreed by all participating nations at the Earth Summit in 1992, stressed the importance of local involvement in ensuring sustainable development into the next century. It highlighted the role of local authorities in encouraging public participation through education, consultation and consensus-building. In response to this the Government produced the *UK Strategy for Sustainable Development* in 1994. In this the government called upon local authorities to develop their own Local Agenda 21 strategies by the end of 1996, however, this is not a statutory requirement. Progress has been made by some councils around the Severn Estuary, although local government re-organisation has inhibited implementation of some of the strategies. The Environment Agency is particularly keen to see progress being made with Local Agenda Plans and strategies since sustainable development indicates respect and concern about the environment. This is of particular importance within the Severn Estuary because of the special conservation value of the area.

Table 3.2: Agenda 21s in plan area

To be completed

Emergency / Contingency Plans

To be completed

I am finding it difficult to draw together all these disparate sectors, many of which contain similar sounding words & phrases. I think that the report so far will confuse many readers.

I don't find the actions very helpful here, - it is rather 'bitty'.

wildlife, habitats and water quality alone, which have a direct effect on the management of the coastal/estuary areas.

Who is involved: Various, including bodies with general environmental duties

Possible ways forward: In addition to the recommendations made under A.1, relevant bodies should exercise their general environmental duties in the context of sustainable estuary management. Voluntary and self-regulatory approaches to the management of certain estuarine activities, such as offshore recreation, should be explored further.

MA.3 Limited statutory protection for the offshore environment

Some organisations and individuals, particularly those with conservation interests, are concerned over the current limited statutory protection for the offshore environment, particularly when compared with the fairly comprehensive system which has evolved for land areas. Certainly, to date most legal designations for nature conservation, such as the Severn Estuary Site of Special Scientific Interest (SSSI), have been intended for areas above the mean low water mark, and, consequently, are not well-suited for integrated estuary management.

Who is involved: UK Government and pSAC relevant authorities

Possible ways forward: The eventual designation of the current possible Severn Estuary Special Area of Conservation (pSAC) under the Habitats Directive (Nature Conservation Section) would ensure that this marine SAC is managed in a sustainable way.

MA.4 Enforcement of legislation

Several organisations have commented on difficulties encountered in enforcing legislation, particularly relating to the regulation of offshore activities. A combination of out-dated and complex local bye-laws, a lack of co-ordination between local regulatory measures, and limited resources dedicated to enforcing such legislation are major impediments to an efficient and effective enforcement system.

Who is involved: Government and statutory

bodies

Possible ways forward: The suggestions outlined under A.1 above should go some way towards alleviating problems of enforcement. In addition the use of simple, but well designed and informed interpretation and volunteer wardening programmes to both educate offshore users of relevant byelaws and to police these bye-laws might be investigated.

MB Inadequacies in national policy and planning policy guidance

MB.1 Inadequacies in national coastal policy

Whilst the publication of *Policy Guidelines for the Coast* by the Department of the Environment has been warmly welcomed for the English side of the estuary, the lack of such a document for the Welsh side has given rise to much concern. Given the commonality of much legislation to England and Wales, such a document would not be difficult to prepare. However, many still feel a need for more detailed policy to guide local and regional level estuary and coastal management than is contained even in this document. Its emphasis on preparation rather than implementation of non-statutory management plans has also received some criticism.

Who is involved: Principally the Welsh Office; IDG/Department of the Environment

Possible ways forward: The production of a Welsh appendix to the *Policy Guidelines for the coast* would be useful in addition to the current production and wide dissemination of *Coastal Zone Management - towards best practice*. The latter provides useful reference material for all estuary decision-makers and users, but, in the absence of detailed policy guidance for estuary management, the management of the Severn Estuary will have to rely on the continued support, initiative and expertise being fostered by the Severn Estuary Strategy. In addition, the Severn Estuary Strategy's participation in national and international workshops and seminars on estuary management, including the English Nature workshops and the annual LES ESTURIALES conference, will ensure that the management of the Severn lies at the forefront

of estuary management in Europe.

MB.2 Inadequacies in national planning policy guidance for coastal areas

A number of individuals have referred to inadequacies in planning policy guidance for coastal areas, particularly commenting on the weak coastal content of Planning Policy Guidance (Wales). When compared with the planning policy guidance note on coastal planning (PPG20), currently operational in England, there are a number of significant gaps in the guidance being provided by the Welsh Office for Welsh Unitary authorities in preparing their Unitary development plans. For example, PPG (Wales) does not refer to the following, all of which are discussed in some depth in PPG20 and are essential considerations/requirements for effective coastal and estuarine development planning:

- *cumulative impacts on estuaries*
- *effects of development on marine activities*
- *the value of tourism in regenerating seaside resorts*
- *managed retreat*
- *public access to the coast as a basic principle*
- *the coast as a strategic issue*
- *the need for LPAs to work with other organisations 'to improve knowledge of coastal processes, to define key issues and co-ordinate policies for the coastal zone'*
- *coastal management plans and the relationship of these to development plans*
- *information gains for development plans from involvement with coastal management plans*

Who is involved: Welsh Office

Possible ways forward: Those involved in the development plan process along with bodies with interests in the co-ordination of coastal /estuarine plans and policies, including the Severn Estuary Strategy and SCOSLA (the Standing Conference of Severnside Local Authorities), should press for more detailed planning policy guidance on coastal and estuarine matters. *Technical Advice Notes (Welsh Office) ...*

MC The organisational framework for

managing estuary resources

MC.1 Complexity of the organisational framework

The plethora of organisations involved in coastal and estuarine matters, including the public, private and voluntary sectors, is viewed as a major impediment to integrated estuary management. The problem is particularly acute on the Severn Estuary where Welsh and English institutions come together. Although the sectoral subdivision of responsibilities encourages high standards of performance within specific management areas, it also inhibits discussion between relevant players. Consequently, poor understanding of organisational roles results in unrealistic expectations of achievements, further friction, 'information gaps' and the formulation of inadequate management solutions to estuarine problems.

Even within individual organisations, such as Local Authorities, complex internal organisational structures are often not conducive towards producing the necessary dialogue for addressing issues relating to integrated estuarine management. Different organisational arrangements often exist between neighbouring authorities, particularly for non-statutory functions.

Who is involved: All organisations

Possible ways forward: The complex organisational structure, which has evolved over decades in response to piecemeal national legislation, cannot be readily amended. However, increased understanding and tolerance of each others roles and approaches will be facilitated by increased dialogue between such bodies, through fora such as the Severn Estuary Strategy and through the wide dissemination of the *Who's Who* currently being produced by the Strategy.

Regarding the complexity of internal organisational structures for estuary management, it is suggested that organisations with estuarine responsibilities should review their internal organisational structures in the light of requirements for integrated estuarine management, and identify a lead department/committee/ individual to co-ordinate

such efforts.

MC.2 Lack of co-ordination between organisations

Largely as a result of the complex organisational framework outlined in C.1 above, many comments refer to the lack of co-ordinated decision-making around the estuary, leading to unnecessary conflict. Specific references have been made to a lack of co-ordination between agencies and between national and local tiers of individual bodies. For many of the estuarine issues outlined in subsequent chapters, such as coastal litter, pollution, coastal defence, a strategic approach, requiring co-ordination between geographically remote or neighbouring organisations, is needed. In an estuary environment one authority's dream solution may be another's expensive nightmare.

Major restructuring and the redefinition of the roles of many key organisations around the estuary has and will continue to disrupt management efforts. Local Government Re-organisation (in Wales and Avon), along with the formation of the Environment Agency, have been the most significant and major changes.

Who is involved: All organisations

Possible ways forward: In addition to the suggestions outlined under C.1 above and D.2 below, it is important that all organisations make efforts to co-ordinate their activities with others in and around the estuary. Involvement in existing and proposed structures to establish communication and dialogue is vital. In particular, the Severn Estuary Strategy and its proposed Topic Groups should facilitate such dialogue and co-ordination along with the reformation of SCOSLA (the Standing Conference of Severnside Local Authorities) and the continued implementation of the Memorandum of Understanding.

MC.3 Accountability of regulators

A considerable number of individuals are concerned over the limited accountability of regulators within the Severn estuary. Specific reference has been made to quangos, recent erosion of local government powers and the role of corporations, notably the Cardiff Bay

Development Corporation. The need for 'democratic development' is a particular issue in areas where large scale development projects in progress or proposed around the estuary.

Who is involved: Regulators

Possible ways forward: A more open decision-making process is needed in which people (regulators and public) are prepared to spend more time working together to understand each other's agenda and achieve positive outcomes. The building up of trust can be a lengthy, but rewarding process. The role of the SES Topic Groups should be invaluable, as experiences with such groups elsewhere, such as in Morecambe Bay, have shown.

MC.4 Inadequate public participation

A considerable number of individuals and representatives of non-government organisations have expressed the need for further public participation and consultation on many matters relating to estuary development and management. Whilst it is recognised that many of the plans referred to above have improved their consultation process over the last decade, the public perception of 'us and them' still remains to a certain extent. Without effective participation apathy and antagonism will continue to perpetuate sectoral 'narrow' thinking, inefficient solutions and lack of 'ownership' of estuary planning and management.

Who is involved: All

Possible ways forward: The role of early, extensive and effective consultation is vital to the integrated management of all estuary activities. The relative merits of such a process have already been proved in numerous estuary and coastal management projects, such as the consultation process enacted for the recent discussion paper on the Dorset coast has exemplified. The continued work of the Severn Estuary Strategy and Local Agenda 21 projects in the Severn Estuary area, along with further improvements in all other public consultation exercises, will ensure greater trust and 'ownership' of estuary problems and solutions.

Plan-related issues:

MD Inadequacies in the planning framework for estuary management

MD.1 The complexity of the planning framework

A significant number of comments have been made regarding the number of plans and the complexity of the planning framework within the estuary. This has resulted in considerable confusion regarding the roles of specific plans and the relationship between them. Within this context reference to 'new' plans, including the Severn Estuary Strategy, has been made.

Who is involved:

Possible ways forward: Given the sectoral division of responsibilities between organisations, the simplification and rationalisation of the planning framework is a long-term goal. However, dissemination of information on 'Who does what' is essential. Participation in Severn Estuary Strategy Topic Groups should also improve understanding of these plans.

MD.2 The need for co-ordination between management initiatives and plans

Specific references has been made to the need for integrated management and co-ordination between estuary plans, particularly between estuary, landscape and shoreline management plans. Concern has also focused on potential overlaps and the need for horizontal and vertical co-ordination between plans. Some references to difficulties in co-ordinating plans, because of the different timing of plan preparation and revision, have also been made. This appears to be especially an issue for the preparation of development plans.

Who is involved: All those involved in the planning and management of the estuary

Possible ways forward: Closer liaison and co-operation between organisations in the preparation and implementation of plans and management initiatives relating to the estuary is essential. The extension and adoption of the MOU to other management plans/activities, particularly the scheme for the pSAC, would be beneficial to the long-term co-ordination of

management efforts and would result in reduced duplication of effort and expenditure. It should be noted that there is a statutory requirement for development plans to consult neighbouring authorities in their preparation; in the case of the Severn estuary this includes trans-estuary consultation between Cardiff and Bristol.

ME Inadequacies in development plan guidance and policy

ME.1 Variations in the regional guidance around the estuary

Several comments have been made regarding potential difficulties arising from attempts to harmonise policies within development plans around the estuary, because of differences in regional planning guidance in Wales and England. Currently, there is no Strategic Planning Guidance (SPG) for Wales, although such a document was issued in consultation form four years ago (1992) for the Assembly of Welsh Counties. Regional Planning Guidance was issued for the South West two years ago (RPG10: 1994) and although this provides the land use planning context for Local Authority plans up until 2011, it is envisaged that revised guidance (taking note of PPG20, the pSAC and the SES) will be submitted to the Government within the next couple of years.

Who is involved: Severn Estuary Strategy; Welsh Office; Regional Conference(s); Local Planning Authorities; SCOSLA

Possible ways forward: SCOSLA, the Severn Estuary Strategy and other relevant bodies must continue to press for the production of regional guidance for Welsh side of estuary and should play an active role in the consultation process for all regional planning guidance. The re-constitution and involvement of a South Wales Standing Conference (post Local Government Reorganisation) would greatly facilitate a 'regional view' to local government actions along the Welsh shores of the estuary.

ME.2 Different coastal policy frameworks / guidance for either side of the estuary

As a consequence of the problems highlighted under B.2 and E.1 there are considerable differences in approach to development planning on either side of the estuary. This

issue is exacerbated by the fact that the county and district tiers of local government were replaced by Unitary Authorities in several localities, resulting in very different sizes of planning units around the estuary. The 'cascade of policies' is therefore much stronger on the English side of the estuary.

Who is involved: Severn Estuary Strategy; Welsh Office; Regional Conference(s); Local Planning Authorities; SCOSLA

Possible ways forward: SCOSLA, the Severn Estuary Strategy and other relevant bodies should press for a similar 'cascade of policies' on either side of the estuary, along with a more co-ordinated and consistent approach to development planning which takes on board examples of best coastal planning policy practice in England and Wales.

Information and assessment-related issues:

MF Inadequacies in information for estuary management

MF.1 Gaps in the information required for estuary management

A considerable number of bodies and individuals have expressed concern regarding the general lack of data relating to certain estuarine activities, notably recreational usage and access, along with inadequacies in the quality of some other information and lack of long-term data sets.

Who is involved:

Possible ways forward: As a first step the *Who's Who* and the *Cybestuaries Project* could provide a preliminary assessment of what information exists for the Severn along with the much welcomed coastal directory produced by the JNCC covering the region and the scoping studies for the Shoreline Management Plan. It is essential that information collection relates specifically to management needs and objectives, rather than merely data compilation for its own sake, i.e. 'intelligence and not information'. The work of the Topic Groups and Local Agenda 21 should help to maintain such a focus to information gathering and collation.

MF.2 The need for a database and Geographical Information System (GIS) for estuary management

There have been several comments relating to the need for a database/GIS to be developed specifically for multiple, integrated estuary management. It has been suggested that the development of a GIS to supplement the relational database constructed as Phase I of the Severn Shoreline Management Plan, might be able to support the development of other estuary plans.

Who is involved:

Possible ways forward: Within the audit described in F.1, assessment of all databases and GIS relating to the management of the Severn could be compiled and assessed following on from the SMP scoping study. This should provide preliminary information for a study of the viability, including the practicalities and costs, of constructing such a system for integrated estuary management of the Severn.

MF.3 Inadequacies in monitoring To be completed.

MF.4 The provision of public information
Several bodies and individuals have expressed concern over the inadequate provision of public information and interpretation on a wide range of topics related to the Severn estuary, notably on the cultural and economic assets of the estuary as well as its natural environment and conservation. Issues raised during the scoping process for this report have highlighted many ill-perceived notions concerning the estuary and its management: statements such as 'Severn estuary water is dirty ... because it is brown' are commonplace.

Who is involved: All bodies with responsibilities / information relating to estuarine use

Possible ways forward: There is a need for a co-ordinated interpretation strategy for the estuary. As part of this, publications on a variety of estuary topics could be produced following the style and content of the booklet produced by the Severn Estuary Conservation

Group as well as the information sheets and packs produced by the Medway estuary. The potential role of the LES ESTURIALES network and the *Cybestuaries* project in the dissemination of 'best practice' information for estuary management must not be overlooked in this context.

MG Lack of strategic assessment

MG.1 Lack of Strategic Environmental Assessment

Several comments have been made relating to the need for Strategic Environmental Assessment i.e. the large-scale environmental assessment of plans in the estuary. Difficulties in cost-counting environmental factors in such an assessment have also been acknowledge as there are as yet no effective mechanisms for valuing environmental resources in economic terms.

Who is involved:

Possible ways forward: It is envisaged that the Severn Estuary Strategy will play a strategic and co-ordinating role in the management of the estuary. Mith respect to SEA, a preliminary assessment of the potential and practicalities of applying such a technique to the estuary could be made following discussion with other bodies which have expertise/experience in coastal SEA. In this context, it is worth mentioning the launch of the draft EC Directive on the SEA of plans and programmes and the intentions of CCW to conduct a SEA exercise, possibly in Cardigan Bay.

4. Urban development, infrastructure & transport

Who does what?

- The Department of the Environment and the Welsh Office are responsible for national planning policy and guidance to local authorities.
- Local planning authorities are responsible for producing development plans and for deciding planning applications.

Stated Government aims

- To regulate the development and use of land in the public interest.
- To reconcile the requirements of development and economic activity with the need to protect, conserve and improve the coastal environment.
- To guide development to the most appropriate place, ensure that it is carried out in an environmentally sensitive manner, and prevent unacceptable development.

Background

Development Plans

Development is controlled by the 15 local authorities around the estuary. They each produce their own Development Plan which has policies and proposals to guide the location and nature of developments. The details of Development Plans is given in chapter 3.

Development pressures

Development Plans allocate sites as appropriate for a particular types of development. A review of Development Plans in January 1996 identified the development sites in the estuary area. The following comments are based upon that review. Whilst the details may have changed since then, the overall development pressures on the estuary area have not changed.

Development allocations within the Severn Estuary area focus on the following types of development:

- Industrial development (including warehouses, offices and prestige sites)
- Housing development
- Large infrastructure projects (including roads and stations)
- Retail and commercial development
- Mixed and other development (including waste, mineral and community sites)

Map 4.1 summarises the potential development patterns within the Severn Estuary area.

In January 1996, there were 65 industrial development sites widely spread across the estuary area. However, the following areas are likely to experience the most development over the next decade:

- Cardiff and Penarth (15 sites)
- Gloucester City area (7 sites)
- Magor and Barry (4 sites each)
- Rhoose, Newport, Rogiet, Caldicot, Bridgwater, Clevedon and Sharpness (3 sites each)

The main sites include 100 ha in Portbury, 100 ha in Severnside, 93 ha in Bridgwater and 97 ha in Llandevelly.

In contrast, areas almost completely free from industrial development proposals include Watchet to Bridgwater, Burnham-on-Sea to Weston-super-Mare, North Bristol fringe to Gloucester City and Nash Point to Rhoose.

Housing development

In January 1996, over a hundred sites were earmarked for development within the estuary area. Although housing allocations are common across most of the region, major concentrations are associated with the main urban areas, particularly in the vicinity of Minehead, Watchet, Bridgwater, NE Burnham, Clevedon, Portishead, Gloucester, Caldicot, Magor, Newport and Cardiff.

The main sites include the following:

- West Wick area (3000 houses)
- Weston-super-Mare (600 houses)
- Portishead (2000 houses)
- Magor (490 houses)
- Rhoose (500 houses)

These are the estimated **maximum** number of houses that can be fitted into each site: in reality, the eventual number of houses may be quite different, depending on the type of houses, local facilities and green areas.

In contrast to these growth areas, the following rural areas are likely to witness little housing development in the near future:

- areas around Hinkley Point and Oldbury-on-Severn
- between Chepstow and Lydney
- Caldicot Levels
- Nash Point to Rhoose

Large infrastructure projects

Thirty large infrastructure proposals have been identified within the Development Plans. Although the majority of these are road schemes, there are also proposals relating to the

development of rail stations, the Avonmouth rail freight terminal and the Avonmouth sewage works. Most of these sites are concentrated along the southern shore of the estuary around Weston-super-Mare, Bridgwater, Portishead and Avonmouth. Barrages are discussed below.

Mixed other developments

Over 28 sites of mixed/other developments have been identified. These range from community-related projects, such as schools and health centres, to mineral working areas and waste disposal sites, and are fairly well distributed across the area. However, notable concentrations of such sites occur in the Cardiff, Bristol, Weston-super-Mare and Clevedon areas.

Retail and commercial development

Not all of the plans include specific reference to such development allocation, however, 28 sites have been identified within the area ranging from small-scale commercial development (hotels) in the Chepstow/M4 area to larger proposals for new district retail centres. The main concentrations of proposals for retail development occur in the vicinity of the following urban areas:

- Weston-super-Mare (9 sites)
- Portishead (3 sites)
- Chepstow (4 sites)
- Cardiff and Penarth (4 sites)

Barrages

There have been many proposals to build barrages in the Severn and its sub-estuaries. While the longest pedigree is undoubtedly the Severn Barrage itself construction of the Cardiff Bay Barrage is now under way having commenced construction in May 1994 and is due for completion in 1998. Proposals have also been made for Barrages on the Usk, Avon, Parrett and Severn at Gloucester.

The main reason for the proposed Severn Barrage is energy generation. The primary aim of most other barrage proposals is to create a waterside location which is attractive for development. The barrage maintains the water levels to cover mud flats normally be exposed at low water. This concept has already brought significant investment to the docks area of Cardiff.

Proposals for a Severn Barrage.

The current proposal is for a 16 km Barrage from Brean Down to Lavernock Point. The proposers of the Barrage claim the following benefits:

- The Barrage would be a major non-polluting source of energy.
- It would generate up to 7% of the electrical consumption of England and Wales.
- It would avoid the release of 17.6 million tonnes of Carbon Dioxide into the

- environment each year, reducing the causes of global warming and acid rain.
- It would provide effective sea defences to the Severn Estuary.
- It would protect and enhance the natural environment of the Severn Estuary.
- 35,000 new jobs could be created.
- The development stimulated could provide up to a further 30,000 jobs.
- Property values would be likely to increase.
- Better opportunities would be offered for sport and leisure.
- A further transport link would be provided between South Wales and South West England.

One of the main problems with all barrage schemes is to obtain sufficient validated scientific data to make meaningful assessments of the effects. Considerable effort has gone into producing data on the Severn-it is probably one of the worlds most studied estuaries! Two major reports have been produced on the possible effects of the barrage-the Bondi Report in 1981 and the Severn Tidal Power Group in 1989.

The Nature Conservation assessment of the potential impacts is as follows:

Any tidal power scheme would produce changes in tidal range, water velocity, salinity pollution dispersion and sediment movement.

- Increased water levels could submerge sites of geological interest, reduce the area of inter-tidal mud available for feeding waterfowl and change saltmarsh communities.
- The reduced turbidity would allow more light penetration through the water giving rise to more algae, eel grass, invertebrates and birds in the estuary.
- The changed sediment regime could obscure sites of important archaeological interest but may also provide more food for birds.
- The modified wave action behind a barrier could lead to changes in patterns of erosion which could significantly affect inter-tidal communities and areas of saltmarsh.
- Changes in salinity would be greater in the river estuaries than in the main body of the Severn Estuary and would inevitably change the distribution of some plants and animals.
- Barrage construction would lead to inevitable direct impacts on the habitats of the estuary and surrounding areas while the presence of a barrage and its operation could create a barrier to the movements of migratory fish.

It would appear that for any barrage construction there would be some adverse impact on features of nature conservation interest although the most obvious change would be in the tidal range-the most striking feature of the estuary.

The present economic climate in this country normally required a short term pay-back for major capital projects. The Severn Tidal Power Group recognise this as a major problem as

electricity would not be available for some ten years after the start of the project resulting in the accrual of a substantial debt. They conclude that public sector support is essential if the project is to proceed. Such support is primarily a National Government decision.

Cardiff Bay Barrage.

Cardiff Bay Development Corporation describe the Cardiff Bay Barrage as 'Europe's most exciting waterfront development'. They introduce the project in their brochure as follows:

'The Cardiff Bay Barrage, now under construction, is one of the largest investment and engineering projects currently taking place in the UK. Measuring 1.1 Km in length the Barrage will impound the rivers Taff and Ely to create a 500 acre freshwater inland bay and a new permanent waterfront of some 12.8 km.'

The project is an integral part of the regeneration of the Cardiff area. The Barrage and new Bay will create a new waterfront environment for the city and will enhance the development potential of the area to attract new business and inward investment to South Wales. Cardiff Bay Development Corporation is responsible for redevelopment of 2,700 acres extending from the Bay to Cardiff City Centre.'

Benefits claimed for the Barrage include:

- Covering up the 'unattractive' mud flats.
- Greater public access to the Bay.
- Development and renewal of the area.
- An attractive design and feature, landscaping and parkland.
- Bringing forward the improvement in sewage treatment and sewerage systems.
- Provision of watersport facility in the Bay.
- Improved flood defences for the docks area.

The main concerns that have been expressed are:

- Maintenance of water quality in the impoundment. The target for dissolved oxygen is a minimum of 5mg/l which may require artificial mixing of water or oxygen injection. This also requires dredging of the present mud to minimise the sediment oxygen demand.
- Salt may enter the impoundment during ship locking giving rise to poor mixing in the lake. This may be prevented by return pumping the lockage water and contouring the bed of the impoundment.
- There are significant sewage and storm sewage discharges to the Rivers Taff and Ely which would affect the quality of the impoundment if unaltered. The main discharges are to be diverted to outfall below the barrage and all storm sewage systems upgraded to cope with much higher flows before discharging (six times the normal dry weather flow).
- The need for removal of debris from the impoundment.
- The requirement to drain the impoundment if pollution problems require such

action.

- Removal of algae from the impoundment and ways of preventing algal blooms.
- Increase in groundwater levels by up to 3 metres in the area immediately adjacent to the bay. To counteract this it is proposed to pump groundwater from 75 wells and to survey up to 19,000 houses for impact.
- The requirement to maintain an adequate flow through the fish pass to attract fish to the Taff and Ely.
- Compensation for any fish killed by algal blooms or general loss of fishery on the Taff.
- Compensation for loss of birds habitat. Although it is an artificial environment, Cardiff Bay holds a significant population of some species. Up to 20% of the Redshank and 10% of Dunlin may be found there. As the area is only 1% of the mud flats in the estuary this does show the importance of the site. Compensation proposed at present is a freshwater wetland and saline feeding area at Goldcliffe which is to be fed by treated effluent from sewage works.

Usk Barrage

The Usk barrage proposal was for partial tidal exclusion and was promoted by Newport Borough and Gwent County Council under the Transport and Works Act 1992. The main reason was the promotion of economic regeneration in Newport although the barrage also aimed to improve water quality and flood protection.

The River Usk is one of Wales' most important rivers, being home to rare and threatened fish species including sea and river lamprey and twaite shad as well as salmon.

The proposal was rejected by the Secretary of State for Wales in September 1995. The Secretary of State supported the Inspectors findings that improved water quality and flood protection could be achieved without the construction of a barrage, whilst the case for improved economic development was not sufficient to offset the irreversible and harmful effects that was considered the barrage would cause on the landscape and fish populations.

Avon Weir

The prime objective of proposals for an Avon Weir is to realise the potential of the river frontage in the heart of Bristol by building a 60 m long weir on the River Avon at Acrams Ferry to retain water at the same level as the floating harbour. The project promoters claim that:

- the Avon will be transformed into an attractive inland waterway
- that the new waterfront will generate private investment and jobs
- a new navigation route will be opened in Bristol

- new opportunities for fishing, recreation and wildlife
- an improvement in water quality.

The loss of mud-flat habitat and impediment to migratory fish are obvious concerns.

The promoters consider that if adequate finance is available the project is ready for final negotiations and implementation and could be commissioned within two and a half years of a decision to proceed.

Gloucester Weir

Preliminary feasibility studies have been undertaken by a group consisting of British Waterways, Bristol Water, The Environment Agency Gloucester City Council and River Users into a tidal exclusion weir at Gloucester. This would probably work only in the summer months with the following benefits:

- Prevention of estuarine silt deposition above Gloucester. This should allow the river between Gloucester and Tewkesbury to remain navigable to depth of 3 metres.
- Prevention of water with high suspended solids being abstracted into the Gloucester Sharpness Canal. This would alleviate the requirement for dredging at Gloucester Docks which is an environmental issue itself. It also would reduce costs for British Waterways.
- It would provide extra lowland river habitat which is more productive than the existing system.
- It could be used to regulate river flow to the estuary so maintaining quality in the river below Gloucester and an adequate flow for fish migration. (See Water Resources Chapter).
- It would prevent saline intrusion to the abstraction at Gloucester which is used to supply Bristol Waters' intake at Purton.
- Provision of a navigable route round Alney island at Gloucester and connection into the Herefordshire and Gloucestershire Canal which is presently undergoing restoration.

The main concerns are:

- Further impediment to the passage of migratory fish and elvers. (By use only in the summer any impact on the elvers should be minimal).
- Impact on land drainage-specifically the Leadon outfall.
- The interruption of some summer Bores.
- Possible changes in water quality due to increases in residence time of the water.

Map 4.1: Major developments

Issues to be completed

5. Agriculture and rural land use

Who does what?

- The Ministry of Agriculture Fisheries and Food (MAFF) and the Welsh Office (WO) are responsible for national policy. They administer several schemes to control and support farming and promote environmental protection and improvement. Examples include the Beef Premium Scheme, Organic Aid Scheme, Environmentally Sensitive Area Schemes and the Countryside Stewardship Scheme.

Stated Government aims

To be completed.

Background

The MAFF Agricultural Land Classification System categorises land into 5 grades; grade 1 land has virtually no limitation on its use whilst grade 5 is extremely limited. Most of the land around the estuary is grade 3, although there are some significant areas of grade 2. There are only very small areas of the other grades.

Agriculture is the dominant use of the land around the estuary although this is declining gradually as the urban areas expand and recreational uses develop. Approximately two thirds of the agricultural land is grassland, mainly older pasture, although this is declining as grassland is turned into cropland and woodland.

Several thousand people work in agriculture around the estuary and in the rural areas it is a significant employer. However, the number of jobs in agriculture is declining, as it is nationally. In addition to those directly employed there are also people working in ancillary industries such as servicing, processing, and professional services which means that agriculture still provides a significant contribution to the economy of the area.

To be expanded

General issues

Specific issues

R1 Balancing the role of the countryside as both a workplace and a place for recreation.

Landowners and farmers are concerned about disturbance and damage as a result of an increase in recreational activity in the countryside. In particular, they are concerned about: unavoidable disturbance of farm animals by both people and dogs, damage to farm property (such as fences), parking in gateways and lanes, unacceptable levels of litter in field ditches and hedges and illegal shooting. These are widespread problems but two areas of particular concern are between St Brides and Ebbwmouth and around Wick St Lawrence because of the potential development of the old railway.

Who is involved: Landowners, farmers, local authorities and recreational groups.

Possible ways forward: Promote and publicise the Countryside Code. Provide facilities such as car parks, stiles, and well maintained and way marked footpaths. Where possible consider the establishment of circular routes. Establish dialogue between farmers and recreational users.

R2 Representation of farming interests in management planning

Farmers and land managers are keen to ensure that their interests are represented in discussions about the future management of land. Farmers feel that they are under pressure from many different groups with differing objectives for land management; for example nature conservation, landscape enhancement and archaeological protection. Farmers feel that they should be more fully involved in such management plans as the professional and traditional land managers. If farmers are not properly involved these management schemes will be less successful.

Who is involved: English Nature, Countryside

Council for Wales, Countryside Commission, local authorities.

Possible ways forward: Ensure that farming interests are properly represented on in the Severn Estuary Strategy Steering Group and topic groups. Improved liaison between statutory bodies and farming interests.

R3 Concern about the effects of modern farming practices on the environment

There are concerns that some modern farming practices, such as the spreading of slurry and the spraying of pesticides, are damaging the environment. The slurry can enrich the soil too much for the more sensitive, often rare plants and the pesticides can kill the plants directly. They can also cause pollution of watercourses although the effects are usually on freshwater watercourses and are less readily observed in the estuary itself.

Who is involved:

Possible ways forward: Publicise MAFF and HSE codes of practice about slurry and pesticides. English Nature and Countryside Council for Wales also provide guidance about farming on the Gwent and Somerset Levels and other SSSIs. Encourage a return to more traditional agricultural practises using ESA and other appropriate grant schemes.

R4 Effects of drainage and land reclamation on wildlife.

There are concerns that drainage and land reclamation are damaging habitats and species long associated with rural areas. Land reclamation by landowners results in loss and damage to intertidal saltmarsh and mudflats. Wildfowlers are particularly concerned about the decline of wetland habitats at Frampton and Lydney in Gloucester.

Who is involved:

Possible ways forward:

R5 Participation of farmers in conservation initiatives and diversification schemes

There is pressure for farmers to retain traditional practices, diversify their activities (to include Bed and Breakfast, craft centres, local produce shops, exhibitions and museums etc) and adopt environmental management schemes. Farmers need to be advised on the procedures necessary to implement suitable diversification schemes and need to be aware of potential funding sources. Some farmers believe that the financial incentives for conservation initiatives and diversification schemes are too low or they are not sufficiently aware of the opportunities.

Who is involved: English Nature, Countryside Council for Wales, Farming and Wildlife Advisory Group, Agricultural Development Advisory Service.

Possible ways forward: Promote Countryside Stewardship, Tir Cymen and other similar schemes.

A6 Saltmarsh management

Whilst grazing of saltmarsh affects its ability to act as an effective natural coastal defence, it is essential to maintain the diversity of saltmarsh communities and species. A better understanding of the effects of grazing regimes on saltmarshes with regard to the above is required to enable us to strike a balance between conservation and coastal defence.

Who is involved: English Nature, Countryside Council for Wales, MAFF, WO, Environment Agency, local authorities and universities

Possible ways forward: Undertake research into the effects of saltmarsh grazing on flood defence and conservation. Promote appropriate grazing regimes.

R7 The threat of development to rural life

There is widespread concern about the encroachment of towns and cities on the countryside, both physically through the loss of land but also through noise and disturbance. In particular rural communities are concerned about increases in industrial and housing developments, increased pressure for transport facilities around the Severn including more motorways and an international airport at Redwicks, and the negative effects of tourism.

Who is involved: Local planning authorities

Possible ways forward:

R8 Concern about flooding of villages and farmland

Rural communities and farmers on the edge of the estuary are concerned about the erosion of the estuary's banks and flooding. See issue ** in Coastal defence chapter.

6. Coastal defence

Coastal defences may give protection against:

- flooding - termed *sea defence or tidal defence*,
- erosion and encroachment by the sea - termed **coast protection**.

This chapter deals with both types of defences.

Who does what?

- The Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office (WO) are responsible for government policy, guidance and funding.
- Local authorities have powers to undertake coast protection works. Maritime Local Authorities are empowered to construct and improve coast protection works with the benefit of government grant aid, although County Councils are expected to contribute financially.
- Both local authorities and the Environment Agency have powers to undertake sea defences.
- Coastal defence groups are developing Shoreline Management Plans.
- Local planning authorities control development in areas of flood risk under the Town and Country Planning legislation with advice from the Environment Agency.

Stated Government aims

- To reduce the risks to people and the developed and natural environment from flooding and coastal erosion by:
- encouraging provision of adequate and cost-effective flood warning systems;
- promoting adequate defence measures which are technically, environmentally and economically sound;
- discouraging development in areas at risk.

Background

The Severn Estuary presents a challenging environment for flood defence. As discussed in the introduction the tidal range in the estuary is the second the highest in the world. The tidal range is large because the estuary is funnel shaped and it faces into the prevailing wind. Adverse weather conditions can raise water levels by more than two metres above the normal. In addition, the average sea levels have been rising since the last ice age and the rate of rise is now increasing due to global warming.

Examples of tide levels around the estuary are given in Table 6.1.

Table 6.1: Tidal data around the estuary

Location	Mean High Water Spring Tides - range (m)	Mean High Water Spring Tides - level (mAoD*)	Predicted y flood level (mAoD*)
Cardiff	11.2	5.9	8.2
Newport	11.8	6.3	8.9
Sharpness	8.7	7.5	9.9
Avonmouth	12.2	6.7	8.7
Burnham	11.0	5.8	7.6
Minehead	9.6	5.2	6.8

* mAOD = metres above Ordnance Datum

Coastal defences

The tidal forces, with their associated waves and currents, are constantly shaping the shoreline and sometimes threaten natural and manmade assets. In 1811 a tidal flood reached 20 km inland to Glastonbury, and as recently as December 1981 over 3500 ha of land and 1300 properties were flooded in Somerset alone. Further up the estuary, storm/tidal floods reached as far as Gloucester in February 1990 and February 1995. Consequently coastal defences have been constructed over hundreds of years to reduce these risks from flooding and coastal erosion.

Today thousands of people around the estuary depend upon artificial defences to protect coastal land and property from flooding and erosion. These defences may protect only a few properties, a seaside town or, in the case of Avonmouth, a major industrial area. In parts of the lowlands in the upper estuary, the Somerset Levels & Moors, and the Gwent Levels many square kilometres of land are more than 3 m below the highest tides. Nevertheless the majority of the shoreline remains naturally defended, as can be seen from Map 6.1 and Table 6.2.

Map 6.1: Existing coastal defences

Table 6.2: Existing coastal defences

Shoreline	Environment Agency Region	Length of Coast (km)	Length of Sea Defences (km)	Length of Coast Protection (km)
Foreland Point to Avonmouth	South Western	192.5	56.6	4.8
Avonmouth/ Chepstow to Gloucester	Midlands	60.4	100.0	7.8 *
Chepstow to Nash Point	Welsh	74.9	38.6	0

* Note: The upstream limit for coastal protection as defined by the Coast Protection Act 1949 is between Sharpness and Purton.

The state of the coastal defences

A survey of all sea defences was undertaken by the former NRA between 1990 and 1993. Similar surveys of coast protection works have been undertaken on behalf of MAFF and WO. This was done to establish the state of coastal defences, in order to assess risk and the need for investment. Overall, approximately 12% of English coast protection works were identified as being in need of moderate or significant improvement but only 1% require urgent attention. Similarly 16% of sea defences in England and Wales were described as being in poor condition or worse.

Sea defence works are carried out to:

- raise the level of defences,
- increase the life of the defences,
- protect the defences against erosion.

The Environment Agency and local authorities undertake programmes of maintenance and improvement works, and many of the defences in need of attention have already been addressed, for example 80% of Welsh defences are programmed for improvement (see Map 6.2 and Table 6.3).

Map 6.2: Planned coastal defences

Table 6.3: Environment Agency planned sea defence capital schemes

Sea Defence Scheme	Programmed
Welsh Region:	
Lighthouse Inn to Cardiff (Wentloog Level)	1996 - 1999
Uskmouth to Goldcliff (Caldicot Level)	1996 - 1999
Goldcliff to Caldicot	1997 - 2001
Midlands Region:	
Weir Green	1996
Longney	1997
Cone Pill to Lydney	1998
Hempsted	1998
Oakle Street	1999
Walmore	1999
Noards Point	1999
Rodley	1999
Westbury	1999
South West Region:	
Brean Sea Defences	1996 - 1997
Lilstock Sea Defence	1999 - 2000
Minehead Sea Defences	1996 - 2000
Hurditches Sea Defences	2000 - 2001
River Axe West Tidal Banks	1997 - 1998
Brue Pill Tidal Banks	1998 - 2000

Standards of protection from flooding

Complete protection against flooding and erosion cannot be provided, instead defences are built to protect against floods of specified sizes. MAFF and WO have published indicative target standards of protection which can be used as an initial guide to appropriate levels of defence for different categories of land use (see Table 6.4). However each scheme must be economically viable and cost effective.

Table 6.4: Target standards of flood defence for different land uses

Current land use	Return period* in years
High density urban containing significant amounts of both residential and non-residential property	200
Medium density urban. Lower density than above, may include some agricultural land.	150
Low density or rural communities with limited number of properties at risk. Highly productive agricultural land.	50
Generally arable farming with isolated properties. Medium productivity agricultural land.	20
Predominantly extensive grass with very few properties at risk. Low productivity agricultural land.	5

* The return period is the frequency at which, on average, a certain flood level is equalled or exceeded.

Flood warning

Flooding can occur any time that certain climatic conditions coincide with high tides but the risk of flooding is highest from September to April. The Environment Agency undertakes flood warning for both river and sea flooding.

Flood forecasting and warning systems enable emergency services, operating authorities and individuals to take measures to lessen the impact of flooding where protection cannot be provided. A national Storm Tide Warning Service is operated by the Meteorological Office. The Environment Agency uses this information, together with meteorological forecasts and its own network of tide level gauges, to forecast flooding problems and to inform maritime local authorities or emergency services who may be affected.

This service is not so comprehensive as the river flood warning schemes, such as for the River Severn upstream of Gloucester. At present, on the estuary upstream of Avonmouth, only Severn Beach receives formal warnings of tidal flooding.

Coast protection

Coastal erosion and accretion are continuous natural processes. Increases in sea level and increased storminess are expected to speed these processes. Interference with the natural process of erosion can threaten the supply of new beach material and should be avoided unless important assets are at risk. The benefits of protection must exceed the cost.

Problems have been identified along the Severn at the following locations shown in Table 6.5. Most of those sites are associated with sea defences and there are only a few (notably Aust and Beachley) where the Coast Protection Act applies.

Coastal erosion problems may be identified when the Wentloog Levels Strategy and Protection of Saltings Pilot Study is completed in 1999.

Table 6.5: Areas of erosion problems in the estuary

East/ South Bank	West/ North Bank
Avonmouth Severn Beach Aust Oldbury-on-Severn Shepperdine Berkeley Purton Slimbridge Hock Cliff & Hock Ditch Arlingham Longney	Beachley Tidenham Woolaston Alvington Lydney New Grounds Awre Newnham Broadoak Westbury-on-Severn

General issues

Specific issues

C1 The need to provide new sea and tidal defences where target standards of protection are not being met.

The MAFF and the Welsh Office have published indicative target standards of protection which can be used by the Environment Agency as an initial guide to providing an appropriate level of defence for different categories of land use (see Table 6.4). Some defences in the estuary do not meet these current standards and therefore need to be improved.

Who is involved: The Environment Agency.

Possible ways forward: The Environment Agency has identified those parts of the coast requiring new defences and has drawn up a prioritised timetable for their construction (see Table 6.3).

C2 The need for coast defences to protect property.

Coastal erosion and accretion are continuous natural processes. Increases in sea level and increased storminess are expected to speed these processes. Interference with the natural process of erosion can threaten the supply of new beach material and should be avoided unless important assets are at risk. The benefits of protection must exceed the cost.

Problems have been identified on the estuary at a number of areas which are listed in Table 6.5. Most of the above sites are associated with sea defences and there are only a few (notably Aust and Beachley) where the Coast Protection Act applies. Coastal erosion problems may be identified when the Wentloog Levels Strategy and Protection of Saltings Pilot Study is completed in 1999.

Who is involved: Maritime local authorities and the Environment Agency

Possible ways forward: Where cost/benefit analysis shows works are needed, these can be

planned either as part of the Environment Agency's prioritised capital programme for sea defences or as part of a local authority programme for coast protection works.

In some cases the best action may be to allow the land to become inter-tidal by moving the defence line inland. This is known as managed retreat. Sometimes the defences are deliberately drawn back to provide environmental gain such as an increase in saltmarsh. An example is at Dunster in Somerset where managed retreat is progressing with the agreement of the local authority. Compensation may be payable and MAFF/Welsh Office can make payments to create saltmarsh on suitable land under their Habitat Scheme. In the upper part of the estuary opportunities for managed retreat are limited by the presence of residential property and by cost. The existing defences are usually built on the higher ground near the shore where saltmarsh accretion is greatest - it would be much more expensive to build defences on the lower ground further inland.

C3 Conservationists are concerned about the loss of salt marsh and beach habitats because of erosion.

The natural physical response to a rise in sea level is for increased erosion causing the shoreline to move inland. Soft shores particularly saltmarshes can be "squeezed" between the advancing sea and hard cliffs or coastal defences. This inter-tidal zone provides important habitat but is also important to coastal defence because it provides a natural buffer against wave action. The Severn Estuary has significant saltmarsh and wetland areas, particularly in the upper reaches, which may be so affected.

Who is involved: Maritime local authorities and the Environment Agency

Possible ways forward: Where "coastal squeeze" occurs against coastal defences, managed retreat may be an option (See B2

Possible ways forward).

C4 The effect of coastal erosion on archaeological sites.

Increasing erosion as a result of increasing sea level is exposing then destroying archaeological sites.

See Archaeology and the historic environment.

C Maintenance of coastal defences - the effect on other uses.

The need to construct 'hard' defences such as rock armoured walls, gabions, or concrete wave return walls eliminates the natural shoreline, removing wildlife habitats and detracting from the landscape. (See Landscape Issue and Conservation, Issue A2).

Who is involved: Maritime local authorities and the Environment Agency.

Possible Way Forward

Defences will only be constructed following a rigorous analysis of the need. Where they are necessary the most natural method feasible should be used with a careful and sympathetic choice of materials following public consultation.

C6 Raised sea levels because of global warming.

It is likely that because of global warming sea levels worldwide will rise by more than 500 mm in the next 100 years, although the present rate is probably about 2 mm per year in the Severn Estuary. With a rise of, say, 3 mm per year, tide levels which have a probability of occurring once every 200 years on average at Avonmouth will be twice as frequent (once in 100 years) within 10 years and twice as frequent again (once in 50 years) within a further 20 years. Hence the standard of a scheme designed for high density urban development would fall to that appropriate for rural communities, within a 30 year period, if action was not taken.

Who is involved: Maritime local authorities and the Environment Agency.

Possible ways forward: MAFF and the Welsh Office have agreed that an allowance of 5 mm per year should be built into the design of all new sea defence schemes. This is above the current estimates of rise. Furthermore they require that all new schemes are designed so that further raising can be provided in future. Local planning authorities will need to carefully control development in areas of flood risk.

C7 Increased storminess as a result of global warming.

It has been suggested that storms will become more frequent and more violent as a result of global warming. Storms can raise sea levels above predicted levels and generate increased wave action, causing overtopping and increased erosion of existing defences. This effect has not yet been confirmed.

Who is involved: Maritime local authorities and the Environment Agency.

Possible ways forward: Existing defences will need to be raised and strengthened.

C8 Reduced drainage from coastal land because of sea level rise.

Lowland drainage is an important issue for coastal zone Internal Drainage Boards. A number of Boards abut the coast or drain to rivers which are themselves affected by tides. These include the Caldicot & Wentloog Drainage Board, South Gloucestershire Drainage Board and a number of Boards within the Somerset Levels & Moors.

Sea level rise will impede drainage from the land. A tide which just reaches the MHWS level at Avonmouth can be expected to be above that level for about an hour if sea level rises by 300 mm, and above Ordnance Datum for about half an hour longer than now. This increase in "tide-lock" may increase land waterlogging and lead to increased dependence on stormwater storage and pumping. It may also have significant effects on the drainage and regime of rivers which outfall into the Estuary. Lengthening of tidal pills because of tidal accretion can also be a problem. Rivers affected are the: Parrett,

Avon, Wye, Usk, Rhymney, Taff, Little Avon, Frome, Dimore, Horsebore, Hatherley, and other Gloucester Brooks, Leadon, Cinderford Brook and Lyd.

Who is involved: Internal drainage boards and the Environment Agency.

Possible ways forward: More stormwater storage and pumping will be required to maintain existing ground conditions.

C9 The need to improve tidal flood warning systems.

Flooding can occur any time that certain climatic conditions coincide with high tides but the risk of flooding is highest from September to April.

Flood forecasting and warning systems enable emergency services, operating authorities and individuals to take measures to lessen the impact of flooding where protection cannot be provided. A national Storm Tide Warning Service is operated by the Meteorological Office. The Environment Agency uses this information, together with meteorological forecasts and its own network of tide level gauges, to forecast flooding problems and to inform maritime local authorities or emergency services who may be affected.

This service is not so comprehensive as the river flood warning schemes, such as for the River Severn upstream of Gloucester. At present on the estuary upstream of Avonmouth, only Severn Beach receives formal warnings.

Who is involved: The Environment Agency.

Possible ways forward: The Environment Agency has plans to improve tidal flood warning systems once it has developed improved forecasting systems.

C10 The need for strategic planning - Shoreline Management Plans

Coastal defences need to be planned within a strategic framework which recognises the many issues and interests which are affected. MAFF and the Welsh Office encourage the establishment of Coastal Groups representing the operating authorities within a "coastal management cell". These lengths of shoreline are selected so that any changes within a cell do not significantly affect those neighbouring. Within the Severn Estuary area there are three Coastal Groups covering: Swansea Bay from Worms Head to Lavernock Point; the Severn Estuary upstream from Lavernock Point and Brean Down; and North Devon, Somerset & South Avon from Hartland Point to Sand Point.

Who is involved: MAFF, the Welsh Office, Environment Agency,

Possible ways forward: Each Coastal Group is preparing a Shoreline Management Plan in accordance with MAFF and Welsh office guidance. These Plans will provide the basis for sustainable coastal defence policies and will set objectives for the future management of the shoreline. Plan preparations is being supported by investigative work to address the issues raised above. The Shoreline Management Plans should therefore be considered an important component to the development of an overall strategy for the Estuary.

7. Tourism recreation and access

Who does what?

Tourism

- The Department of National Heritage and the Welsh Office are responsible for government policy, guidance and funding. They fund three statutory tourism bodies to promote tourism and advise the government:
 - British Tourist Authority
 - English Tourist Board
 - Wales Tourist Board.
- The eleven Regional Tourist Boards in England promote tourism in their regions.

Recreation

- The Department of National Heritage is responsible for government policy on active recreation and sport.
- The Sports Council promotes appropriate sport and active recreation in coastal areas.
- Individual national governing bodies are responsible for the practical management and representation of specific sports.
- The Countryside Commission promotes opportunities for people to enjoy and appreciate the landward coast for informal recreation.
- The Environment Agency promotes recreation in inland and coastal waters and on associated land.
- Local authorities also take action to promote sport, recreation and tourism in their areas.

Access

- Highway authorities are responsible for ensuring that landowners maintain public rights of way.

Stated Government aims

Tourism

- To create the conditions which will encourage inward and domestic tourism so that the industry can make its full contribution to the economy and increase opportunities for access to our culture and heritage.
- To promote the sustainable development of tourism in ways which contribute, rather than detract from, the quality of our environment.

Recreation

- To help reconcile possible conflicts between different sport and leisure uses, and with other activities on the coast and in coastal waters.
- To encourage safety management and protection of the environment in sport and recreation activities.

Access

- To be completed.

Background

Tourism

Tourism is well developed along the Somerset coast with popular holiday locations such as Minehead, Burnham on Sea and Weston-super-Mare where there are many caravan sites. These are centres from which holiday makers explore the local attractions of the Quantocks and historic areas such as Brean Down. On the north shore, Barry Island and Penarth have long been associated with holiday-making. Tourism is also strong in the historic Forest of Dean, with its many walking, cycling and bridle trails. On the east bank of the estuary, historic flood plain towns such as medieval Gloucester attract many tourists.

Coastal areas provide space for golf courses and opportunities for sand yachting and motorsport at locations such as Weston-super-Mare. On the north shore of the estuary, there are golf courses or driving ranges at Peterstone, St. Mellons, Coedkernew, Penarth, Caerwent and Llanwern and Country Parks at Porthkerry and Comeston Lakes. Further upstream to Lydney and beyond there is less formal recreation.

The West Somerset Railway gives access to the coast and its greater use could promote a more environmentally friendly access into the heart of the tourist area, avoiding car traffic and consequent congestion.

The Severn Bore is an attraction which brings thousands of visitors to viewing spots alongside the upper estuary; attempts are made to surf and canoe the more significant bores.

Map 7.1: Major tourist attractions and recreational areas

Recreation

Sailing and boating

Sailing and boating are popular activities in the estuary. Each part of the estuary is host to quite different types of recreational sailing and boating.

From Gloucester to Sharpness and Beachley there is little in the way of boating interest as the conditions are very hazardous. The estuary provides opportunities for a limited amount of water skiing and power boating and there is no navigation speed limit. Pleasure sea fishing is popular during the autumn. The Gloucester - Sharpness canal is a centre for pleasure boat activity, including canoeing and rowing. There is sailing from yacht clubs at Oldbury Pill, Lydney and Chepstow and there is a marina at the old docks in Sharpness.

The Bristol Avon estuary is used for recreational sailing by boats from clubs at Shirehampton and Pill. Pleasure boats also use it as a route connecting the Severn Estuary with Bristol and potentially the Thames via river and canal. Further down the Severn there is coastal sailing from centres such as Clevedon, Weston-Super-Mare, Burnham-on-Sea, Highbridge, Watchet, Minehead and Portishead. There are moorings at several locations along most of Avon and Somerset and there is a small marina in the mouth of the River Axe at Uphill.

On the Welsh coast there is considerable interest in pleasure boating from the residents of Newport and Cardiff. There are boat or yacht clubs at Uskmouth, River Rhymney, Cardiff Bay, Penarth and Barry, and a new marina at Penarth. There are moorings up most of the rivers, ie. Usk, Rhymney, and Ely. Moorings in Cardiff Bay are likely to increase on completion of the Barrage. Numerous slipways are dotted around the coast.

There are boat trips to the islands of Steep Holm and Flat Holm.

Sailing in the Severn Estuary is challenging - the high tides and currents present peculiar difficulties to yachtsmen and women. This is one of the attractions of the estuary - together with the fact that relatively few yachts use the area.

Walking

Walking is a popular activity and there are several long distance footpaths as well as many local rights of way. The south-west peninsula coastal footpath officially terminates at Minehead, but footpaths follow the coast more or less continuously between there and Bristol. These footpaths generally follow the line of coastal defences. Along the north shore public footpaths extend along most of the coastline except for gaps at Cardiff, the Wentlooge Levels between Cardiff and Newport and the Newport area. Sea walls are often used by walkers even if there is no right of way. In Gloucestershire, the Severn Way links footpaths, bridleways and roads beside the Severn. Work is in hand to start the west bank route from Lydney to Mythe Bridge, near Gloucester.

Cycling

Cycling is a growing recreational activity nationally and there is significant demand for cycling around the estuary. However, cycleways are less continuous than the footpaths and

cyclists sometimes use coastal paths although they have legal no right of way. There are proposals for new cycleways along or adjacent to the shore between Chepstow and Newport as part of a national network. There is an existing designated cycleway between Penarth and Sully. On the estuary there have been suggestions that cycleways might follow and/or use the flood defences.

Bird watching

Thousands of people come to the estuary to watch the birds, particularly in winter when large numbers of waders and wildfowl can be seen. Some of the most important areas are: Brean Down, Sand Point, Bridgwater Bay, the Wildlife Trust's reserve at Blake's Pool and further north at the Wildfowl and Wetland Trust's reserve at Slimbridge. The latter site contains the world's largest collection of wildfowl. The large expanses of water and the spectacular views from numerous vantage points attract many thousands of visitors every year.

Bathing

Bathing is popular at beaches from Weston-super-Mare to Minehead and on the north shore at Barry and Penarth. The Environment Agency monitors bathing waters in thirteen areas identified as bathing waters by the European Union. This is discussed in Chapter 8 on Waste management, pollution and environmental quality.

General issues

- TA** Provision of tourism and recreational facilities on land around the estuary.
- TB** Provision of water based tourism and recreational facilities
- TC** The effects of recreation on the estuary and other users
- TD** Recreation management

Specific issues

TA Provision of tourism and recreational facilities on land around the estuary.

TA1 Improvement of recreational facilities to increase tourism and quality of life

Improved recreational facilities are wanted by many people to improve their quality of life. As shown in the issues above these improvements would also have benefits for other uses by helping to better meet demand in a controlled manner.

Who is involved:

Possible ways forward:

TA2 Improving the tourism industry

Thousands of visitors come to the estuary each year and contribute to the financial well being of the area. Some people believe that there is insufficient investment in tourism, and believe that some assets are not being properly exploited to the benefit of the area. They believe that in addition to the general recreational improvements above, tourism would benefit from improved signposting of tourism facilities, the development of themed trails, the use of multilingual signs, improvement of the built environment and visitor facilities.

However, tourism can often have an adverse impact on the host communities and so this development of tourism needs to be done with the involvement of local communities and with careful management to avoid damaging the

resources upon which the industry is based.

Who is involved:

Possible ways forward:

TA3 Provision of footpaths around the estuary

Ramblers are concerned about the length of footpaths available to them, the scarcity of paths in certain areas, such as between Portishead and Clevedon, the quality of way marking and the safety of sea walls and sea defences.

Who is involved:

Possible ways forward:

TA4 Concern about condition of beaches

There is widespread concern about the condition of beaches. In particular many users are concerned about: loss of beach material, particularly Porthcawl and Culver Sands; water quality at sites which are not designated bathing waters, which is of particular concern to sailors and windsurfers; and the seasonal management of beaches.

Who is involved:

Possible ways forward:

TA5 Access

Access to the shore is limited by the provision

of: car parking facilities, rights of way to the foreshore, public transport and slipways for boat access. Some people believe that access is further restricted by: sea defence works, new developments, private ownership of foreshore and landowners blocking legal rights of way.

Who is involved:

Possible ways forward:

TB Provision of water based tourism and recreational facilities

TB1 Access to small harbours for recreational boats.

The Severn Estuary is potentially dangerous waterway because of the strong tides and currents. Small recreational vessels need harbours as refuges. Many recreational boat users believe that there are not enough harbours on the Somerset and North Devon coast. Some of the existing harbours are not well maintained and access is sometimes restricted by siltation, for example as St. Pierre Pill, Lydney and Watchet Harbours.

Who is involved:

Possible ways forward:

TB2 Provision of moorings

Fishermen and sailors are finding it difficult to moor-up in or near the estuary. This is due to a lack of floating anchorages (eg Watchet Harbour) and the increased competition for moorings (eg on the river Axe at Weston). In some areas the drainage of the levels is making the rivers deeper and so making it difficult to maintain moorings. More marinas would be one solution. However, there are some negative effects associated with marinas and these are discussed later in this section.

Who is involved:

Possible ways forward:

TB3 Provision of laying-up facilities for small boats.

Many users of small boats believe that there are not enough laying-up facilities for boats at low tide. In addition, they believe that there are not enough well maintained slipways. This restricts the use of the estuary by fishermen and sailors to a couple of hours either side of high tide.

Who is involved:

Possible ways forward:

TB4 Accomodating motorised watersports in the estuary

There are several areas where motorised watersports, such as speedboating and jetskiing, are popular activities but they are unpopular with some other users of the estuary. In particular, sailors are concerned about safety, and ramblers and birdwatchers are concerned about the effects on the quiet of the countryside and wildlife. Conversely, powercraft users are concerned that their use of the estuary will be restricted unnecessarily.

Who is involved: User groups, navigation authorities.

Possible ways forward: Identify areas where these noisy activities can be best accommodated and protect sensitive areas. See issue in chapter on conservation and wildlife.

TC The effects of recreation on the estuary and other users

TC1 The impact of recreation and tourism pressure on the rural environment

There is a dramatically growing use of the countryside for informal recreation, such as walking and cycling. Most users are properly behaved and abide by the Countryside Code and other regulations. However, the sheer number of people visiting the countryside, usually by car, is putting pressure on the rural environment and sometimes overwhelming the facilities. For example, through increased traffic and car parking, erosion of footpaths, more caravan parks and disturbance of wildlife.

Who is involved: Local authorities, Countryside Commission, Countryside Council

for Wales and recreational groups.

Possible ways forward: Identify pressure points and seek ways to relieve that pressure, for example by promoting less used areas and providing good facilities such as well maintained and way marked footpaths including interpretation and education. Promote initiatives to lengthen the tourist season and so avoid high numbers of tourists in one place at one time of year. Promote visitor management schemes. Control parking in sensitive areas and consider park and ride schemes.

TC2 The effects of irresponsible recreational use on farming

Landowners and farmers are concerned about disturbance and damage as a result of an increase in recreational activity in the countryside. In particular, they are concerned about: unavoidable disturbance of farm animals by both people and dogs, damage to farm property (such as fences), parking in gateways and lanes, unacceptable levels of litter in field ditches and hedges and illegal shooting. These are widespread problems but two areas of particular concern are between St Brides and Ebbwmouth and around Wick St Lawrence because of the potential development of the old railway.

Who is involved: Landowners, farmers, local authorities and recreational groups.

Possible ways forward: Promote and publicise the Countryside Code. Provide facilities such as car parks, stiles, and well maintained and way marked footpaths. Establish dialogue between farmers and recreational users.

TC3 Marinas

There is a growing demand for marinas to satisfy the demands for moorings and harbours identified above. However, some people are concerned about the effects of marinas on the environment and on other, traditional boat users.

Who is involved:

Possible ways forward: There is a requirement to undertake an Environmental Impact

Assessment for proposed marina development under the (EC) Council Directive on the Effects of Certain Public and Private Projects on the Environment.

TD Recreation management

TD1 Complexity of recreation management

Many people are confused about who does what in the management of recreation. Some questions that were raised at our public meetings included:

- i) Who maintains harbours and jetties ?
- ii) Who is responsible for the maintenance of small craft navigation channels ?
- iii) Who is responsible for flood gate and siltation management ?
- iv) Have emergency access implications been considered ?
- v) What are the byelaws and who enforces them?

Who is involved:

Possible ways forward: Improve communication between management bodies, regulators and users

TD2 Reducing perceived conflicts between recreational users

Many people believe that there is a lot of conflict between different types of recreation and between recreation and other users. Whilst some of this conflict is real much can be avoided by carefully planning and liaison between user groups and managers.

Who is involved:

Possible ways forward: Improved coordination and communication between estuary user and management groups and more consultation between users and the community.

TB4 Over-regulation of water based recreation.

Some recreational sailors are concerned about over-regulation of water based recreation. They are concerned about regulations which restrict their use of the estuary.

Who is involved:

Possible ways forward:

8. Ports, shipping and navigation

Who does what?

- The Department of Transport is responsible for:
 - the safety of shipping;
 - the control of pollution from ships, via the Marine Pollution Control Unit.
 - taking steps to minimise the threat of pollution from ships and for the National Contingency Plan.
- The Environment Agency is responsible for the control of pollution from shore based activities.
- The Department of Transport regulates commercial harbours.
- Almost all ports are administered by statutory harbour authorities. Their statutory powers and functions relate to safety of navigation and the public right of access to port facilities.
- There are several navigation authorities responsible for regulating moorings and traffic and for maintaining navigation aids and channel depth for the benefit of commercial and pleasure craft.

Stated Government aims

- To take account of the importance of the shipping industry to the economy.
- To protect the marine environment from ship-borne pollution.
- To ensure adequate compensation is available in the event of marine pollution.
- Regulation of the ports industry:
 - ensures public health and safety;
 - safeguards navigation;
 - assesses the environmental effect of developments;
 - requires that proposals take account of:
 - conservation;
 - public access;
 - historic and archaeological interests.

Map 8.1: Ports and harbour authorities

Background

Ports and shipping

The Bristol Channel is a busy shipping route with large ships from national and international destinations using the estuary's ports. The major ports are at Avonmouth, Newport, Cardiff, Barry Docks, Gloucester and Sharpness and the Royal Portbury Dock.

Navigation in the Severn Estuary and around the various harbours and ports is controlled by several bodies. The Bristol Port Company is the Navigation Authority for the eastern side of the Severn Estuary around the Bristol Ports, down towards Weston-Super-Mare and the Avon estuary up river to Bristol. On the Welsh coast Newport Harbour Commissioners and Associated British Ports (ABP) are the navigation authorities at Newport. At Cardiff and Barry ABP also have responsibility, though at Cardiff this will pass to Cardiff Bay on completion of the Cardiff Bay Barrage in 1998. The Navigation Authority for the Gloucester-Sharpness Canal is British Waterways. The Gloucester Harbour Trustees are the Competent Harbour Authority for the tidal River Severn downstream of the weirs at Maisemore and Llanthony.

Sedgemoor District Council is the statutory port and pilotage authority for the Port of Bridgwater which includes an area of Bridgwater Bay extending into the River Parrett estuary to Bridgwater, the tidal River Brue and a small southern part of the Axe estuary. The passenger boats P.S. Waverley and M.V. Balmoral both ply the estuary in summer visiting several of the holiday resorts. Boat trips are run from Weston-Super-Mare to Steep Holm island in the channel. A summertime passenger ferry operates in the mouth of the River Axe connecting Brean Down to Weston-Super-Mare. Several 'rod and line' fishing boats operate along the coastline both privately and commercially for charter.

There are a number of smaller harbours and wharfs along the coast which are included on Map 8.1.

Small commercial boats using ports, harbours and marinas include survey boats, fishing charters, sea fishing boats, barges, small dredgers and light freight boats. Recreational boats also use the small ports.

Inshore lifeboat stations are based at Minehead, Porlock, Weston-Super-Mare, Burnham and Portishead on the Somerset coast and at Barry, Penarth and St. Donats on the Welsh coast. The Severn Area Rescue Association is based at Beachley and Sharpness. The Burnham Area Rescue Boat operates in Bridgwater Bay from Burnham.

Recreational boating and sailing

Recreational boating and sailing is discussed in Chapter 6 on Tourism, recreation and access.

General Issues

- PA** Concern about over-regulation of ports, shipping and navigation.
- PB** Concern about navigation safety
- PC** Concern about the effects of ports and shipping on other users of the estuary.
- PD** Concern about recreational access and facilities.
See issues in tourism, recreation and access.
- PE** Concern about pollution from shipping
See issues in the waste management and pollution chapter

Specific issues

PA Concern about over-regulation of ports, shipping and navigation.

PA1 Concern about the impact of the Special Area of Conservation (SAC) on ports.

The port companies are concerned that the designation of the SAC will severely restrict their activities and the contribution they make to the economy. In particular, they are worried about additional operating costs to comply with conservation regulations, restrictions on future development of port facilities and how they can combine their legal responsibilities as harbour authorities and relevant authorities for SAC management.

Who is involved: English Nature, Countryside Council for Wales, Port companies.

Possible ways forward: The interested parties should come to a common understanding of the implications of the SAC on ports and navigation in the estuary and how the SAC will be managed.

PB Concern about navigation safety

PB1 Concern that some untrained recreational users affect navigation safety

Many people who use the estuary for navigation are concerned about the safety of navigation, especially with increasing numbers and size of ships using the Severn as a commercial

waterway. Whilst many recreational users are well trained there is particular concern about untrained sailors on the estuary who do not understand the rules of the sea, and the increasing numbers of recreational vessels who do not carry navigation charts on board.

Who is involved: Navigation authorities and recreational user groups.

Possible ways forward: Support recognised training initiatives. Examples of existing initiatives include: Barry Yacht Club's Youth Awareness Campaign; Burnham Yacht Club's programme to train RYA approved instructors for training cadets; Chepstow Boat Club's sail training programme for novices to RYA standard; and training initiatives at Penarth Motor Boat and Sailing Club and Sully Sailing Club.

PB2 Concern about navigation safety because of changes in navigation aids and coastguard services.

There are concerns amongst navigation users of the estuary about the researching of safe navigation on the estuary. In particular they are concerned about the provision of navigation aids, removal of staff from light houses, reductions in Coastguard Service manpower and the adequacy of search and rescue facilities.

The Bristol Channel Marine Emergency Plan (BCMPEP) is a voluntary scheme which provides

the command, control and communication structure to co-ordinate marine emergencies. The statutory agencies and voluntary bodies work within that framework to ensure effective responses to incidents.

Who is involved: Port and harbour authorities, HM Coastguard, RNLI, SARA.

Possible ways forward: Promote the BCMEP to ensure that navigation users are aware of the support available to them. SARA is extending a new lifeboat station and refurbishing a grade II listed building on Old Pierhead, Sharpness. SARA is currently fund raising for phase II of the Chepstow Station development. Investigate how yachtsmen can fund some safety initiatives.

PB3 Concern about the safety of canal craft using the estuary below Sharpness.

There is some concern amongst navigators that some of the canal craft which use the estuary are not designed for such waters and are therefore unsafe.

Who is involved: Navigation authorities and canal boat user groups.

Possible ways forward:

PC Concern about the effects of ports and shipping on other users of the estuary.

PC1 Impact of port development on conservation.

Conservationists are concerned that port development will affect wildlife habitats. In particular they are concerned about the effects on the areas used by wildfowl for feeding, roosting and breeding and about the effects on resident species which are already scarce in the developed areas.

Who is involved:

Possible ways forward:

PC2 Concern about the impacts of maintenance dredging for navigation on the estuary.

The estuary is an important part of the strategic transport network of the region and has been dredged for many years to keep it as a commercial waterway. Many people are concerned that dredging disturbs coastal processes, however, it is widely believed that the effects of navigation dredging are less than the effects of dredging for aggregates. See issue ** in Aggregates for further information.

Who is involved: The navigation authorities who dredge the estuary, DoE, MAFF and the WO.

Possible ways forward: Further scientific studies should be carried out to determine the short and long term effects of dredging on the estuary as a whole. This understanding can then be used to develop a long term management strategy for dredging. The WO are funding a study of Bristol Channel marine aggregates: resources and constraints.

PD Concern about recreational access and facilities.

See issues in tourism, recreation and access.

PE Concern about pollution from shipping

See issues in the waste management and pollution chapter

9. Waste management and pollution

Who does what?

- The Department of the Environment/ Welsh Office are responsible for formulating policy and providing a legislative framework on water and air quality issues including actions arising from EC Directives such as the identification of bathing waters.
- The Environment Agency regulates discharges to water, air and land including:
 - discharge of trade or sewage effluent to the estuary;
 - all discharges from certain industrial processes as set out in the Environmental Protection Act 1990 (Part A);
 - most waste management activities on land, including landfill sites;
 - the use and disposal of radioactive materials.
- The Environment Agency monitors water quality in the estuary for compliance with relevant standards.
- The Environment Agency and MAFF/WO share responsibility for regulating waste disposal from Nuclear Licensed Sites.
- Ministry of Agriculture, Fisheries and Food and the Welsh Office licence disposal of material in the sea. In some cases applicants will also require consent from the Department of Transport under provisions relating to the maintenance of safe navigation.
- Local authorities control some aspects of waste management activities through their environmental health powers.
- Local authorities licence atmospheric discharges from industrial processes as set out in the Environmental Protection Act 1990 (Part B).
- Local planning authorities are responsible for controlling some aspects of waste management developments, such as the location of landfill sites, through the land use planning system.

Stated Government aims

- To protect, maintain and improve the quality of coastal waters.
- To improve air quality, to reduce any significant risk to health, and to achieve the wider objectives of sustainable development in relation to air quality.
- To safeguard human health and protect the marine environment, including fisheries from any adverse effects of depositing wastes and other materials at sea.
- To minimise interference between those placing materials at sea and others engaged in legitimate exploitation of marine resources or using the sea.
- To prevent the pollution of ground and surface water, or damage to wetlands caused by disposal of waste to land and to protect other uses.

Background

This chapter is divided into two main parts:

- **Waste management;** which describes the various activities in the estuary:
 - sewage disposal
 - industrial discharges to water
 - industrial discharges to air
 - nuclear discharges
 - solid waste management
- **Environmental quality of the estuary;** which describes:
 - monitoring work
 - water quality
 - air quality
 - radioactivity
 - litter.

Waste management

Sewage effluent disposal

There are 47 consented sewage discharges to the estuary operated by the Sewage and Water Utilities and these are identified on Map 9.1. The discharges have a combined total volume of 1033400 m³/d as shown in Table 9.1. They are monitored regularly by the Environment Agency to show compliance, or otherwise, with their consent conditions. Over 600 samples are taken each year for this.

The majority of Dŵr Cymru Welsh Water discharges are of untreated sewage and mainly serve the south-east Wales valleys and the towns of Newport, Cardiff, Penarth and Barry. These discharges are made directly to the estuary via outfalls, many of which discharge at the low water mark, but some which discharge at or just below the high water mark.

Table 9.1: Sewage discharge consents

Company	No. of discharges	Estimated total volume of discharge m³/d
Dŵr Cymru Welsh Water	15	710600
Severn Trent Water	6	59000
Wessex Water	26	261600
Others	20	2200

Improvements have already been made at Gloucester (Netheridge) Sewage Treatment Works by Severn Trent Water. Other discharges in this area are only partially treated at present.

The majority of Wessex Water's discharges receive some treatment, ranging from screening to biological treatment. The majority of effluents receive biological treatment although the largest single discharge, from Avonmouth, receives primary treatment.

Some of the Wessex Water discharges, which have a potential to impact upon EC Bathing Waters, are disinfected with chlorine during the bathing waters season to reduce the numbers of sewage bacteria being discharged. The Environment Agency and Wessex Water are discussing long term plans for disinfection.

Many of the larger volume effluents consist of a mixture of domestic and industrial effluents and may therefore contain heavy metals or organic chemicals. Where these have been identified in the effluents, limits have been set in the discharge consents to control the quantities of these substances entering the estuary. (See section on Dangerous Substances)

EC Urban Wastewater Treatment Directive

This Directive from the European Union sets minimum standards for sewage treatment and sewage collection systems. It specifies secondary treatment for all discharges serving population equivalents greater than 2,000 to inland waters and estuaries, and greater than 10,000 to coastal waters.

In the Severn Estuary there are 11 schemes where secondary treatment will be installed to meet the main requirements of this Directive. There are three other schemes which will also meet the appropriate treatment requirements of the Directive as shown in Table 9.2.

This Directive also allows lower standards of treatment for discharges to 'less sensitive' areas. Less Sensitive Areas or 'High Natural Dispersion Areas (HNDAs)' are those estuarine or coastal waters which are naturally very turbulent. In these areas a lower level of sewage treatment is required. However, dischargers must demonstrate that no harm will be caused to the environment by the lower level of treatment. The Environment Agency is responsible for ensuring that these studies are carried out correctly by the Water Utilities.

Map 9.1: Major sewage discharges

The DoE, in consultation with the Environment Agency, has proposed the area off Watchet as HNDA. Wessex Water will be carrying out comprehensive studies to establish whether the a lower level of treatment for the discharge at Watchet will cause adverse environmental effects.

Severn Estuary boundary - judicial review

The DoE's decision to define the seaward boundary of the Severn Estuary at the old Severn Road Bridge for the purposes of the UWWTD was the subject of a judicial review brought by Bristol City Council and Woodspring District Council. The Court upheld the applicants' case because the DoE's decision was made taking into account costs, which was not the correct approach.

Following the Judicial Review, the DoE consulted the Agency on the location of the estuary boundary. Based on advise from the Agency, the DoE has decided to draw the seaward limit of the Severn Estuary at a line from Lavernock Point through the Holms to Howe Rock on Brean Down. This decision means that secondary treatment will be required at Avonmouth and Portbury in the Severn Estuary.

All improvements made to sewage treatment levels through out the estuary will assist in reducing the amounts of sewage bacteria, sewage derived litter, and to some extent nutrient levels. However riverine sources of litter and nutrients are also significant. These will also be reduced as sewerage improvements are made throughout the river catchments draining into the estuary under UWWTD.

Table 9.2: Planned improvements to sewage treatment for the Severn Estuary

Scheme	Level of treatment	Date	Notes
DDCW Schemes			
Chepstow-Sedbury (Hunger-Pill Outfall)	Secondary	2000	Includes Hunger-Pill Outfall
Caldicot	Secondary	2000	<i>To be finalised</i>
Magor Pill	Secondary	2000	<i>To be finalised</i>
Cardiff East (Western Valley, Rhymney Valley, Cardiff Eastern and Cardiff Central Outfalls)	Secondary	2000	DDCW Have asked for an extension to the completion date on technical grounds
Cardiff West - Lavernock (Cardiff Western, Penarth Marina, Penarth Head, Penarth Kymin, Penarth Lower, Barry East Outfalls)	Secondary	2000	
Cardiff West - Barry (Barry West Outfall)	Secondary	2000	
Llantwit Major	Secondary	2000	
Severn Trent Water			
Blakeney	Secondary	2000	
Lydney	Secondary	2005	
Broad oak		2005	
Newnham Maccrator	Fine screening	2005	<i>Improvements to meet "Appropriate Treatment requirements of Directive "</i>

AMP2 Scheme	Level of treatment	Date	Notes
Wessex Water			
Thornbury	Secondary & relocate outfall	2000, 2005	
Avonmouth	Secondary	2000	
Portbury	Secondary	2000	
Aust	Relocate outfall	2005	
Kingston Seymour	Secondary	2000	
Weston-super-Mare	Secondary and Disinfection	2000	To meet EC BWD and UWWTD requirements
Minehead	Secondary and Disinfection	2000	To meet EC BWD and UWWTD requirements
Watchet	Primary and outfall relocation	2000	Primary treatment subject to outcome of HNDA studies
Donifon	Primary	2005	Improvements to meet "Appropriate Treatment requirements of UWWTD"
Bridgewater	Secondary	2000	
West Huntspill	Secondary	2000	

Industrial discharges to water

There are two main areas of industrial discharges: the Newport - Cardiff - Barry area and Avonmouth. The main industries are paper manufacture, steel-making, chemical manufacture and smelting. Disposal of sludge is dealt with in Solid Waste Disposal below. The major industries with discharges to the estuarine waters are shown on Map 9.2.

Most of the discharges resulting from these operations are large and reflect the siting of these industries to take advantage of the large dilution afforded by the estuary. The composition of the effluents discharged vary according to the type of processes carried out at each site. Many of these discharges contain toxic substances, such as heavy metals and organic compounds. Limits are imposed in the consents and authorisations to restrict the concentrations of such substances to a level at which environmental impacts are minimised. Samples are taken by the Environment Agency to monitor these discharges, or to audit sites which self-monitor under their IPC authorisations. On occasion, the Environment Agency has had to bring enforcement action through prosecution, but the compliance record of industrial dischargers with the Authorisations and Consents issued for their premises is generally good. The limits imposed reflect the requirements of the EC Dangerous Substances Directive to ensure Environmental Quality Standards (EQS) are met in the receiving waters. The limits also take into consideration the North Sea Conference (Annex 1A) decisions which are the driving force to reduce the input of the more toxic or persistent substances to coastal waters.

Map 9.2: Major industrial discharges to water

Industrial discharges to air

The major industrial sites around the estuary discharge volatile wastes and combustion products to the atmosphere. These discharges are limited by authorisations from the Environment Agency (Part A processes) or by local authorities (Part B processes) under the Environmental Protection Act 1990. Limits are set using EC Mandatory Environmental Standards for Air Pollutants where applicable and World Health Organisation or Expert Panel on Air Quality Standards guidelines and recommendations for other pollutants. National Air Quality Strategy standards will apply once these are formalised. Authorisations ensure that production of harmful waste products is either prevented, minimised, or the substances are rendered harmless, and each site has a detailed improvement plan aimed at reducing emissions.

Emissions from vehicles, landfill sites, waste burning and natural processes also contribute to air pollution on a local scale.

There are ** authorised (Part A) sites within the plan area as shown on Map 9.3.

Nuclear discharges

There are four nuclear power stations within the plan area at Berkeley, Oldbury and Hinkley Point A and B as shown on Map 9.3. These are operated by Magnox Electric, except Hinkley Point B which is operated by Nuclear Electric Ltd. The reactor at Berkeley is presently being decommissioned. Their operation is licensed by the Nuclear Installation Inspectorate, under HSE. However discharges of radioactive wastes are regulated by Environment Agency Authorisations. Limits are set to protect people living in the locality identified as critical groups, which are the most exposed groups of individuals. These groups receive acceptably low doses which are well below doses from naturally occurring background levels. Where conditions of the authorisation are breached enforcement action will be taken. An example of this is at Hinkley Point where Nuclear Electric plc were prosecuted prior to privatization by the former HMIP in 1995.

Small users of radioactive materials are also licensed by the Environment Agency. These include hospitals, research establishments, and some engineering and manufacturing industries. Often the radioactive sources used are 'closed', and these are registered by the Agency. Where radioactive waste is produced this may be discharged to sewer or the atmosphere under authorisation. The assessment of resultant doses in the locality follows a similar approach to that described above.

Map 9.3: Major atmospheric discharges and nuclear sites regulated by the Environment Agency.

Solid waste management

Solid waste management will be considered in two ways. The impact of solid waste disposal to land, either now or in the past, and the impact of solid waste disposal to sea and estuarine waters, either legally through licensed dumping at sea or illegally through fly-tipping to rivers, estuaries and from shipping.

Disposal to land

There are over 60 waste disposal sites within the plan area. Most of these are relatively small, so only major sites are shown on Map 9.4. These are at Sudmeadow, Gloucester; Lamby Way, Cardiff; Maesglas, Newport; Walpole Drove, Bristol and Harnhill, Burnham. There are also numerous waste transfer, storage and some treatment facilities in the plan area.

Contaminated land

Past domestic and industrial landfill sites were operated on a 'dilute and disperse' principle and the areas around and within these former sites may still be contaminated by leachate and residual fill material from previous disposal activities. Any redevelopment of such sites may mobilise residual leachate and expose fill material to rainfall, significantly increasing the potential for contamination of both groundwater and streams.

The redevelopment of former industrial sites can also present potential pollution problems, mainly because of ground contamination that has occurred as a result of previous operational activities over a long period of time. Large areas of the urban conurbations around the estuary are currently undergoing regeneration of the older, former industrial sectors of these towns.

The former importance of South-East Wales within the industrial development of the western world has left large areas of derelict and abandoned industrial land. In the Avonmouth area, zinc and other non-ferrous metal smelting has taken place for the past hundred years. Historically, the slag, which is contaminated by metals, especially zinc, lead and cadmium, was seen as an asset and widely used for raising land levels in areas prone to flooding or below sea level. Another site known to be contaminated is British Gas land off Bristol Road, Gloucester which is up for redevelopment.

Redevelopment plans for these areas have required extensive ground contamination surveys to quantify the extent and type of contamination that exists within a given site and in many cases, Environmental Assessments which have quantified the degree of risk posed by the redevelopment and the remediation measures proposed to overcome the potential risk.

Sludge disposal to land

The disposal of municipal sewage sludge and industrial sludge to land is an increasing practice. This is licensed by the Environment Agency and steps must be taken to avoid potential groundwater and surface water contamination.

Within the plan area there are two areas where land spreading is undertaken to beneficially condition the land, these areas are the Gwent levels to the East of Newport, and the coastal belt South of the A48 in South Glamorgan. In these locations three main types of waste are spread:

sewage sludge, paper industry waste and biological effluent treatment plant waste.

As these materials are spread in order to enhance the quality of the soil for agricultural purposes there is unlikely to be a detrimental environmental impact from these activities. However, they will certainly bring amenity issues for residents of the area and visitors using the area for recreation.

Farm slurry is spread onto land in accordance with the code of Good Agricultural Practice and there are no consents to dispose of such wastes to the upper estuary. Nitrate levels are seen to rise in the River Severn Catchment during winter and this is considered to be from farm run-off.

The levels in the Severn do not exceed the drinking water directive of 50 mg/l but can do for a limited time in the Gloucester Sharpness Canal water which is abstracted at Purton for Bristol's Drinking Water supply. As a consequence the canal catchment is being considered as a candidate for sensitive area eutrophic status under Urban Waste Water Treatment Directive.

Disposal at sea

Under the OSPAR Convention (1992) this form of disposal will be limited to dredged material. Applications for disposal at sea will not be permitted where a safe and practical method for dealing with the waste is available. Disposal of sewage sludge at sea will cease in 1998, but has already stopped in the Severn Estuary. However the estuary is used illegally for waste disposal through fly tipping either directly to the estuary or to its tributaries, or from shipping. Fly-tipping occurs at sites around the estuary such as Aust, and in the upper estuary for unauthorised bankside erosion measures using large rocks.

Environmental quality of the estuary

Monitoring

The Environment Agency monitors water quality in the estuary and takes over 1000 samples each year at 102 sites. The monitoring sites are shown on Map 9.5. We take over 800 samples to measure background levels of contaminants within the estuary against EC Directive standards and other international agreements at 59 sites.

Additional monitoring is carried out by the Environment Agency's National Centre for Marine Surveillance within the estuary, where 43 sites are sampled by helicopter six times a year. Bacterial numbers, sediments and biota at some sites are also monitored. Mussels and seaweed take up certain metals and organic compounds from seawater and concentrate these substances within their tissues. This process is known as Bioaccumulation. Analysis of mussel tissue and/or seaweed gives an indication of contaminants present in seawater. The Environment Agency has monitored the quality of mussel tissue at two sites in the Severn Estuary and the quality of seaweed tissue at seven sites.

Bacterial quality of bathing waters

Numbers of sewage bacteria are monitored at thirteen EC Identified Bathing Beaches, nine other 'non-identified' beaches, and twenty-five mid channel sites. Of these, six of the EC beaches have failed to meet the standards, in at least one of the last four years, as have six of the non-identified beaches. The EC Identified Beaches which have failed are Barry - Jackson's Bay, Barry - Whitmore Bay, Clevedon, Sand Bay, Weston Main and Weston Uphill. Relatively low numbers of sewage bacteria are found in the mid-channel of the outer and middle estuary, but numbers increase from Chepstow to Gloucester.

EC Dangerous Substances Directive

The EC directive on dangerous substances protects the water environment by controlling discharges that contain harmful substances to rivers, estuaries and coastal waters. This Directive describes two lists of compounds. List 1 contains substances regarded as particularly dangerous because they are toxic, they persist in the environment and they bioaccumulate. Discharges containing List 2 substances must be controlled by Environmental Quality Standards (EQSs) issued through Daughter Directives. List 2 contains substances which are considered to be less dangerous but which can still have a harmful effect on the water environment. Discharges of List 2 substances are controlled by EQSs set by the individual Member States.

The Agency is responsible for authorizing, limiting and monitoring dangerous substances in discharges. We are also responsible for monitoring the quality of waters which receive discharges containing Dangerous Substances and reporting the results to DoE who decide whether the standards in the Directive have been met. Where the requirements of this Directive are not met, we are responsible for identifying sources of pollution and making sure that improvements are made.

Map 9.5: Environment Agency water quality monitoring sites

Compliance with the Directive is determined by comparing the annual average concentration for each contaminant monitored in the estuary with the relevant EQS. Over the last 3 years all sites associated with discharges in the estuary have been within the EQS.

North Sea Conference Annex 1A Reduction Programme

In addition to EC Directives, there are other international agreements made at North Sea Conferences which aim to reduce levels of harmful substances.

The Environment Agency has been monitoring loadings of Annex 1A substances entering the Severn Estuary from major industrial and effluent discharges and rivers. The Severn Estuary receives large volumes industrial effluent and has several major rivers flowing into it which have contributed significant loadings of trace metals, and the organic solvents chloroform and tetrachloromethane. In addition contaminated land within a chemical manufacturing site has also contributed significant loadings of PCBs.

Through cooperation between major dischargers and the regulators, and subsequent investment by dischargers, substantial reductions in the loadings of mercury, cadmium, zinc, chloroform and tetrachloromethane have been made from major industrial areas, and also in the loadings of PCBs from Newport area due to investment.

However, Environment Agency monitoring has shown significant loadings of arsenic entering the Severn Estuary from the Avonmouth area, although monitoring under the EC Dangerous Substances Directive has shown that the EQS for arsenic in the estuary has been met.

The Environment Agency will continue to monitor the loadings of Annex 1A substances entering the Severn Estuary from significant riverine sources and discharges to ensure that the reductions achieved to date are sustained.

Water quality in the estuary

General

We use the NWC Estuary Classification Scheme to provide a simple, subjective assessment for estuaries based on biological, chemical and aesthetic quality. The classification is as follows:

Estuary Class	Description
A	Good
B	Fair
C	Poor
D	Bad

The Severn Estuary is divided into eleven reaches for NWC Classification purposes, from Gloucester to Lavernock Point/Parrett Estuary. These are shown on Map 9.6. The most recent classifications (1995) are class A (3 reaches) and class B (8 reaches). These have not changed

since 1990 except two reaches below Gloucester (Netheridge) Sewage Treatment Works to Epney which have improved from C to B following better treatment at the works.

Nutrients

Nitrate and phosphate levels throughout the estuary have exceeded those standards that would be indicative of a 'sensitive' water under the Urban Waste Water Treatment Directive over the past six years. The high suspended solids loading and turbidity, due to the high tidal range, limit the amount of light penetration so that algae cannot grow to nuisance levels. Throughout the lower estuary, chlorophyll levels have almost always been below the standard indicative of a sensitive water. In the middle to upper estuary where the turbidity is less, then algae do grow to give high levels of chlorophyll during summer months, but there is little visual evidence of blooms. This in itself is not harmful to other aquatic life, but a more intensive monitoring study should be undertaken to understand the full cause and effects of such algal growth.

Heavy metals

Dissolved Copper was always around the Environmental Quality Standard (EQS) of 5 ug/l annual average throughout the six year monitoring period. There are many sources of copper to the estuary, in rivers and discharges, but the specific source of the high levels is not known. All other heavy metals (Mercury, Cadmium, Lead, Zinc, Arsenic and Chromium) were well below their respective EQS values at all sites throughout the monitoring period.

Metals levels within estuarine sediments have remained at a similar level to those reported in the mid seventies and early eighties apart from Cadmium which has declined markedly (*Figure xx*). Compared to other industrialised estuaries such as the Clyde and the Mersey, the Severn has lower sediment metals concentrations.

Over time there has been a decline in some metals (Copper, Zinc, Cadmium and Lead) within the Severn Estuary biota. Compared to other Welsh industrialised estuaries such as the Dee, highest levels of Copper, Zinc, Cadmium and Nickel are found within the Severn. Compared to other UK sites, such as the metalliferous mining areas of South West England, concentrations of metals in biota are low apart from Cadmium. The highest UK levels of Cadmium were found in biota from the Severn in the late seventies and mid eighties but levels have now declined markedly (*Figure 9.1*).

Figure 9.1: Levels of Cadmium in Severn Estuary Biota

Map 9.5: Water quality

Organic chemicals

A number of trace organics were recorded in the water column throughout the monitoring period (Chloroform, Carbon Tetrachloride, Gamma HCH, Atrazine and Simazine were the most frequently recorded). The significance of these is unknown but the frequency of the detection does concern the Agency. Most were below the respective EQS values but some exceedances were observed (e.g. Endrin). Endrin is an extremely persistent organochlorine insecticide with a high acute toxicity, and has been banned from use since 1984. If Endrin is found in water samples today it is mostly likely to be derived from soil leachate. It is anticipated that environmental concentration of Endrin will gradually decrease over the years.

PCBs are detected in low concentrations occasionally in the water column, but at high concentrations in sediments at sites in the middle estuary. The manufacture of PCBs was banned in the UK in 1977, but their widespread use and persistence has meant that they are found ubiquitously in the environment at background levels. Unusually, there is however a point source discharge to the Estuary from the main UK manufacturing plant almost 20 years after production stopped due to contaminated groundwater on the site. The company concerned has invested heavily to reduce their point source input under the Annex 1A Reduction programme. The site is now regulated by the Environment Agency through an IPC Authorisation which includes an improvement programme and will require further and continued improvements to be made to the effluent handling system and the quality of the effluent discharge.

In addition the sediment load is likely to represent historic input from the identified point source and other point sources such as sewage inputs and diffuse input.

Trace organics are almost always below the limits of detection in the biota. It would appear that unlike the sediments, the biota are uncontaminated by organics.

Air quality over the estuary

Air quality within the plan area is monitored routinely at only 3 sites at Cardiff, Gloucester and Bristol. Ambient quality will depend on weather conditions and local discharges to the atmosphere. Under some conditions, emissions do not disperse and can cause poor air quality locally.

Studies in the late eighties have shown that atmospheric deposition from industrial sites around the estuary are significant inputs to the estuarine waters. 50% of the Lead and Zinc inputs and 10-20% of Cadmium, Copper and Nickel were found to come from the atmosphere, but only a small proportion of the Chromium, Iron and Manganese was from this source. Most of the Cadmium, Copper and Lead came from the lower atmosphere near Avonmouth and Cardiff Bay.

These studies showed a decline in inputs compared to the early eighties, and it is likely that recent improvements in emissions under Environmental Protection Act 1990 authorisations will have furthered this decline.

Radioactivity in the estuary

Levels of radioactivity in the environment and food are monitored and reported by MAFF. The latest reports are 'Radioactivity in Coastal and Surface Waters of the British Isles 1994' and 'Terrestrial Monitoring Programme Report for 1994'. Environment Agency compliance records are available for individual sites.

Litter

The very extensive tidal range of the Severn estuary is also associated with a large tidal excursion. The estuary receives large inputs of freshwater from rivers which generally have travelled through urban and industrial conurbations. Inevitably, these rivers will carry litter that will generally have been derived from land sources and will end up in the estuary. The large tidal range of the estuary will carry litter over long distances and will deposit litter extensively over the banks and saltmarshes. If the deposits occur on tides going from spring to neap ranges, the litter will remain where deposited for several weeks, until the next range of spring tides is able to lift the litter from the banks. If the deposit occurs on a large spring tide, the litter may remain in-situ for months before a large enough spring tide can again lift it.

Litter in the estuary will also come from ship-borne sources. The large volumes of commercial shipping and leisure craft that use the estuary unfortunately results in litter deposits from this source.

Along the Welsh Region shore of the estuary, although there are on occasions substantial deposits of litter that will have come from both land and water-borne sources, there are no recognised areas or locations that give rise to specific or continual complaints of litter deposits.

General issues

- WA** Public concern pollution and its visual effects
- WB** Public concern about pollution and its effects on public health and human activities,
- WC** Public concern about pollution and its effects on environmental quality.
- WD** Public concern about pollution management.
- WE** Public concern about pollution from major accidents
- WF** Waste reduction initiatives

Specific issues

WA Public concern pollution and its visual effects

WA1 General Litter

Litter on beaches and the shore is an important concern to many people who use the estuary. Many people believe that litter indicates poor quality water and are therefore concerned about entering the water and using the beach. General marine litter does not necessarily indicate poor quality water or present a health risk, but it does carry problems of its own - contamination by hazardous substances, risk to wildlife by physical entrapment, risk of injury (e.g. on broken glass), etc. Identifying the sources of marine litter is in itself a major problem. Studies by litter action groups have concluded that sources can be both diverse and very distant. The issue therefore is not only how to solve the problem of litter but also quantifying it in the first place.

Who is involved: Local authorities, Environment Agency, land owners, shipping companies, the public.

Possible ways forward:

WA2 Sewage debris on beaches, foreshores and moorings

One of the most obvious signs of pollution of the estuary is the amount of sewage debris, such as sanitary towels and condoms, which is stranded on beaches, foreshores and boat moorings. This causes great public concern, and

affects people's enjoyment of the estuary as a recreation area and a tourism destination. The debris enters the estuary from crude sewage outfalls around the coast, and also rivers.

Who is involved: Severn Trent Water, Dŵr Cymru Welsh Water, Wessex Water and some small private dischargers.

Possible ways forward: Many of the large untreated discharges on the northern side are programmed for full treatment by 2005 by Dŵr Cymru Welsh Water. (See Table 9.2) The majority of discharges in the upper estuary and southern side are already screened, and may be programmed for further improvements as required under UWWTD by Wessex Water. Improvements to inland storm sewage discharges are underway. However, schemes to address all unsatisfactory discharges may take many years to complete, although the worse discharges should be improved as a priority. The Environment Agency may be able to negotiate for the installation of temporary screening facilities at storm discharges known to cause significant problems.

Wider public uptake of the 'Bag it and Bin it Campaign' would reduce the amount of litter entering the sewerage network.

See also options for general litter above.

WA3 Visual effects of untreated and partially treated sewage discharges.

Untreated and partially treated sewage is discharged at five points into the upper estuary, as shown on map x. Some of these outfalls are exposed at low tides and the plume of sewage entering the estuary can be seen. People are concerned as these visible discharges affect their enjoyment of the estuary as a recreation area and a tourism destination. This problem may also be more widely applied to other discharges in the estuary.

Who is involved: Severn Trent Water, Dŵr Cymru Welsh Water and Wessex Water.

Possible way forward: Improvements are planned within the Sewage Undertakers investment programmes as identified in Table 9.2.

See also the issue on Sewage Litter, as reduction in litter will reduce the visible impact of these discharges.

WA4 Visible oil pollution from contaminated surface water run-off.

In some parts of the estuary, surface films of oil form where run-off from roads and car parks enters the water. These may also be caused by spillages from boats, and are most obvious in harbours where wave action is least likely to disperse the oil. Rivers, and industrial and sewage discharges may also contain oil, which give rise to public complaint, for example at Hinkley Point Power Station.

Who is involved: Environment Agency, Site operators

Possible ways forward: Environment Agency to continue with its 'Oil Care Campaign', and to regulate and enforce surface water discharge consents as appropriate. Environment Agency to seek to improve site management at Hinkley Point Power station to lower the risk of accidental discharges of oil.

WB Public concern about pollution and its effects on public health and human activities,

WB1 EC Directive failures at identified bathing beaches

There are six bathing waters in the estuary which have failed to comply with the mandatory limits of the EC Bathing Waters Directive on one season or more in the last five years. The causes of non-compliance on the Welsh side of the estuary, at Barry - Jacksons Bay and Barry - Whitmore Bay, are known. The reasons for the failure of the bathing waters at Clevedon, Sand Bay, Weston Main, and Weston Uphill have not yet been identified, despite intensive investigations by the Environment Agency.

Who is involved: Dŵr Cymru Welsh Water, Wessex Water and the Environment Agency.

Possible ways forward: The discharges causing *failures* at Barry are due to be addressed by Dŵr Cymru Welsh Water by December 1997. Further investigations will be carried out by the Environment Agency to identify problem discharges causing failures on the Wessex Coast.

WB2 Disinfection of sewage effluents

Disinfection of sewage effluent using chlorine prior to discharge has been conducted by Wessex Water at a number of sites (Weston super Mare, Kingston Seymour, Minehead, West Huntspill, Bridgwater) on a seasonal basis, to ensure compliance of these sites with the Bathing Waters Directive.

Who is involved: Wessex Water

Possible ways forward: Review the effectiveness of chlorine treatment and if effective the Environment Agency could give consent for Wessex Water to use chlorine permanently.

WB3 Minehead Park stream

This watercourse discharges onto the beach in close proximity to the identified bathing water site. The stream is culverted through the town and is known to receive several illegal direct sewage discharges from domestic properties.

The stream is routinely monitored for bacterial quality throughout the bathing season and some high bacteria levels have been found which could influence bathing water compliance due to the proximity of the stream to the bathing water site.

Who is involved:

Possible way forward: Somerset County Council has provided close circuit video information on the condition of the culvert to trace illegal discharges. Once identified, the illegal discharges can be diverted to the foul sewer and water quality of the stream should improve.

WB4 Mid-channel microbiological quality

Data from surveys in the last five years indicate relatively low concentrations of sewage bacteria in the outer and middle estuaries, well below EC Bathing Waters Directive limits. However from Chepstow to Gloucester bacterial numbers increase and can exceed limits of the EC Bathing Waters Directive.

Who is involved: Environment Agency and the sewage companies.

Possible ways forward: Continual improvements to sewage discharges around the estuary will ultimately lead to reductions in sewage derived bacteria.

WB5 Monitoring of other beaches

In addition to the identified EC Bathing Waters, we also monitor the quality of nine popular, "non-identified" bathing waters in the Severn Estuary. Of the nine sites, six have failed to meet the standards of the Bathing Waters Directive in one or more years. These sites reflect the areas of the estuary where compliance of the EC identified bathing waters is less than satisfactory. The reasons for non-compliance of identified bathing waters have been given in issue W1 above.

Who is involved: Environment Agency and the sewage companies.

Possible ways forward: There is no statutory need to achieve compliance at these sites, however the Environment Agency expects that improvement work aimed at improving quality at the EC identified waters will also result in improvements at non-identified sites.

WB6 Pollution risk to Gloucester/Sharpness Canal drinking water supply to Bristol

The canal is an important abstraction for Bristol Waterworks at Purton and is also used for industrial abstraction, navigation and amenity purposes. It is fed by the Rivers Cam, Frome and other streams, supplemented from the River Severn at Gloucester Docks in summer.

There is a pollution risk primarily from industry at Gloucester, Stroud and Cam. Alongside the canal at Gloucester are 4 timber chemical treatment plants and two organic chemical production plants. In Stroud and Cam are wool, food, engineering and oil industries alongside the river valleys.

Agricultural pollution is largely from seasonal usage of pesticides and *nitrates* within the Severn and canal catchments. Although *pesticide* levels do not exceed Water Supply Regulations the concentrations can occasionally reach levels of concern. In winter, nitrate levels in the canal can exceed the 50 mg/l drinking water supply standard.

Who is involved: Environment Agency, industry and agriculture.

Possible ways forward: The Environment Agency will continue routine sampling and remote monitoring stations are being installed as early warning stations. Industry and agriculture could be encouraged to adopt better pollution prevention measures. The canal could be designated as Sensitive Water under the terms of the EC UWWTD.

WB7 Radioactive discharges from licensed nuclear sites.

There are three nuclear power stations around the estuary at Berkeley, Oldbury and Hinkley. The discharges of radioactive waste from these sites are controlled by the Environment Agency under Radioactive Substances authorisation.

The radioactive discharges are monitored by.... and have remained within the limits imposed since.....

Who is involved: Environment Agency, Nuclear Electric Ltd and Magnox Electric.

Possible ways forward: Environment Agency to continue monitoring and enforcing RAS authorisations. Authorisations will be reviewed every four years and ongoing improvement plans will be used to minimise discharges.

WB8 Atmospheric discharges from industry

Many major industrial sites are sited around the estuary which discharge some waste gases to the atmosphere. Numerous public complaints are received about the effect these discharges may be having on people's health, and also the visual and odour effects. The potentially most polluting activities are regulated by the Environment Agency, other processes are controlled by local authorities. Emissions from vehicles and some weather conditions can aggravate the problem.

Who is involved: Environment Agency, local authorities and industry.

Possible ways forward: Environment Agency to continue monitoring and enforcing authorisations. Authorisations will be reviewed every four years and ongoing improvement plans will be used to minimise discharges. Local authorities to continue monitoring and enforcing their controls. Implementation of the National Air Quality Strategy and its standards, and monitoring against these, will enable the true extent of the problems to be accurately assessed and resolved.

WC Public concern about pollution and its effects on environmental quality.

WC1 Nutrient levels

Nutrient pollution from sewage and agriculture is causing eutrophication within the estuary. Nitrate and phosphate levels through out the estuary over the last six years have exceeded

standards. This is particularly an issue in the upper estuary and is also of concern when water is to be impounded by barrage construction, for example in Cardiff Bay. Increased nutrient levels can lead to algal blooms. Algal blooms do not occur in the lower part of the estuary due to its high turbidity, but do occur in the middle and upper reaches.

Who is involved:

Possible way forward: An intensive monitoring study should be undertaken to understand the full cause and effects of algal growth in the middle and upper estuary.

Within Cardiff Bay, negotiations are on going between the Environment Agency and Cardiff Bay Development Corporation (CBDC) on management of the impoundment. The WO will determine the status of the impoundment under the Urban Waste Water Treatment Directive in 1998. CBDC will remove algal and weed accumulations as necessary after 1998.

See also section on barrages

WC2 Pesticide Levels

There is concern over pesticide levels within the estuary. Some persistent trace organic chemicals derived from pesticides have occasionally been found in water at levels which require further investigation. Also as new pesticides are being used it is necessary to revise monitoring and develop techniques to detect them.

Who is involved:

Possible way forward: Environment Agency monitoring programmes within the estuary are to be assessed and revised following analysis of the data collected so far. The Environment Agency will continue with its national R&D programme into the sources and control of pesticides in the aquatic environment.

WC3 Pollution from vessels

Some pollution in the estuary is due to direct or accidental dumping from ships and boats of litter, sewage and oil. This contributes to litter

accumulating on shores (see...). In most cases small amounts of sewage and oil will disperse naturally in the estuary and will not have a significant effect. However, where dumping occurs close to shore or within ports and harbours it will give cause for concern.

Who is involved: Harbour/Port Authorities

Possible way forward : Harbour/Port Authorities to ensure adequate waste disposal facilities are available.

Mariners to be made aware of environmental concerns.

New legislation in the form of the Marine Pollution Bill will provide stricter controls of pollution from shipping.

WC4 Thermal pollution

The estuary is used as a source of cooling water for power stations. Large volumes of water above ambient temperature are returned to the estuary. Some other industries also use the estuary for cooling waters. This shows as plumes of warm water when detected using remote thermal imaging, but we do not know what effect these have on the local estuarine ecosystem.

Who is involved: The Environment Agency and major dischargers of heat.

Possible ways forward : The Environment Agency can carry out surveys to establish the extent of thermal plumes and their ecological impact. The results to be used to set appropriate temperature consent limits on the discharges.

WC5 Water pollution from industry

Many heavy industries have grown up around the estuary which discharge wastes either now or have done in the past. Some discharge directly to the estuary, others via the local sewerage system or to other inflowing rivers. Some of these major discharges are known to have a localised detrimental effect on the animal life living on the floor of the estuary. General examples, and sites where there are specific

concerns are covered below.

WC6 Heavy Metals

In general, monitoring by the Agency has shown levels of metals included in the Dangerous Substances Directive comply with their Environmental Quality Standards (EQS). Copper levels are also around EQS at a number of sites around the estuary.

Metals do remain bound up in the sediments for long periods and levels have changed little in the last twenty years despite reductions in levels actually within the water. However, levels in the Severn Estuary sediments are low compared with other industrial estuaries such as the Clyde and Mersey. Levels of Cadmium have significantly declined in sediments.

The animal and plant life within the estuary still accumulate metals at some locations. Levels are higher in the Severn than other Welsh estuaries, but low compared with other UK sites, except for Cadmium, though levels of this are declining as in sediments.

Particular concerns to the Environment Agency are Avonmouth, specifically Kingsweston Rhine. One discharge to the Kingsweston Rhine at Avonmouth has indicated a steady increase in arsenic loading in the period 1992 to 1994. To satisfy the Annex 1a load reduction commitment, the company concerned is actively exploring all sources of the arsenic contamination on site.

Who is involved: Industry, Environment Agency

Possible way forward: The Environment Agency to continue monitoring, and investigate EQS failures as required

Environment Agency and Industry to continue to limit levels discharged under the Dangerous Substances Directive and Annex 1a Reduction Programme.

Environment Agency to continue monitoring to assess mass flux of arsenic from the site. The company concerned will continue to investigate

sources of arsenic and reduce emissions to satisfy the Government's reduction targets

Environment Agency to carry out extensive chemical and biological investigations in areas of concern, to identify the range of substances present and their impact on the local environment.

Environment Agency to carry out site inspections to identify, regulate and control illegal discharges and to provide pollution prevention advice.

WC7 Organic compounds, including PCBs.

Organic compounds enter the estuary from industrial discharges, and also from rivers and sewage discharges. There is concern that levels of these compounds are high, but it is only rarely that EQS levels are exceeded. However the reason for and significance of these levels is unclear, with the exception of PCBs. These are found at high levels at some sites in the estuary due to contamination at a plant which previously manufactured these compounds until their use was banned 20 years ago.

Who is involved:

Possible ways forward: The Environment Agency to continue monitoring programmes, and to investigate EQS failures.

The Environment Agency to enforce consents, and to work with industrial dischargers to reduce levels of organic compounds in effluents under EC Dangerous Substances and Annex 1a reduction programmes.

The site which is the source of the PCB contamination is to complete an improvement programme under its IPC authorisation to reduce the levels in the discharge.

WC8 Lydney Paper Mill

The existing papermill has recently expanded. Investment by the company has resulted in the increased discharge of a large volume of much higher quality effluent to a new point in the estuary.

Concerns have been raised by local fishermen regarding the possibility of fish avoidance.

Who is involved: Environment Agency

Possible ways forward: Environment Agency to investigate fishermen's concerns.

WC9 Pollution from contaminated land

A number of sites around the estuary have historically been used for industry. Spoil tips, leakages and tipping of waste to raise land levels have left land contaminated, often to an unknown extent. Contamination can lead to pollution of groundwater or surface waters, either as an ongoing problem, or when sites are reclaimed for new developments. Some known contaminated land problems are PCB's at a site near Newport, a range of contaminants at Avonmouth, an old coal gas works in Gloucester and industrial land at Lydney.

Who is involved:

Possible way forward: Methods for remediation of contaminated land problems need to be considered on a case by case basis. Where possible, contaminated surface waters should be treated or diverted to sewer to avoid contamination of other watercourses or ground water. Under the Environment Act 1995 Part II, Local Authorities and the Environment Agency will allocate regulatory responsibilities for such sites dependent on the category of waste they are believed to contain.

WC10 Effects of dredging activities on water quality and wildlife

Large areas of the estuary are dredged to maintain navigation channels and also to extract aggregates for construction. This can effect water quality in that resuspension of sediments and disposal of dredgings can lead to low oxygen levels, high turbidity and the release of toxic compounds (see 'Natural effects'). Poor water quality can restrict fish movements and even cause mortalities. Physical effects include destruction of reefs of sediment biota and lower light penetration and can lead to changes in coastal erosion patterns. (See flood defence).

Some of the areas where this is a particular issue are Gloucester Docks and Cardiff Bay.

Who is involved:

Possible ways forward: A working protocol to be agreed for all dredging activities throughout the estuary by the Navigation Authorities, other bodies and the Environment Agency.

WC11 Pollution from land based waste disposal.

There are several major landfill sites located around the estuary which discharge leachate. Tide locking of drainage ditches and high water table levels exacerbate the problems of controlling the leachates. Some examples are Sudmeadow Tip and Harnhill Quarry.

Who is involved:

Possible way forward: Improved leachate management systems involving new options to dispose of leachate to either the foul water sewer or via an on-site treatment plants into the estuary.

WD Public concern about pollution management.

WD1 Public concern at the level of Environmental Quality Standards.

There is public concern that the levels of standards for harmful substances which are set to protect the environment do not give adequate protection.

Environmental Quality Standards (EQS) are set by the appropriate body, such as the EC or Department of the Environment using the best scientific knowledge available at the time. Standards are periodically reviewed as new data become available, and are being set for new substances, using advice from the relevant environmental and scientific organisations.

Who is involved: Department of the Environment, EC

Possible ways forward: WRc will continue to

review Environmental Quality Standards (EQSs), on behalf of the DoE and the Environment Agency, as new, good quality information on a substance becomes available.

Continuation of derivation of EQSs on behalf of DoE and the Environment Agency for candidate List I, List II and Red List substances by appropriate experts.

Continuation of the Environment Agency R&D programme to derive EQSs for substances which are not covered by List I, List II and the Red List, but are of concern due to the frequency of occurrence in the environment and discharges or due to their potential for impact on the environment.

Provision of advice and tentative standards internally by the Environment Agency's Environmental Toxicity Advisory Group for substances which currently have no EQSs but require consenting.

The introduction by the Environment Agency of Direct Toxicity Assessment of effluents and the ability to control complex discharges containing a number of substances, for which there are no EQSs, by including a toxicity based criterion in the consent.

WD2 Public concern over levels of substances permitted in consented discharges

The estuary has always been used as a convenient route for the disposal of liquid wastes. Historically, such discharges would not have been

controlled, but all are now consented or authorised by the Agency. There is public concern that the levels of these discharges are too high.

Who is involved: Environment Agency

Possible ways forward: The Environment Agency will continue to review consents for discharges to the estuary, and to liaise with industry to reduce discharges of substances under the Dangerous Substances Directives and Annex 1a reduction programmes. The Environment Agency to consider discharges from authorised sites using the principles of Best

Practical Environmental Option (BPEO) and Best Available Techniques Not Entailing Excessive Costs (BATNEEC) and individual site improvement plans to reduce the levels of discharges. The environmental impact of such discharges will continue to be assessed, and any changes acted upon.

WD3 Public concern about monitoring and enforcement of consented discharges

Discharges are monitored (section....) to ensure that they comply with their consents by the Environment Agency. There is public concern that this monitoring is not adequate, and that companies which failure to meet consent conditions are not penalised.

Who is involved: Environment Agency

Possible ways forward: The Environment Agency to regularly review monitoring programmes to ensure monitoring and enforcement levels are maintained. The public to be made aware of availability of compliance data, and also of any enforcement action taken through PR by the Agency.

WE Public concern about pollution from major accidents

WE1 Pollution from oil tankers

The Sea Empress Oil Disaster in February 1996 when an oil tanker ran aground at the mouth of Milford Haven has raised many issues concerning the emergency plans in place to deal with such accidents. Accidents can occur during movement of vessels within the estuary, and also during loading and unloading operations.

Who is involved:

Possible ways forward: Recommendations of inquiries into marine accidents to be used to formulate appropriate legislation, such as the Merchant Shipping and Maritime Security Bill

The Department of Transport, Environment Agency and other regulatory bodies to take appropriate prosecution procedures in the event

of such accidents.

Emergency procedures such as the Severn Estuary Oil Pollution Plan to be reviewed in the light of recent experiences

WE2 Major accidents at nuclear installations.

The presence of three nuclear power stations close to the estuary cause some public concern at the possibility of a major nuclear accident. The stations are licensed by the Nuclear Installations Inspectorate under the Health and Safety Executive. The licensing procedure includes detailed consideration of the design, operation and maintenance of the power stations to ensure that the risks from accidents are acceptably low. The procedure also involves drawing up of detailed emergency plans to cover all eventualities such as plant failures, terrorist attacks and accidents such as plane crashes in the vicinity of the sites.

Who is involved: Nuclear Electric/Magnox Electric

Possible ways forward: Nuclear Electric/Magnox Electric to increase public awareness of emergency plans.

WE3 Accidents at major industrial sites

Recent events at Albright & Wilson, Avonmouth, Aberthaw Power Station and other large industrial complexes through the country have increased public anxiety at the potential for catastrophic releases from such sites. Environment Agency Authorisations regulate site management procedures so that the best available techniques not entailing excessive costs (BATNEEC) are used to limit discharges to the environment. In addition many such sites are designated as CIMAH sites, and as such have detailed emergency plans in the event of accidents or plant failures. This aspect is regulated by HSE.

Who is involved: Health & Safety Executive, Environment Agency

Possible ways forward: Environment Agency to take appropriate enforcement action when site

management procedures which could cause accidents are breached.

CIMAH emergency plans to be in place for all such sites

WF Waste reduction initiatives

To be completed.

10. Aggregates and minerals

Who does what?

- Minerals dredging in territorial waters and on the sea bed can only be carried out with the consent of the owner of the mineral rights.
- The Crown Estate owns some 55% of the foreshore and virtually all the sea bed. It is therefore responsible for licensing most seabed extraction and issues licences both for prospecting and production.
- Under current procedures production licences are only given by the Crown Estate when there has been a favourable 'Government View'. New statutory procedures will shortly be introduced empowering the Secretaries of State for the Environment and Wales to authorise dredging regardless of ownership.
- The Government view is a non-statutory process co-ordinated by the Department of the Environment or the Welsh Office.
- MAFF is consulted about the implication of dredging applications on the marine environment, sea fisheries and the coastline.
- Local authorities, acting as Mineral Planning Authorities (MPAs), control onshore mineral working and landing facilities for dredged minerals, and in some special cases [eg. Bristol] control off-shore dredging.
- The Department of Trade & Industry operates the licensing system which controls oil & gas exploration and production.
- Various other agencies provide advice through the consultation process - eg. the Joint Nature Conservation Committee advises on conditions in marine areas of environmental sensitivity.

Stated Government aims

- To ensure the sustainable provision of marine dredged aggregates for construction and beach nourishment, consistent with the limit of the resource and the potential environmental impact.
- To encourage exploration to discover new fields and extend existing fields.
- To ensure environmental concerns are properly addressed.
- To safeguard navigation through the grant of Department of Transport consents for location of offshore installations.

Background

The estuary bed is used as a source of natural resources, especially aggregates (sand & gravel) and other minerals (eg. waste coal from historic washings), both of which are obtained by dredging. Mineral extraction is licensed at eight sites within the estuary.

In addition, dredging to maintain navigation channels is carried out at Cardiff, Newport, Gloucester and Avonmouth docks. Dredging for navigational and similar purposes is covered in the chapter on navigation.

Other mineral activities may occur in future (eg. oil and exploration), though there are no current proposals in the estuary.

On-shore mineral working may have an impact (eg. Limestone at Rhoose, Waste Slag at Cardiff Foreshore, Power Station Ash at Aberthaw, Newport, etc), though there are no known instances of removal of minerals from beaches in this part of the estuary.

The estuary is used for transporting minerals. For example, there are movements of coal from South Wales ports and aggregates imports & exports more widely.

Policy

Government policy is set out in a series of guidance notes and circulars, of which the most important are "MPG 6 : Guidelines for Aggregates Provision in England", and "Planning Guidance (Wales) : Planning Policy." These aim to ensure an adequate and steady supply of material to the construction industry, at national, regional and local level, at the best balance of social, environmental and economic cost, through full consideration of all resources and the principles of sustainable development. MPG 6 also supports the use of marine aggregates as a means of reducing the pressure on land of agricultural or environmental value and states that marine aggregates will continue to contribute to maintaining supplies of aggregates for the construction industry.

MPG 6 was updated for England in 1994 and advises in relation to dredging that "*there is a presumption against extraction unless the environmental and coastal impact issues are satisfactorily addressed.*" The equivalent guidance for Wales has not yet been updated and the original (1988) version of MPG 6 still applies. In contrast, this advises that "*dredging should be encouraged wherever this is possible without unacceptable damage to sea fisheries and the marine environment.*" Dredging is not dealt with in "Planning Guidance (Wales) : Planning Policy" though guidance on minerals planning policy is expected shortly. It will be interesting to see whether the current divergence in policy is satisfactorily resolved.

Research

Through the Department of the Environment, the government funds and organises research into various mineral, geological and related topics. This includes research aimed at better understanding of the effects of mineral operations as well as research to identify new sources of minerals and substitutes. Of particular relevance here is the recently commenced "Bristol Channel Marine Aggregates : Resources and Constraints Study" which will investigate the nature and distribution of marine resources, and the environmental constraints on working them.

It aims firstly to develop a comprehensive understanding of the sediment transport regime in the Bristol Channel, and the extent to which the sediment deposits are interlinked. Secondly it aims to define the marine aggregate resources and to evaluate constraints on their extraction in the Bristol Channel. The study will take two and half years (completion April 1999) and will be divided into three phases comprising data collation, modelling and preparation of a draft report.

GENERAL ISSUES

AA. Society's need for minerals

Why does society need marine sand and gravel, what alternatives are available and in what ways can this need be reduced?.

AB. Environmental impact of aggregate extraction

There is widespread public concern about the environmental impact of dredging for marine sand and gravel in the Severn Estuary.

AC. Extent of regulation

Many people are concerned about lack of local involvement and inadequate regulation of marine dredging in the estuary; conversely, the industry perceives excessive regulation compared to other industries.

SPECIFIC ISSUES

AA. Society's need for minerals

Severnside's sand and gravel needs can be met?

AA.1 Need for marine sand and gravel

Marine sand and gravel are used in a wide variety of projects required by society to support economic growth and to maintain the standard of living. Roads, housing, schools, hospitals, sea defences and beach replenishment, and commercial and industrial buildings all depend to varying degrees on the supply of such minerals. Much of the estuary's production is sand, which is essential in making concrete or tarmac. Transport costs and the aim to reduce the need to travel militate against reliance on imports from elsewhere. Severnside should aim to provide for its own needs as far as possible rather than exploit other areas. Over 80% of sand used in South Wales is dredged from the Bristol Channel, and there are few alternative sources presently worked. It is important therefore that an adequate and steady supply of minerals is available for the construction industry. However this need should be balanced against the need to protect the environment.

Possible way ahead : What policies should MPAs and Government adopt to ensure that

AA.2 Alternative sources of sand and gravel

The alternative to dredging sand and gravel from the Bristol Channel is to use land-based sand and gravel. This is usually concentrated in river valleys or along the coastal plains. These areas by their nature are environmentally sensitive and extraction of sand and gravel from them would have a detrimental effect on the landscape and conservation interest of these areas.

Possible way ahead : Should MPAs rule out this source in their Development Plans on environmental grounds?

AA.3 Demand Management

The demand for marine dredged sand and gravel can be reduced in two ways. Firstly by promoting efficient use of materials, minimising wastage and avoiding the use of higher quality materials where lower grade materials will suffice. Secondly by the use of more secondary aggregates and recycled materials wherever possible. It is important that, where they are technically, economically and environmentally acceptable as substitutes, secondary materials

should be used. In keeping with its commitment to sustainable development, the government encourages both these forms of demand management, supports practical measures to promote greater efficiency of use, and is committed to increasing significantly the level of use of secondary materials.

Possible way ahead: This is the preferred option identified by the government on sustainability grounds to reduce the amount of marine sand and gravel extracted. What is your view on this?

AA.4 Economic Impact

At present it is more economically and practically attractive to use natural sources of aggregates than to use secondary materials, since reserves are abundant and access to markets is good with landing facilities and quarries near most urban centres. The government is attempting to shift this economic advantage, for example by introducing the Landfill Tax on 1st October 1996 (which may encourage greater use of secondary materials) and by reducing policy support for the use of marine sand and gravel.

Possible way ahead : Options include :-

1. funding more research into the use of secondary aggregates
 2. encouraging the establishment of more materials recovery facilities
 3. using ever tougher fiscal measures (eg. tax incentives / disincentives).
- Are there any other options?

Environmental impact

AB.1 Coastal erosion, sediment transport, & beach replenishment

There has been considerable concern that marine sand and gravel extraction can lead to increased coastal erosion due to changes in sediment transport patterns and reductions in beach replenishment. This has implications for the conservation of the Severn Estuary SSSI's, SPA, SAC's and Glamorgan Heritage Coast. MPG 6 in England states that proposals to dredge must have full regard to the potential

effects on the coastline and that there will be a presumption against extraction unless the coastal impact issue is satisfactorily resolved. The connection between dredging and coastal erosion has not been proved and research in licensed areas has found that extraction does not affect sediment movement and therefore the coastline. However the cumulative effects of dredging needs investigating and the results of the Bristol Channel Study should aid this.

Proposed way forward : Await results of the government's Bristol Channel Study in 1999.

AB.2 Pollution of Water Environment

Increased turbidity and an increase in suspended solids in the water column will result from dredging and discharge activities. This reduces light penetration through the water column reducing the productivity of plankton and causing damage to fish and invertebrate breathing and feeding apparatus and a reduction in the water aesthetic quality at beaches. Dredging could also result in the resuspension of contaminants locked up in the sediment. In addition fuel driven vessels have the potential to contribute to oil pollution of the marine environment, particularly if an accident occurs. However this effect will be localised and temporary in nature though research could still be undertaken to reduce these temporary effects.

Are the existing standards adequate for the Environment Agency to act upon?

AB.3 Effect on Fisheries & Wildlife

There are a number of impacts to fisheries which may result from aggregate dredging activities. Fish movements may be altered by an increase in turbidity, suspended solids, availability of shellfish, or noise resulting from dredging. More mobile fish species are likely to move away from areas of disturbance unless the local food supply is enhanced due to the resuspension of organic material. This will in turn affect commercial and recreational fishing and related bird life. However given the limited extent of dredging in the estuary any impacts should be minimal.

Do the Ministry of Agriculture, Fisheries & Food and the Environment Agency have sufficient powers to protect fisheries and wildlife from dredging and is existing monitoring adequate?

AB.4 Marine Traffic & Navigation

Obviously marine dredging will slightly increase the amount of shipping in the estuary with resultant implications for water quality. However this should be balanced against the reduced need for road transport of sand and gravel due to the close proximity of landing facilities to markets. In addition, dredging in the vicinity of a major shipping lane could put vessels at risk of collision and cause delays to both shipping and dredging.

: Are existing navigation systems adequate?

AB.5 On-shore Development

On-shore mineral operations and related development such as cement manufacture, power generation and wharfage can have an effect on the estuary through particulate run-off with resultant effects on water quality and marine ecology.

Is on-shore mineral working adequately controlled by MPAs and government?

AB.6 Visual Impact

Shore-line quarries and sand workings can both deny access to the coastline and damage the visual attraction of the coastline. For example, coastal quarrying at Rhose Point has already caused erosion of the coastal footpath, and could lead threaten the integrity of the cliffs at Wales' most southerly point.

Is landscaping and visual impact control by MPAs and government of shore-line mineral workings adequate?

AC Extent of Regulation

AC.1 Public Accountability of Dredging Control

There has been widespread public concern over

the accountability of dredging control. The Crown Estate is both landowner and regulator which leads to a potential conflict of interests. In addition the procedure is not accountable to local public interests, being administered by the Department of Environment or Welsh Office, and suffers from remoteness. As outlined above the government intends reviewing the procedure when parliamentary time allows, though this will still leave control out of local influence; in some areas (eg. Bristol) such control will become more remote than now.

Will the reforms to dredging control proposed by the government lead to a more accountable system?

AC.2 Adequacy of Control & Monitoring Systems

There has also been concern over the adequacy of dredging control and the associated monitoring system. The current system is non-statutory and operates essentially on goodwill. It is extremely slow, operates outside the normal planning system, is not seen to take full account of all environmental issues (though the usual requirements for Environmental Statements apply), and is not consistent throughout all coastal waters. It is certainly not consistent with on-shore control over the same minerals. In addition, monitoring is presently undertaken by the landowner (the Crown Estates) which could lead to conflicts of interest. As outlined above the government intends reviewing the system when parliamentary time allows, though there is little scope for local public involvement.

Will the government's proposed reforms to dredging control go far enough?

AC.3 Over-regulation of Industry

On the other hand, the dredging industry has expressed concern about over-regulation, particularly in the light of the proposed government reforms, and considers the industry suffers more regulation than most industries.

Is marine sand and gravel extraction over-regulated and what effect will the proposed government reforms have on the industry?

11. Water resources

Who does what?

- The Department of the Environment and the Welsh Office are responsible for government policy.
- The Environment Agency is responsible for ensuring the sustainable management of water resources. They licence most impoundments of and abstractions from rivers, watercourses and defined areas of the estuary.
- Harbour authorities, inland drainage boards, water companies, English Nature and the Countryside Council for Wales are consultees on licence applications.

Stated Government aims

To be completed

Background

The major abstractions direct from the estuary are for cooling water for power stations. Water is also abstracted from the Severn Tunnel for industrial use and there is some interest in the development of groundwater resources beneath the estuary. Minor abstractions are also taken for agriculture on the tidal rivers feeding into the Severn. There is a major abstraction the Severn at Gloucester which feeds the Gloucester Sharpness Canal. This water is used for lockage at Sharpness Docks and the majority of the abstraction for the Bristol Water intake at Purton which provides over 50% of Bristol's water in summer months. Both these abstractions can be affected by estuary processes such as salt water intrusion. Major abstractions require the use of pumps and they inevitably draw fish through them. This can be minimised by careful design operation and screening but there is still some impact. The knowledge of fisheries in the estuary has been much improved by analysis of fish from the screens of Berkely Power Station.

Local abstractions may also have an impact on the estuary or the surrounding area. Sediment distribution in local creeks used by yachts may be affected by river control and abstractions in the adjacent wetlands can have an impact on the estuary habitats.

Probably the main impact of water resources management on the estuary, however, concerns flows which are left in the river which pass to the estuary. Table 10.1 below lists the flows below which it is suggested adverse effects may occur for five of the main rivers and the reasons for those flows. The table also relates the flow to the observed flow exceeded for 95% of the time (Q95) and gives an indication of how natural the flow normally is below this critical flows. To avoid additional problems flows in rivers should be as near as possible to natural below these levels. This requires management of releases from support reservoirs such

as on the Wye and Severn or strict control of abstractions. The residual flow to the estuary is calculated from the following:

Residual flow= Natural flow + River Support - Abstracted Water.

Table 10.1: Critical flow levels for the Rivers Severn, Avon Wye, Usk and Parrett.

RIVER	R.F. (MI/d)	Q95 (MI/d)	R.F/Q95	REASON	PRESENT FLOW
Severn	1200 (neaps)	1850	0.62	D	B
	1800 (neaps)		0.97	F,S,ST,Q	B
Avon	120	425	0.28	E,N	C
Wye	1230	900	1.37	F,N,Am	A
Usk	227	540	0.42	F,D.	B
Parrett	218	218	1.0	D,F,S.	B

Key: RF=Residual Flow Q95= Flow exceeded 95% of time.

Reasons for setting residual flow

Am= Amenity

D = Dilution

E = Ecology

F = Fisheries

Q = Quality

S = Saline intrusion

St = Silt/ suspended solids resuspension

Flow factor:

A = Potentially balanced abstraction and releases

B = Flows potentially below natural

C = Flows significantly below natural.

Studies on the required flow to estuaries for environmental reasons suggest that different flows may be needed at different times of year- for example to meet the needs of migratory fish. Different flows may also be needed for spring tides and neap tides- for example to keep saline water away from water supply intakes or to prevent landward movement of marine silt. There is a suggestion for inland rivers to set the critical flow levels as a fraction of the Q95 and this may also be appropriate for residual flows to estuaries.

Water supply.

Water supply in the area is provided by three Regional Water Companies who also provide sewage treatment (Severn Trent Water, Welsh Water and Wessex Water) and Bristol Water who provide the water to Bristol and surrounding area. The water supply areas are shown in Fig 10.1.

As an idea of water useage in the estuary area Bristol Waters figures are the most appropriate and are shown in Table 10.2.

Table 10.2: Use of water in Bristol Supply Area.

To be completed

While leakage rates for Bristol are better than the national average there may be some scope for further reductions. Water companies now have a general duty to promote water conservation and waste management initiatives in Industry should reduce demand. Such reductions could save companies money, reduce energy requirements and leave more water for the environment.

Map 11.1: Major abstractions and water company supply areas

General issues

- XA. Maintenance of environmentally acceptable flows to the estuary
- XB. Effect of abstractions and water resource installations on the ecology of the coastal zone
- XC. Water saving initiatives

XA1. Flows required for migratory fish.

Flow is required to attract salmon to their original breeding river. There is also a flow level required to induce migration. Some studies suggest that flows of nearly twice the dry weather flow may be needed to induce salmon migration. Flows may also be important in the migration of eels and shad.

Who is involved: Environment Agency.

Possible Way Forward : Regulation and abstraction from rivers needs to take the requirements for migratory fish into account. Better understanding of the relationships between flow and fish migration are needed.

XA2. Maintenance of flow to ensure quality.

Studies by Birmingham University and the Environment Agency in the Upper Severn Estuary have shown that water quality is dependent on residual river flow. The extent of sediment resuspension during spring tide bores varies with river flow. As the sediment has an associated oxygen demand this can sometimes put additional stress on migratory fish when river flows are less than their natural level.

Flows to estuaries are also needed to maintain adequate dilution for Sewage Works which are below the tidal limit.

Who is involved: Environment Agency.

Possible way forward: During periods of low flow and high spring tides flows from rivers need to be as near as possible to their natural flow. This may require further control of abstractions or local balancing of flows.

XA3. Maintenance of flow to prevent saline

intrusion.

During low flows and high tides salty water may occasionally penetrate above the British Waterways abstraction point at Gloucester which feeds the Gloucester Sharpness Canal. Water is abstracted in turn from the Canal for Bristol's water supply and can provide more than 50% of the City's needs. Even small amounts of salt can cause problems for water suppliers. The penetration of the saline water is very dependent on the prevailing freshwater flow. The method of pumping during tide at Gloucester is also important. This factor may become more important if sea level rise affects the extent of saline intrusion.

Who is involved:: Environment Agency, British Waterways, Bristol Water.

Possible way forward: British Waterways are investigating new pumps at Gloucester Docks so that enough water can be abstracted during the part of the tide when salt and silt levels are at their lowest. They are also looking at best use of water in the canal. Bristol Water are investigating ways of using less water from the canal during high tide and low flow periods. The Environment Agency are investigating several options to increase flow during high tides and low flows.

XA4. Maintenance of flow to prevent landward movement of sediment and increased sediment resuspension.

When low flows correspond with high tides solids having their origin in the estuary are moved inland. The level of suspended solids in the vicinity of the Gloucester abstraction can also become very high-reaching almost 10 % solids under extreme circumstances. These

problems can be exacerbated by river flows less than would naturally be expected. The landward migration of silt has caused problems for craft trying to navigate between Gloucester and Tewkesbury and also reduces the bottom feeding areas available to fish. There are many other factors which may contribute to this problem such as changes in boat traffic, lack of dredging and weirs. The abstraction of water with a high silt content into the Gloucester Sharpness Canal leads to high dredging costs and environmental concerns in the disposal of dredgings.

Who is involved: Environment Agency, British Waterways.

Possible ways forward: Flows should be maintained as near to the natural level as possible during critical periods. This is unlikely to solve all the problems discussed in this issue and the possibility of an adjustable weir at Gloucester which could exclude some tides is under consideration. Such a weir could also increase flows during spring tides. Bristol Water, Gloucester City Council and Gloucester Harbour Trustees are also involved in these discussions.

XA5 Maintenance of flow to preserve estuarine ecology.

Some species in the estuary rely on the input of fresh water to provide their best habitat. The Baltic Tellin, for example is an important source of food for birds and is noted for adaptation to brackish waters. The effect of river regulation and abstraction on such species in the estuary is not well understood. Lower flows in summer may also mean less nutrient or organic input to the estuary. The effect on the food chain in the estuary again has not been extensively studied.

Who is involved: English Nature, Countryside Council for Wales, Environment Agency.

Possible ways forward: Establish the impacts of abstractions on the ecology of the estuary by use of models.

XB1 The effect of water levels on wetlands.

In the upper Severn Estuary and tidal river there are important wetland areas where level can

influence the drainage pattern and by implication the ecology. There are very few breeding waders in these areas. The effect of level is likely to be less than that of land drainage practices. Level is also more likely to be affected by flood control works and weirs than river regulation and abstraction but these factors have not been fully evaluated.

Who is involved: Environment Agency, Conservation Regulators, Internal Drainage boards

Possible way forward: These issues may be included in Water Level Management plans. Further work may be needed to identify the contribution of each factor to the problem.

XB2 The effect of abstractions on the coastal zone.

Some abstractions take place in levels close to the estuary. One such site is Walmore Common which is a RAMSAR site just below Gloucester. RSPB and English Nature have expressed concern that this abstraction may be contributing to the low groundwater table during the wading bird breeding season. RSPB and the Environment Agency have undertaken groundwater level monitoring to investigate the effects of the abstraction.

Who is involved: Environment Agency, Conservation Regulators, RSPB, Internal Drainage Boards.

Possible way forward: The effects of abstractions on these estuary habitats needs to be carefully considered and monitored. This could be included in Water Level Management Plans.

XB3 The effect of a bankside storage reservoir near Purton on the Gloucester-Sharpness Canal

One option for addressing many of the concerns discussed previously in this Chapter is to consider a bankside storage reservoir near Purton on the Gloucester-Sharpness Canal. This could reduce the requirement for pumping to the Gloucester Sharpness Canal during spring tides and provide additional protection against loss of supply through pollution to Bristol Water. Any

such storage may impact on the feeding grounds for wildfowl or the neighbouring Slimbridge Wildfowl and Wetlands Trust.

Who is involved: Environment Agency, Bristol Water, English Nature, Wildfowl and Wetlands Trust.

Possible way forward: Preliminary discussions have taken place between the Environment Agency and the Wildfowl and Wetlands Trust on this option. Some sites are obviously problematic but there is a possible option which could be beneficial to the Trust. Further discussions on this option should be held.

XB4 The effect of large pumped abstractions on fisheries

Although they are usually screened major abstractions can kill fish that are sucked through pumps or are caught on the screens. This is potentially a larger problem in tidal rivers rather than the more coastal parts of the estuary as a larger proportion of the migratory fish population could be affected. In particular discussions have recently been held with British Waterways in regard to the installation of new pumps at Gloucester.

Who is involved: Major abstractors, Environment Agency

Possible way forward: Abstractions to be designed to minimise impact on fish. Operating agreements may also mitigate the effect.

XC1. Water Saving initiatives round the estuary.

Drought problems have been of significant interest over the last few years. With heavy industry round the estuary there are many significant water users. Controlling water use can save companies money. It can also reduce energy requirements so reducing atmospheric discharges of gases which contribute to global warming. Reduction in water requirement also leaves more water in rivers-ultimately affecting the residual flow to the estuary!

Who is involved: Water Companies, Large Industrial Water Users, Environment Agency.

Possible way forward. Waste management schemes are being considered or are already in progress round the estuary (eg the Sabina project). Water demand management needs to be an integral part of these schemes.

12. Fisheries and angling

Who does what ?

- The Ministry of Agriculture, Fisheries and Food (MAFF) and the Welsh Office (WO) are responsible for the conservation of fish stocks and the management of marine fisheries in UK waters.
- Sea Fisheries Authorities regulate sea fisheries in the estuary. These are usually Sea Fisheries Committees (SFCs), but in areas where there is no SFC the Environment Agency may act as the Sea Fisheries Authority.
- Sea Fisheries Authorities can establish byelaws for fisheries management and general protection of the marine environment. Byelaws must be confirmed by MAFF and the Welsh Office as appropriate.
- The Environment Agency is responsible for regulating salmon and sea trout fisheries in the estuary.

Stated Government aims

- To conserve and manage fish stocks.
- To promote a safe and efficient fishing industry whose capacity and effort are in line with what stocks will bear.
- To ensure that fisheries management takes proper account of the impact of fishing on the marine environment, and preserves its biodiversity.

Background

There are many species of fish in the estuary including marine estuarine, freshwater and migratory species. The two most important species are eels and salmon. Young eels (elvers) inundate the estuary each spring from the Sargasso Sea. All rivers draining into the estuary have good eel populations. Many thousands of salmon pass through the estuary each year to spawning grounds in the Severn, Wye and Usk. Large numbers of salmon on their way to these rivers are also attracted into Bridgwater Bay, the Bristol Avon estuary and a few go up rivers such as the Parrett, the Bristol Avon and Taff.

The estuary and its tributaries the rivers Usk, Wye and Severn are important conservation areas for two species of shad which are nationally rare: the twaite shad and allis shad. Allis shad are protected by law.

There are also many marine species which depend on the estuary, mainly as a nursery area. The

most common are: sand gobies, whiting, flounder, sole, bass, sea snail, cod, poor cod, thin-lipped grey mullet, herring, sprat and bib.

The main fisheries areas are shown on Map 12.1

Angling

Anglers fish from the shore and from boats within the estuary. There is shore fishing for a variety of species including cod, whiting and bass along most of the coast and there are several sea angling clubs. Angling from boats is very popular in the estuary with privately owned boats and charter boats operating from many of the ports and harbours from Barry around to Minehead.

Salmon

There is a very important and productive commercial salmon fishery operating off the Welsh coast. Whilst salmon is by far the most common species caught, a small number of sea trout are also taken.

Salmon are caught using drift nets, fixed engines (putts and putchers), hand held lade nets and occasionally using dip nets. The areas where these techniques are mainly used are shown on Map 12.1. There are 8 licensed boats using drift nets. These operate from Newport and fish up to ten miles upstream and downstream, and within two miles of the coast. There are also ** fixed engines in the estuary, though this technique appears to have declined in recent years.

There has been a long-term decline in the number of salmon caught in the rivers Severn, Wye and Usk. The proportion of spring salmon in the catch has also declined - a phenomenon which has been observed throughout the North Atlantic range of the salmon. Spring salmon are Atlantic salmon which return to freshwater in the spring before 1st May, having spent two or more winters at sea. Spring salmon are generally the larger sized fish in the population and are the same species as the later migrating Atlantic salmon grilse, but are particularly highly prized by anglers. Conversely, populations of salmon in some of the South Wales rivers, notably the Taff, Rhymney and Ebbw, have been increasing over the past 15 years due to the decline in heavy industry and associated pollution. The factors that have caused the decline of the spring salmon are complex but they include effects acting on all life-stages of the fish including environmental conditions and over-exploitation in home waters and distant water fisheries.

Distant water fisheries are outside the UK's jurisdiction. However, where over-exploitation within the estuary can be demonstrated the Environment agency will introduce byelaws to limit fishing effort. The Environment Agency can only introduce measures to control exploitation for conservation reasons or to protect individual fish stocks.

Within the estuary, tagging studies have shown that some of the salmon caught in the commercial fishery are from mixed stocks ie. destined for more than one river. The Environment Agency policy is that exploitation of salmon should take place, as far as possible, where the stock of salmon is from a single river. Where a fishery can be shown to be predominantly mixed stocks, fishing will be phased out over an appropriate timescale.

Whitefish

In the lower parts of the estuary, there is a little commercial fishing for white sea fish. This includes some trawling and the use of beach nets for cod, whiting, bass, sole, plaice and mullet.

Eels and elvers

There are established elver fisheries on the rivers Parrett, Severn, Wye, and Usk. In the spring large numbers of elvers ascend the Severn and its tributaries which are fished for commercially by individuals using licensed hand nets. Silver eels are caught commercially in the River Severn in the Gloucester area. Yellow eels are caught in the River Severn and other tributary rivers using fyke nets and putcheons.

The European eel has a life strategy opposite to the salmon, whereby its spawns in the marine environment and then the young develop and mature in freshwater. Elver catches in the rivers of the estuary have declined as they have throughout Europe. This is thought to be caused by factors such as changes in oceanic currents in the Atlantic. Such global factors are clearly beyond the control of the Environment Agency. It appears from research work that there are still more than enough elvers arriving in the estuary to fully populate the upper river system and the tributaries of the estuary. Indeed in some of the catchments, eel stocks have improved due to restocking programmes. The Environment Agency has and will continue to install eel and elver passes to facilitate easy upstream movement where it is considered necessary to increase dispersal and enhance stocks of adult eels.

Shellfish

There are no designated shell fisheries within the estuary though there is a small commercial brown shrimp fishery in the estuary downstream of Lydney in late autumn.

Map 12.1: Main fisheries and administration areas

General issues

FA. Fisheries management

The fisheries of the estuary are an important resource for local communities and the wider economy. The management of the fisheries is therefore important to ensure sustainable exploitation and protection of the environment.

FB. Effects of fishing on other users and resources

Some fishing activity, both recreational and commercial affects other users of the estuary. In particular there is conflict in some places between anglers and conservationists and with recreational users.

FC. Access for anglers

Some anglers believe that they do not have adequate access to the shore to fish. Sometimes this access is blocked by physical obstructions such as flood defences and sometimes by landowners withholding consent.

FA1 Decline of salmon catches

There has been a long-term decline in the number of salmon caught in the rivers Severn Wye and Usk. The proportion of spring salmon in the catch has also declined. These declines have been observed throughout the North Atlantic range of the salmon.

Who is involved: Environment Agency

Possible way forward: The factors that have caused the decline in spring salmon are complex but they include effects acting on all life-stages of the fish including home waters and distant water fisheries. the Environment Agency can introduce byelaws to further control salmon fishing in the estuary.

FA2 Phasing out of mixed stock salmon fisheries

The salmon in the lower part of the estuary, where the main commercial salmon fishing takes place, are destined for more than one river. Exploitation of such mixed stock fisheries can adversely affect stocks in some of the rivers.

Who is involved: Environment Agency

Possible way forward: The Environment

Agency wishes to phase out the exploitation of such fisheries and therefore commercial fishing in the lower parts of the estuary.

FA3 Complexity of fisheries regulation

The management of fisheries in the estuary is the responsibility of the South Wales Sea Fisheries committee and three Regions of the Environment Agency. Each authority operates different byelaws.

Who is involved: Environment Agency and South Wales Sea Fisheries Committee.

Possible way forward: Regulatory authorities could harmonise fisheries byelaws.

FA4 Eel and elver catch returns from fishermen

The Environment Agency requires fishermen to return information about their catches. However, some of this data is not very accurate and there is some illegal fishing for elvers. The management of the fishery could be improved if the accuracy of the catch information could be improved.

Who is involved: Environment Agency.

Possible way forward: Environment Agency should investigate ways of improving the accuracy of the data.

Who is involved: Angling groups, landowners and the Environment Agency.

Possible way forward: These groups could get together to identify problem areas and ways of resolving the conflicts.

FA5 Future of heritage fisheries

Some of the salmon fishing techniques, such as using withy putchers, have been used in the estuary for centuries and have a cultural significance. Fewer people now use these techniques, in part because their financial viability is declining. The value of their catches has declined because of large scale salmon farming reducing the price of salmon. The cost of licences to fish salmon have risen.

Who is involved:

Possible way forward: Explore ways to ensure that the historic putchers and other heritage fisheries are not lost. This may require licence fees to be reduced or grants to be found from other sources such as those with a responsibility for cultural heritage.

FB1 The effects of fishing on other users of the estuary.

Some fishing activity, both recreational and commercial affects other users of the estuary. In particular there is conflict in some places between anglers and conservationists and with recreational users. For example bait digging is a concern in some areas.

Who is involved: Environment Agency and user groups.

Possible way forward: The Environment Agency can act as a mediator between the various user groups who use the estuary to promote mutual understanding and resolve conflicts.

FC1 Access to the shore for anglers

Some anglers believe that they do not have adequate access to the shore to fish. Sometimes this access is blocked by physical obstructions such as flood defences and sometimes by landowners withholding consent.

13 Landscape

Who does what?

- The Department of the Environment and the Welsh Office are responsible for government policy, guidance and funding.
- The Countryside Commission and the Countryside Council for Wales are responsible for advising the Government on landscape issues. They promote landscape conservation and identify areas for designation as National Parks, Areas of Outstanding Natural Beauty and Heritage Coasts.
- Local planning authorities prepare development plans which include policies to protect landscape.
- Local authorities also prepare management plans particularly covering national Parks, Areas of Outstanding Natural Beauty and Heritage Coasts.
- The Ministry of Defence is developing conservation management plans covering areas of Heritage Coast in its ownership.
- The Environment Agency has a duty to have regard to conservation in its water management activities.

Stated Government aims

- Protection and enhancement of the natural beauty and amenity of the coastline.

Background

The Severn Estuary is characterised by typical expansive flood plain landscape. Despite the major conurbations of Cardiff and Newport and several smaller urban areas, the northern coastline is of considerable landscape interest. There are many notable landscapes within the estuary, the coastal zone between Aberthaw and Penarth, Glamorgan Heritage Coast and the Quantock and Mendip Hills AONB. The landscape quality in general is notable and is reflected by the popularity of the Welsh and Somerset coasts as tourist and recreational areas. The main landscape character areas are shown on Map 131.

Further upstream on the west bank, the coastal lowlands are bordered by the Forest of Dean, a visually significant backdrop of mixed and broadleaved woodland lying within the Wye Area of Outstanding Natural Beauty. Narrow and fast flowing watercourses cut their way through tree-lined channels across the largely pastoral floodplain to join the estuary.

Map 13.1: Main landscape character areas and designations

The southern shore of the estuary is dominated by views of Exmoor, the Quantock and the Mendip Hills which form a dramatic visual backdrop to the low lying area of the Somerset Levels and Moors. The high land is open and windswept, with steep valleys draining down from open heathland onto the coastal levels and so to the sea. At the western end of the ridge lies Brean Down and Sand Point/Middle Hope, important outcrops of limestone jutting out into the sea. Special Landscape Areas designated in Local Plans include the West Somerset Coast, Brent Knoll and much of the North Somerset coast.

The natural coastal landscape in this area is fragmented by man made structures, such as Hinkley Point Nuclear Power Station and urban developments such as Minehead and Weston-super-Mare. Holiday camps and caravan sites reduce its natural character. Recent industrial development at Portbury Dock and at Avonmouth is on a massive scale and has a significant impact on the landscape of the Lower Gordano Valley and the estuary around Avonmouth.

Upstream of the Second Crossing, the floodplain is variable in form and width, but is characterised as elsewhere on the estuary by a grid of rhines and ditches. Many have become straightened by constant and enthusiastic maintenance. Vertical emphasis is given by the hedgerows and pollarded willows which are typical of the flood plain landscape. Upstream of the Second Crossing, the landscape is rural and agricultural, with the exception of the settlements of Lydney, and the structures of Sharpness and Berkeley Power Station. It is predominantly pastoral, but with many remnants of old orchard systems.

Nearer to the channel, the floodplain is occupied by washland grazing and both high and low level saltmarsh which is eroding rapidly in places such as Hock Ditch and expanding rapidly in others. The extensive mudflats are typical of the estuarine landscape and at low tide, these are punctuated by rock outcrops such as English Stones, Sand Point, Middle Hope and the Islands of Steep Holm and Flat Holm.

The estuary is open and windswept and has few substantial areas of marginal vegetation such as reedbed; the currents are hazardous and the tides strong often making the river a wild and muddy torrent, eddying and swirling around the sandbanks which are constantly changing in shape.

Specific Issues

L1 Impact of development on landscape character

Many people value the natural, wilderness feel of the estuary. There is widespread public concern that development in and around the estuary is adversely affecting the character of the estuary. The open flat character of the estuary means that some large developments are visible for long distances. At a smaller scale the materials used for buildings and landscaping are sometimes inappropriate to the landscape character of their setting.

Who is involved: Planning authorities and developers.

Possible way forward: More consideration should be given to the effect of development on the landscape character of the estuary. This should include consideration of location, design and materials.

L2 The adverse impact of flood defences on the landscape of the estuary

The construction and upgrading of flood defences can affect the landscape of the estuary. At the local level they can lead to the loss of gardens, natural vegetation, access to the shore and views of the estuary. At a larger scale they can intrude into the perceived naturalness of the estuary and they influence use of adjoining land.

Who is involved: Environment Agency

Possible way forward: The Environment Agency should ensure that landscape assessment is part of the early design of all sea defence schemes to minimise the negative effects and maximise the positive effects on the landscape of the estuary.

L3 Impact of river bank protection on landscape character

In the upper estuary the Environment Agency reinforces the river banks to prevent erosion, using such materials as stones, gabions and sheet piling. There is some public concern that the materials used for this are sometimes inappropriate and spoil the landscape character of the river.

Who is involved: Environment Agency

Possible way forward: The Environment Agency should ensure that where bank protection is necessary the materials used are appropriate to the landscape character of the river.

L4 Effect of farming on the landscape

The landscape of much of the estuary is the product of centuries of human activities; particularly farming. Some of these landscapes are now valued highly but are under threat from changing farming practices. There are already some initiatives to encourage farmers to manage their land to protect and improve landscape character.

Who is involved: Countryside Commission, MAFF and farmers.

Possible way forward: Farmers could be further encouraged to manage their land to protect and improve landscape character.

14. Nature conservation and wildlife

Who does what?

- The Department of the Environment and the Welsh Office are government policy, guidance and funding. Specifically they are responsible for:
 - fulfilling the Government's objectives and policies for nature conservation; and
 - ensuring that its obligations under international conventions and European and national law are met.
- English Nature and the Countryside Council for Wales, are responsible for advising Government on nature conservation matters, identifying and notifying Sites of Special Scientific Interest (SSSIs) and sites meeting criteria for international designations.
- The Environment Agency has a duty to promote conservation through its water management activities and to have regard to conservation in its pollution control activities.
- Local authorities play an important role through statutory development plans and control of development, producing countryside management plans and undertaking direct management of some local nature reserves.

Stated Government aims

- To assist in the conservation and enhancement of the abundance and diversity of wildlife and habitats.
- Where conflict of interest is unavoidable and irreconcilable, to minimise the adverse effects on wildlife.
- To meet international responsibilities and obligation for nature conservation.

Background

The estuary is an internationally important conservation area. This value has been recognised by the UK government, the European Union and the international community.

The estuary is one of the largest estuaries in Britain with an extremely large tidal range which, combined with its funnel shape, creates a unique, highly dynamic environment. It supports a range of distinctive aquatic communities. These include the most extensive subtidal reefs of the

tube-building worm *Sabellaria alveolata* in Britain. There are also many worms, snails and crustaceans buried in the broad inter-tidal flats of mud and sand some of which are rare. These provide food for the many migratory waterfowl that visit in winter. The estuary supports eleven overwintering waterfowl species of national importance and six species of international importance; dunlin, Bewick's swan, European white-fronted goose, shelduck, gadwall and redshank. Total numbers are in the region of 70-80,000 birds. It is also nationally important for several species of passage migrants in the spring and autumn, including ringed plover and whimbrel. These birds are very sensitive to disturbance.

Saltmarsh is a significant and threatened habitat of the estuary's fringes. There are many types with both gradual and stepped transitions from bare mud to upper saltmarsh. They are threatened by erosion and their plant communities are significantly affected by the levels of grazing by sheep or cattle. Several nationally rare or notable species are present. Common cord grass (*Spartina anglica*) is abundant on the seaward fringes of the marshes, where it occurs as dense monocultures.

Other habitats around the estuary include sand dunes, downs, cliffs, shingle ridges, reedbeds, saline lagoons, freshwater and the low-lying pasture around Slimbridge and on the Somerset and Gwent levels. The Gwent Levels are the result of land-claim and form an extensive area of wet pasture drained by a network of ditches and the continued management of them is vital for maintaining their conservation interest. Many of these habitats support rare and notable species. There are extensive sea defence works, often earth embankments, and these too support some notable plants.

In addition, the estuary supports over 80 species of fish which is more than any other British estuary. They include 7 migratory species such as salmon and eels and the rare allis and twaite shads and the sea and river lampreys. Otters appear to use of the edge of the estuary to move between inland rivers.

Due to its configuration the estuary carries vast quantities of suspended sediment which is added to by disturbance by man's activities. Research is continuing into the movements of sediments in the estuary.

Conservation designations

The estuary is a nationally important conservation area. As Map 14.1 shows, much of it is covered by three large Sites of Special Scientific Interest; the Upper Severn SSSI, the Severn Estuary SSSI and Bridgwater Bay SSSI National Nature Reserve. These sites include only those areas above Mean Low Water. Also within the estuary, are the three island SSSIs of Sully, Flat Holm and Steep Holm. These sites are of geological and geomorphological, as well as biological interest.

These National designations have been incorporated into two International designations which emphasises the estuary's importance:

- The Severn Estuary Special Protection Area (SPA)
- Wetland of International Importance (Ramsar Site).

The former was designated under the EC Directive on the Conservation of Wild Birds on the basis of the estuary's overwintering bird population. The latter designation, under the terms of the Ramsar Convention, is based on the estuary's physical features, unusual estuarine communities, migratory fish and bird populations.

A slightly larger area, including the subtidal zone, is currently a possible Special Area of Conservation (SAC) under the EC Habitat Directive on the grounds of its subtidal sandbanks, intertidal flats, saltmarsh and range of habitats. These designations serve to emphasise the national and international importance of the estuary as a whole. ** more.

In addition to the above, the estuary includes 38 other SSSIs, 2 National Nature Reserves, 18 Local or County Trust Reserves, a Wildfowl and Wetlands Trust Reserve and many other sites of importance.

Map 14.1: Designated conservation areas

General issues

NA. The effect of development and other uses on wildlife

There is widespread public concern that development and other uses of the estuary is having an adverse impact upon the wildlife and nature conservation value of the estuary. In particular, there is concern about industrial and housing development, coastal defences, pollution and recreation.

NB. The impact of nature conservation designation on other uses

To protect wildlife habitats some uses of the estuary are restricted. There is particular concern that the proposed Special Area of Conservation will severely restrict economic activity such as shipping and the development of ports.

NC. Funding of conservation initiatives

Conservationists are concerned that initiatives to encourage nature conservation are not properly funded. These include habitat management schemes for agricultural land and measures to manage nature reserves.

ND. Management of wildlife habitats

Some of the important wildlife habitats in the estuary have been created by man and are artificially maintained. The management of these areas needs to consider their nature conservation value.

Specific issues

NA1. The loss and deterioration of wildlife habitats and diversity of wildlife

There has been a net loss of wildlife habitats and in the diversity of wildlife - biodiversity. The causes are many and include urban development, changing agricultural practices, and pollution. Nature reserves protect some habitats and species but they do not provide the protection to the wider environment which some people believe is necessary.

Who is involved: Planning authorities, developers, Environment Agency, English Nature, Countryside Council for Wales, voluntary conservation organisations, farmers, MAFF, FWAG, ADAS and others.

Possible way forward: Take a holistic view of nature conservation as part of the wider

environment. Specific issues deal with details.

NA2. The impact of development on areas of nature conservation value.

There is widespread public concern that development is having an adverse impact upon the wildlife and nature conservation value of the estuary. In particular there is concern that the value of wildlife habitat, particularly areas designated as important for nature conservation, is not given sufficient weight in decisions about development.

Who is involved: Planning authorities, developers and nature conservation organisations.

Possible way forward: Planning authorities, developers and nature conservation

organisations should carefully consider how the effects on wildlife and nature conservation value are taken into account in decisions about development. In particular they should consider what information is needed for this. They should explain to the public why decisions about development are made, the valuations placed on nature conservation and the predicted effects of developments on wildlife and nature conservation value.

NA3 Public concern about the effects of sea defences on nature conservation.

There is widespread public concern that sea defences unnecessarily damage or change wildlife habitats and affect nature conservation value. The Environment Agency maintains and improves sea defences. They consult statutory organisations, voluntary nature conservation groups and landowners.

Who is involved: Environment Agency

Possible way forward: Improve consultation with the public about sea defence schemes. Explain the aim of the defences, the benefits, the impacts on nature conservation and the reasons for the choice of design.

NA5 Public concern about the effects of coast protection on nature conservation.

There is widespread public concern that coast protection measures unnecessarily damage or change wildlife habitats and affect nature conservation value. Local authorities maintain and improve coast protection. They consult statutory organisations, voluntary nature conservation groups and landowners.

Who is involved: Local authorities

Possible way forward: Improve consultation with the public about sea defence schemes. Explain the aim of the protection, the benefits, the impacts on nature conservation and the reasons for the choice of design.

NA6 Minimising the negative effects of sea defences on nature conservation.

Sea defences need to be improved to respond to changes such as rising sea level and development in areas at risk from flooding. This work can affect wildlife habitats, both for the better and for the worse. The Environment Agency already undertakes environmental assessment of all its operations before it undertakes work and designs mitigation measures to reduce the environmental impact. If a significant effect cannot be avoided then the Environment Agency undertakes a public environmental impact assessment.

Who is involved: Environment Agency

Possible way forward: The Environment Agency should consider whether its current procedures are adequate and if appropriate develop new procedures to minimise the negative effects and maximise the positive effects on nature conservation.

NA7 Minimising the negative effects of coast protection on nature conservation.

Coast protection needs to be improved to respond to changes such as rising sea level and development in areas at risk from erosion. This work can affect wildlife habitats, both for the better and for the worse. Local authorities already undertake environmental assessment as part of the design of schemes.....

Who is involved: Local authorities.

Possible way forward: Local authorities should ensure that environmental assessment is part of the early design of all sea defence schemes to minimise the negative effects and maximise the positive effects on nature conservation.

NA8 Recreational users can disturb wildlife.

Some of the estuary's wildlife, such as its internationally important bird populations, are very sensitive to disturbance by people and small boats. In parts of the estuary recreational use can significantly affect wildlife and the estuary's nature conservation value.

Who is involved: Local authorities and the Environment Agency

Possible way forward: Identify the wildlife's sensitivity to disturbance in each part of the estuary. Encourage recreation in the less sensitive areas and prevent it in the most sensitive areas.

NA9 Concern about the effects of dredging on wildlife.

There is widespread concern that dredging for aggregates and to maintain navigation channels adversely affects wildlife. The extent of the impacts is not properly understood.

Who is involved: MAFF and those who dredge for aggregates and navigation.

Possible way forward: Investigate further the potential impacts on the estuary of dredging.

NA10 Public concern about the effects of pollution on wildlife.

NB1. Concern about the effect of the pSAC on other activities

There is concern that the proposed Special Area of Conservation will severely restrict other activities in the estuary. In particular, port development, shipping, recreation and flood defence.

Who is involved: English Nature and the Countryside Council for Wales

Possible way forward: Conservation agencies and users of the estuary need to develop a common understanding of the implications of the SAC for activities in the estuary.

NC1 Lack of funding for conservation initiatives

Conservationists are concerned that initiatives to

encourage nature conservation are not properly funded. These include habitat management schemes for agricultural land and measures to manage nature reserves.

Who is involved: DoE, MAFF, English Nature and the Countryside Council for Wales.

Possible way forward: Funding departments and conservation organisations should consider whether the initiatives are adequately funded and if necessary how additional funds can be secured.

ND1. Water level management of wildlife habitats.

Possible way forward: Develop Water Level Management Plans for all water dependant SSSIs where the water level can be controlled. Similar plans could be developed for other wildlife areas not designated as SSSIs.

ND2. Management of agricultural grazing of man-made wildlife habitats.

The estuary supports many small areas of saltmarsh. Usually these are limited to a narrow strip between the mean high water mark and sea defences. They form an important part of the estuary's nature conservation value and also contribute to coastal defence. Grazing is important in maintaining their conservation value, but too much grazing damages that value and can lead to increased erosion.

Possible way forward: Identify the appropriate grazing for each area of saltmarsh and investigate how that can be achieved. Consider the role of initiatives to encourage farmers to maintain the appropriate grazing regimes with financial incentives.

15. Archaeology and the historic environment

Who does what?

- The Department of National Heritage and the Welsh Office are responsible for:
 - Below high water mark, the Protection of Wrecks Act 1973, including licensing diving on sites.
 - Above low water mark:
 - maintaining and updating the schedule of Ancient Monuments and deciding applications for Scheduled Monument Consent;
 - listed buildings of special architectural interest.
- English Heritage and CADW advise the Government, local planning authorities and others about the protection of the historic environment on land. They also designate Scheduled Ancient Monuments and Listed Building and Listed Parks and Gardens.
- Local planning authorities are responsible for deciding most listed building consent applications.
- The Environment Agency has a duty to promote conservation of features of archaeological, historical, engineering and architectural interest.

Stated Government aims

- To identify and protect nationally significant aspects of the historic environment, on land and sea, and to increase access to them.

Background

The Severn Estuary is well known for the wealth of features of archaeological importance and historic interest. Its archaeological potential is not fully illustrated by the number of nationally designated Scheduled Ancient Monuments or sites recorded in Regional Sites and Monuments Records, as many sites which await discovery are sealed within the accumulation of marine sediments and peats which make up the Severn Levels.

Archaeological evidence recovered from the intertidal zone points to the full potential of the area, with finds reflecting the presence of settlement sites; fords, ports and landing places; fish weirs and traps, derelict drainage systems, wooden trackways, sea defence embankments and of

course ancient boats.

Palaeolithic handaxes and Mesolithic footprints and stone tool scatters recovered from the foreshore indicate the presence of hunter-gatherer groups before the introduction of farming. Later prehistoric sites include the Bronze Age settlement at Brean Down, roundhouses recorded on intertidal peats off the Gwent Levels, and a deeply buried site at Caldicot where relict silted river channels contained the remains of fords, fish traps, bridges and boats. A concentration of rectangular buildings connected by a system of trackways recently excavated in the intertidal area near Goldcliff and dating to the Iron Age are unique.

Roman exploitation of the estuary saw the first systematic attempt to manage the estuary through the construction of drainage systems and seabanks along the left bank of the estuary in Gloucestershire, in the North Somerset Levels and on the Wentlooge Levels. Much of the evidence for coastal settlement has been lost through erosion by the sea but artefacts and environmental evidence point to: widespread trade in iron ore, from the Forest of Dean; trade in pottery, from south-east Dorset; and agricultural activity including the production of cereals on the coastal plain. The recent discovery of a near-complete boat at Barland's Farm may indicate the kind of craft which worked the estuary at this time.

During the centuries after the end of Roman rule, sea defences around many of the Severn Levels broke down. The recolonisation of the wetlands began in Somerset in the Saxon period, but later on the Gwent Levels, probably from the eleventh to thirteenth centuries. The complex systems of land division, characterised by open drainage ditches developed behind new seabanks. These sea banks were set back in the fourteenth centuries in response to increased storminess which led to considerable coastal erosion. The present landscape of the Severn Levels owes its origins to the medieval period and reflect the efforts of successive generations of farmers to manage and exploit the coastal margins of the estuary.

The estuary forming such easy access point deep into the western half of the British Isles require strategic defences during times of war. Most notable of those features date from both the Napoleonic and 2nd World Wars with fortified defences on both Flat Holm and Steep Holm and most promontories in the lower estuary.

It must be stressed that whilst many sites of archaeological important and historic interest are known and recorded it is likely that other sites remain undiscovered.

Map 15.1: Scheduled Ancient Monuments

Specific issues

H1 The threat to archaeological sites from development on the levels.

Increased development on the levels is threatening the archaeological resource. For example, the proposed Severnside International Airport will develop the intertidal zone between Goldcliff Pill and the area just south of the Gwent Levels and will thus destroy important archaeological sites at Goldcliff, Redcliff, Cold Harbour Pill, Magor Pill and Chapel Trump. Also in the area affected are the findspots of a Bronze Age spearhead and a palstave from Porton Grounds and a Neolithic axe from Magor. Future development sites where there would be a potential conflict with archaeological resource include those areas facilitated by the Second Severn Crossing, eg. Caldicot and Rogiet.

It is interesting to note, however that many important archaeological finds only come to light because of routine assessments undertaken prior to development. The Gwent Europark steelworks is an example which produced the Barland's Farm Boat.

Who is involved: Planning authorities and developers.

Possible ways forward:

H2 Damage to archaeological remains by erosion.

The rise in sea level and thus the consequent increase in erosion is revealing a suite of archaeological sites. Erosion in the last couple of years has revealed three new bronze age sites in the intertidal zone at Rhunney Great Wharf yielding cobbles, pottery fragments, animals bones and teeth and charcoal fragments. Exposed sites are particularly vulnerable to damage from human activities such as development and natural processes such as waves.

Who is involved: Planning authorities and developers.

Possible ways forward: Additional recording of sites as they are exposed and before they erode away forever.

H3 Effects of water level changes on archaeological remains

Saturated soil and peat tends to preserve archaeological remains better than dry soils because the water prevents the normal processes of aerobic decay which degrade the organic parts. Water abstraction and drainage can affect the water table and hence the preservation of archaeological remains.

Who is involved: Environment Agency, local authorities, internal drainage boards, landowners

Possible ways forward:

H4 Inadequate information about and awareness of the archaeology of the estuary.

The estuary contains a wealth of archaeological remains but only a relatively small part of it has been properly surveyed. The distribution of sites recorded in regional Sites and Monuments Records and/or protected as Scheduled Ancient Monuments does not reflect the true density of sites sealed in the levels. Without a good knowledge of the resource it is difficult to protect it on a strategic rather than site by site basis. Information about the intertidal area is particularly scarce although some work has been done, such as the Severn Estuary Intertidal Peat Survey being carried out along a 25km stretch of estuary between Cardiff and the Second Severn Crossing.

Many users of the estuary are therefore unaware of the importance of the archaeology of the estuary and this leads to accidental damage.

Who is involved: Local authorities, English Heritage.

Possible ways forward: Undertake more surveys of the estuary as a whole and of the inter-tidal area in particular. Make this

information widely available to decision makers and users of the estuary.

Possible ways forward:

H5 Potential effects of sea defence works on undiscovered archaeological sites

There is concern amongst archaeologists that flood defence schemes could damage semi-exposed or near surface archaeological sites. Particular concerns relate to the sea defence improvement scheme between Newport and Chepstow due to be completed within the next three years. There is may also be a small amount of damage associated with construction vehicles and equipment.

Who is involved: Local authorities, English Heritage, Environment Agency.

Possible ways forward:

H6 The maintenance of historic ports

There are concerns amongst archaeologists historic ports such as Watchet, Portishead and Lydney are declining and their historic value being lost.

Who is involved: Local authorities, English Heritage, Environment Agency.

Possible ways forward: Investigate ways to ensure the maintenance of the ports.

H8 Protecting the historic landscape of the Severn Levels

The present landscape of the Severn Levels reflects centuries of management of the area by successive generations of farmers. So, in addition to being highly valued as an attractive area, the landscape character and its component features are part of the archaeological resource. Alterations to this system of land and water management and sea defence have archaeological impacts which need to be addressed and assessed.

Who is involved: Environment Agency, landowners, English Heritage.