Environment Agency

managing flood risk

Parrett
Catchment Flood Management Plan

Consultation Draft (v5)
(March 2008)

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Contact details

The Parrett CFMP will be reviewed within the next 5 to 6 years. Any comments collated during this period will be considered at the time of review.

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Foreword

Parrett DRAFT Catchment Flood Management Plan

I am pleased to introduce the draft Parrett Catchment Flood Management Plan (CFMP). Flooding is a natural process; however it can pose a serious risk to human lives and uses of the floodplain. This CFMP contains policies that will lead to sustainable flood risk management in the catchment over the next 50 to 100 years. Flood risk has to be managed in a sustainable way in order to cope with future changes and therefore provide long term benefits.

There are many factors within a catchment that affect flood risk. This CFMP assesses these factors and identifies those that will have the greatest impact on flood risk now and in the future. Within the Parrett catchment climate change and land use changes are the key drivers behind increased future flood risk to the catchment. The policies that have been chosen reflect the likely impact of these changes to flooding in the catchment and managing the increased risks.

The CFMP policies will steer our future investment in flood risk management and therefore the policies have implications for other land use policy makers and planners. We want our public and private partners to use the information and policies in the CFMP in their decision making, especially as guidance for the planning of land use.

We have developed a set of actions to implement the policies. The policies and actions were agreed following consultation with partner organisations in the catchment and public consultation. In some cases, we are not the body responsible for delivering the actions. Some of the actions are short term and others will be delivered throughout the lifetime of the Plan, depending on budgets that are available.

The CFMP will be a 'living document' that develops as we understand more about flood risk. There will be a formal review after five or six years or when there are significant changes in flood risk.

If you would like more information on flood risk, please refer to our website www.environment-agency.gov.uk . If you would like to discuss any issues from the CFMP please contact Ken Tatem at ken.tatem@environment-agency.gov.uk

Richard Symonds North Wessex Area Flood Risk Manager

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Appendices

The following appendices provide supporting information for this draft CFMP:

Appendix A – Responsibility for flood risk management
Appendix B – Environmental report and policy appraisal tables
Appendix C – Review of consultation responses (to be completed after completion of public consultation)

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Executive summary

Welcome to the Parrett Catchment Flood Management Plan (CFMP). This document gives an overview of the flood risk in the Parrett catchment and sets out our plan for its sustainable flood risk management over the next 100 years.

We aim to ensure that all policies and plans that affect land use planning, rural development, agriculture, transport, recreation, nature conservation and the historic environment take into account flood risk. This document provides key information to support this aim.

It is vital that all our partners and the community support the CFMP policies. We need people from different organisations to contribute to the plan, such as: planners; environmental groups; farmers; local communities; drainage engineers; transport planners; emergency services and many others. So far, we have received wide-ranging contributions from all of these groups. We trust that this interest and support will continue.

Catchment overview

The rivers and streams flow from their source in the hills in the southwest and east of the catchment; they flow in a north and westerly direction down into an extensive lowland floodplain, before flowing out into the Bristol Channel through the Parrett Estuary. Watercourses are typically steep, narrow and unconstrained in the uplands; while further downstream they are slower moving and more heavily constrained by flood embankments, particularly through the low-lying, flat floodplain characteristic of the Somerset Levels and Moors. Key communities include Taunton, Bridgwater and Yeovil. Many of the key environmental features are within the Somerset Levels and Moors which rely on effective water management.

Current flood risks and management

Many areas in the CFMP flood regularly but without significant risk to life or property. In fact high water tables and frequent small scale flooding of the low-lying areas in the CFMP are important features, as these features benefit the local ecology, agriculture and archaeology. There are, however, a number of places where flooding from rivers is a problem, particularly where it affects large populations, such as in Taunton and Bridgwater. Surface water flooding is also a problem in the catchment; often caused by runoff from agricultural land, and exacerbated when the capacity of drainage systems is too small or when blockages occur. This flood problem is particularly evident further up the catchment, in towns such as Yeovil and also in parts of the catchment that are particularly vulnerable to soil erosion during heavy rainfall.

We currently use a combination of different approaches to manage flood risk. We have a flood mapping programme which aims to improve the understanding of flood risks within the catchment. We provide flood warnings for the main areas at risk of flooding. There has also been considerable investment in river defences, particularly within the lowlands. These works include flood defence embankments and pumping stations.

Using our broad scale catchment model, we currently estimate that the number of residential properties at risk from a one per cent Annual Exceedance Probability (AEP) event is 3300 with economic damages estimated to be around £150 million. Annual average damages are estimated at £7 million.

Future changes

As the catchment changes in the future there are various factors that will impact on flood risk. We have looked at changes that are likely to occur in the Parrett catchment and our studies have shown that climate change and changing land use and management are likely to result in a substantial increase in flooding in the catchment. If we do nothing about this, flooding will increase in locations currently at risk, as well as introducing new locations at risk. In this future scenario annual average damages are estimated to rise to £25 million. In a one per cent AEP event 6600 residential properties are likely to be at risk and economic damages are estimated to increase to about £300 million.

Catchment objectives
We have developed objectives that set out what we want the CFMP policies and actions to achieve in the Parrett catchment. These objectives relate to people, the economy and the environment. Whilst managing flood risk, we can also make the most of opportunities to create other benefits in the catchment such as environmental improvements. We have identified these as well as constraints to possible future flood risk management.

Policy appraisal
We and our partners have developed policies to manage flood risk in the future. These policies set out our vision for a more sustainable, cost effective and natural approach to managing flood risk in our catchments. These policies are:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise.
2. Reduce existing flood risk management actions (accepting that flood risk will increase over time).
3. Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
4. Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change).
5. Take further action to reduce flood risk (now and/or in the future).
6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, e.g. for habitat inundation). Note: This policy option involves a strategic increase in flooding in allocated areas, but is not intended to adversely affect the risk to individual properties.

We have selected the most appropriate policy for various parts of the catchment (referred to as 'policy units'). This is based on how well various policies help achieve the catchment objectives and catchment opportunities and constraints. The policies selected for each of the 10 policy units are shown in Figure E1.

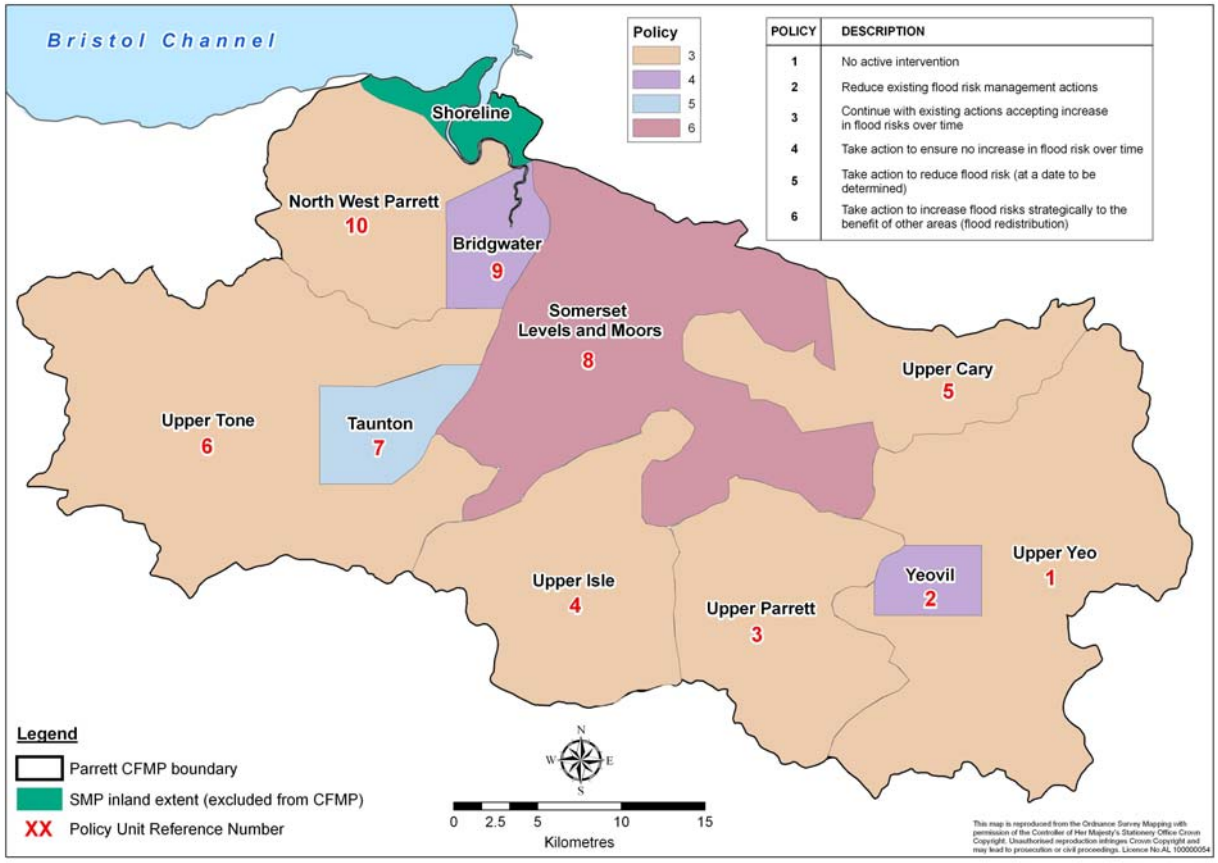


Figure E1. Parrett CFMP policy units and policies

Action Plan
We have produced a list of actions for ourselves and our partners to undertake to achieve the selected catchment objectives, and identified indicators by which we can monitor the implementation of these over the life of the plan.

1 Introduction

In this section we explain what a Catchment Flood Management Plan (CFMP) is, what it will achieve, and how it fits into the overall flood risk management process.

1.1 Background

Flooding is a natural hazard that can have a major impact on lives, communities, the economy and the environment. We cannot prevent floods, but we can manage them.

The Department for Environment, Food and Rural Affairs (Defra) is responsible for setting policy for managing flood risk in England. The policy aims to manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as to:

- reduce the threat to people and their property; and
- deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.

This is known as 'sustainable flood risk management.'

Flood risk is made up of two parts: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it happened. Flood risk management can reduce the chance of flooding happening by managing land use, river systems and flood defences, and reduce the effect of flooding by influencing development in flood risk areas, flood warning and emergency response.

A Catchment Flood Management Plan (CFMP) is a long term planning document we have developed working with other main decision-makers within a river catchment. We are developing CFMPs for the whole of England and Wales. A CFMP may cover just one catchment or a number of smaller catchments combined to form a single study area. The CFMP does not focus on the detail of flood risk in specific locations but takes a broad scale look at the catchment as a whole to identify the key flood risk issues and areas. From our studies we will develop policies to manage flood risk for the next 100 years. We will review CFMPs every six years.

CFMPs look at flooding from rivers, groundwater and surface water. They are based on a standard approach to make sure they assess flood risk and policy options in a consistent way. They also cover flooding from tidal rivers and estuaries (flooding influenced by changes in sea levels as well as river flows) but not flooding directly from the sea, which is covered by Shoreline Management Plans (SMPs).

The two sets of plans overlap at the coastline, with no gap in between them. Therefore the shoreline area (see Figure E1) is not addressed in the CFMP.

1.2 Aims and scope

The area covered by the Parrett CFMP is shown on Figures 1.2.1 and 1.2.2, and in Appendix E. The aims of the Parrett CFMP are to:

- reduce the risk of flooding and harm to people, the natural, historic and built environment caused by floods;
- work with natural processes so that flood risk management brings benefits and contributes effectively to sustainable development; and
- inform and support planning policies and statutory land use plans.

The CFMP achieves these aims by setting policies for managing flood risk in the area now and in the future. These policies take into account the likely impacts of changes in climate and the effects of land use and land management. They will bring a range of environmental and social benefits and contribute towards sustainable development.

We have prepared the CFMP by:

- carrying out a strategic assessment of current and future flood risk from all sources (rivers, sewers, groundwater, surface water) within the area covered, by understanding the likelihood and impact of flooding and the effects of current ways of reducing risk. The scale of risk has been measured in economic, social and environmental terms;
- identifying opportunities and constraints within the area for reducing flood risk through changes in land use, land management practices and flood risk management;
- finding ways to work with nature to maintain, restore or improve natural and historic assets (including biodiversity); and
- working out priorities for studies or projects to manage flood risk within the area and identifying potential partnerships.

We have devised specific catchment objectives during the study to provide the framework to develop and appraise sustainable policies.

Note: the results of the hydraulic modelling carried out for the study, including any flood outlines developed, do not replace any existing information we may hold on flood risk in a particular area and are not intended to replace the Flood Zone maps on our website.

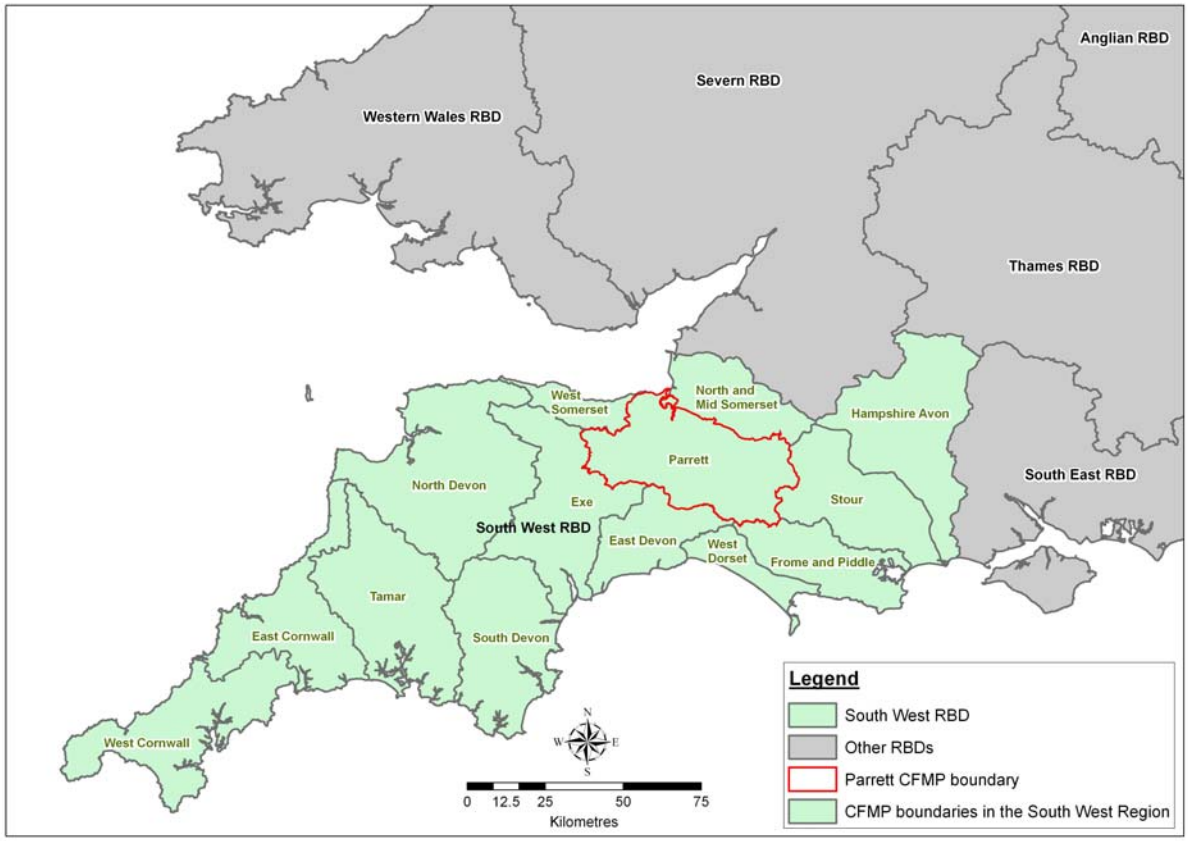


Figure 1.2.1. CFMP boundary in relation to other CFMPs and River Basin Districts (RBD)

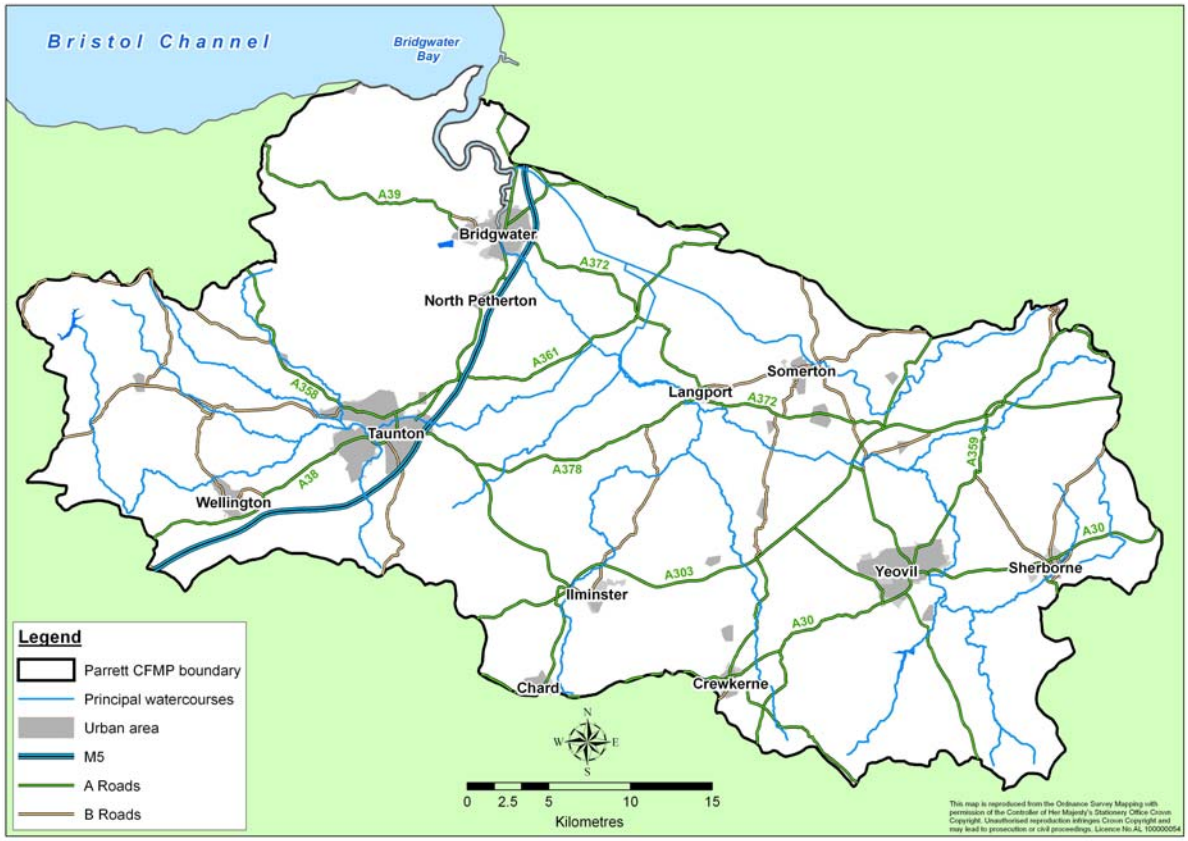


Figure 1.2.2. Parrett CFMP location plan

1.3 Policies

CFMP policies are driven by the extent, nature and scale of current and future flood risk across the whole catchment, with the overall aim of reducing flood risk within the catchment by meeting specific CFMP objectives. The policies aim to set the right approach in managing the overall flood risk within the catchment. Within many catchments it is not possible to reduce flood risk everywhere so we need to understand where the greatest risks are, and why they are there, before choosing which policies to implement. We have to decide where we will need to take further action to reduce flood risk, where we will simply need to sustain the current risk and where we may have to accept that the risk will increase.

The CFMP shows the broad areas where these actions should be applied. These areas are known as policy 'units' and it is here that we will set policies to manage flood risk. Measured against catchment objectives and possible future changes, these policies will address the level of risk in the catchment. There are only a limited number of policies that we can apply. These are:

1. No active intervention (including flood warning and maintenance). Continue to monitor and advise.
2. Reduce existing flood risk management actions (accepting that flood risk will increase over time).
3. Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
4. Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change).
5. Take further action to reduce flood risk (now and/or in the future).
6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, e.g. for habitat inundation). Note: This policy option involves a strategic increase in flooding in allocated areas, but is not intended to adversely affect the risk to individual properties.

These policies will determine whether we should take action to increase, decrease or maintain the current level of flood risk.

Based on what we understand about the catchment, we have divided the Parrett CFMP area into ten separate 'policy units.' These are areas that face similar types of flooding (source and pathway of flooding) and contain similar assets that are vulnerable to damage during flooding (receptors of flooding). Details of the Parrett CFMP 'policy units' can be found in Section 6.

1.4 Links with other plans

CFMPs are essential plans to enable a strategic and proactive approach to flood risk management. The development of CFMPs and Shoreline Management Plans (SMPs) will allow us to plan to deliver flood risk management in a way that reduces flood risk whilst maximising opportunities to deliver multiple benefits. These multiple benefits include the environmental objectives presented in River Basin Management Plans (RBMPs) under the Water Framework Directive (WFD).

The European Commission has recently proposed a new directive, on the assessment and management of flood risks (the Floods Directive). The Floods Directive aims to reduce the risk to human health, the environment and economic activity associated with floods. The Directive will require the preparation of Flood Risk Management Plans (FRMPs) that will sit alongside the RBMPs prepared under the WFD. Subject to some minor changes, we anticipate that our Catchment Flood Management Plans and Shoreline Management Plans will meet the requirements of Flood Risk Management Plans.

The main aim of the European Community Habitats Directive (92/43/EEC) is to promote measures to maintain or restore natural habitats and wild species at a favourable conservation status. CFMPs are covered by this directive and so, where the CFMP is likely to have a significant effect on a European site (Special Area of Conservation (SAC), Special Protection Area (SPA) or Ramsar site), it must be subject to an 'appropriate assessment'. The appropriate assessment is included in Appendix B.

The Government is currently developing a new strategy to manage flooding. In July 2004, the Government launched the 'Making Space for Water' consultation exercise paper, which was followed by the first Government response in March 2005. The aim of the new strategy is:

> *"To manage the risks from flooding and coastal erosion by employing an integrated portfolio of approaches which reflect both national and local priorities, so as:*
>
> - *to reduce the threat to people and their property; and*
> - *to deliver the greatest environmental, social and economic benefit, consistent with the Government's sustainable development principles.*
>
> *To secure efficient and reliable funding mechanisms that deliver the levels of investment required to achieve the vision of this strategy."*

The concepts outlined in Making Space for Water have been considered when preparing the CFMP. More specific aspects will be addressed when implementing CFMP actions as identified in Section 7.1.

The CFMP represents the first 'tier' in the strategic flood risk management process, providing the overall framework within which to carry out more detailed assessments of flood risk, such as strategy plans and strategic flood risk assessments (SFRA). These assessments cover smaller areas and so are generally

better able to address local issues, opportunities and constraints, although there are places where it is more appropriate for the CFMP to recommend specific flood risk management measures.

Figure 1.4.1 shows the framework within which we are developing the CFMP and how it will fit within the wider statutory and non-statutory planning framework in England and Wales. The CFMP's relationship with the land use (spatial) planning process is particularly important and operates at two levels, with a strong link to the Regional Spatial Strategies and a slightly weaker, but still important, link to the Local Development Frameworks. The other significant external link is to rural land management plans.

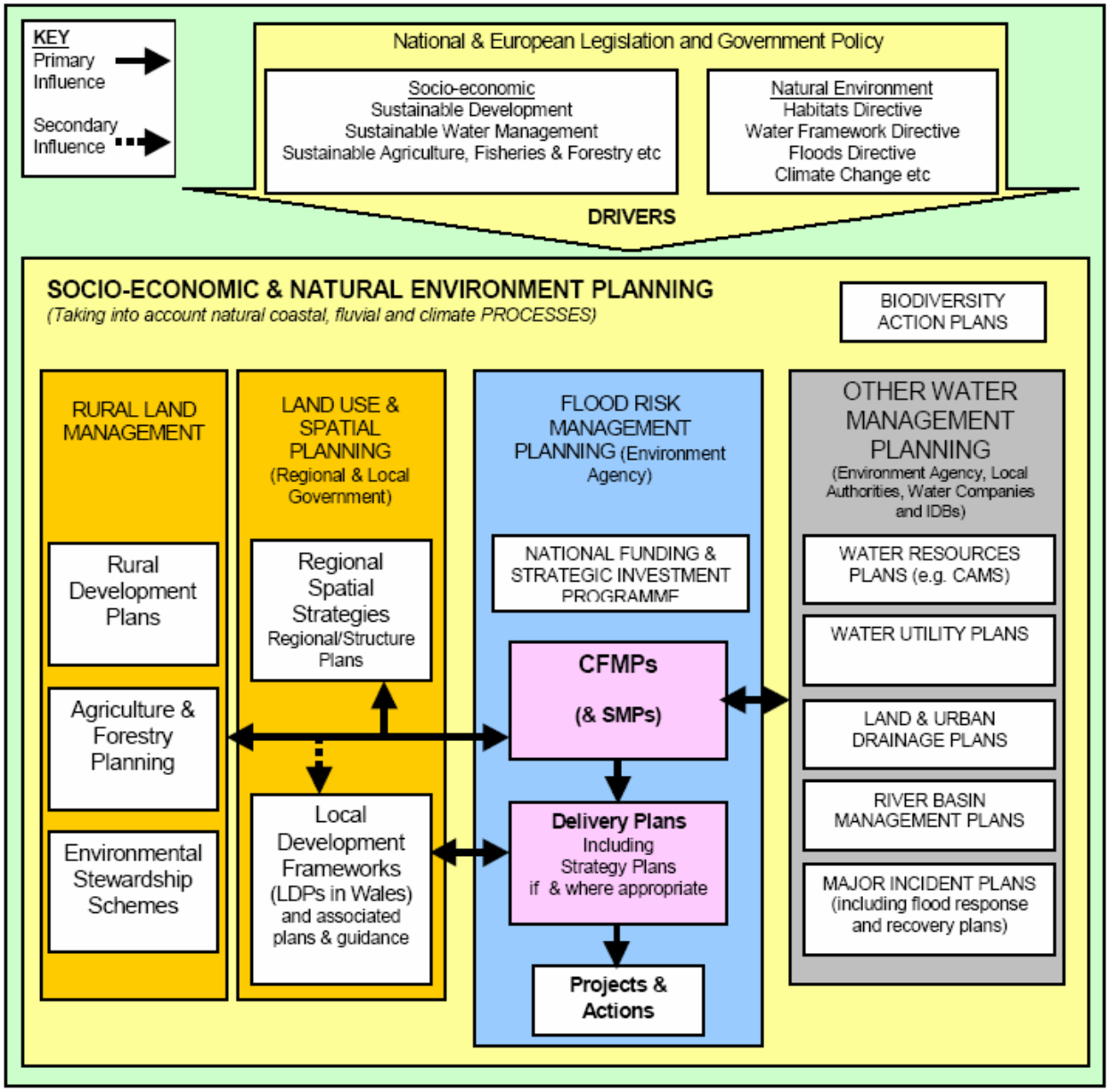


Figure 1.4.1. Context of CFMP within wider planning framework

One important aim of CFMPs is to influence regional land use plans. In this case, however the development of the South West Regional Spatial Strategy (SWRSS) has coincided with developing the Parrett CFMP. The SWRSS Consultation Draft is now available and it should be finalised towards the end

of 2008. Clearly the timing has limited the opportunity for the CFMP to influence the SWRSS Consultation Draft, but it is expected that the relationship between the plan and strategy will be considered further during their first reviews.

The SWRSS Consultation Draft provides the following description of flood risk management:

> *"As well as protecting the built and historic environment, flood risk management is about exploiting the benefits of natural flooding for biodiversity in an integrated way that will accommodate the inevitable impacts of climate change. The role of wetlands in ameliorating flood risk should also be recognised. With this in mind a catchment and coastal cell approach is needed to guide investment and land use planning decisions. Catchment Flood Management Plans are being developed to support this. Around the coast, opportunities for managed retreat should be supported to reduce the risk of flooding and create new wildlife habitat."*

The SWRSS recognises the need to maintain and improve the environmental excellence of the region whilst allowing for the scale of growth and change needed to meet Government targets and policies. Positive planning is at the heart of delivering the strategy particularly for the growth and development of strategically significant towns and cities and to meet the need to provide new homes. The strategy encourages rural communities to remain viable through appropriate development.

Planning Policy Statement 25 was issued by the Department for Communities and Local Government in December 2006. This statement requires each Local Authority to produce a Strategic Flood Risk Assessment (SFRA). A SFRA has recently been prepared for Taunton Deane and was finalised in September 2007. The Taunton SFRA is based on similar data used in the CFMP, and future SFRAs in the Parrett catchment will follow the CFMP and therefore it is unlikely that they will produce assessments that contradict policies adopted for CFMPs. Both processes involve consultation to make sure that each understands the other.

Other statutory and non-statutory plans, strategies, programme and studies we considered when developing this CFMP are summarised in the following sections.

Statutory plans, strategies, programme and studies

The many statutory strategies and plans have highlighted the area's existing and future pressures or objectives. We looked at the policies and objectives in these plans that concerned water management that could affect, or be affected by, our CFMP. In particular, we looked for constraints and opportunities that we would have to consider in developing our flood risk management policies. The following are particularly important:

- Floods Directive.
- Water Framework Directive (WFD).

- Habitats Directive.
- Regional planning guidance / regional spatial strategies.
- County structure plans and local development frameworks.
- Local plans and other planning documents.
- Planning Policy Statement 25 (including PPS25).
- Planning Policy Statement 9 (including PPS9).
- The Wildlife and Countryside Act, (1981 as amended).
- The Countryside and Rights of Way Act, (2000).
- The Land Drainage Act (1991)
- The Reservoirs Act (1975)
- The Conservation (Natural Habitats, &c.) Regulations, (1994 as amended).

Non-statutory plans, strategies, programmes and studies

There are a number of non-statutory plans, strategies and programmes that set priorities for protecting and improving aspects of the CFMP that we need to consider when setting CFMP objectives and policies. The following are particularly important:

- Making Space for Water (Defra).
- Shoreline Management Plans (SMPs).
- Water Level Management Plans (WLMPs).
- Sustainable Development Framework for the South West of England (Sustainability Shaper)
- UK Biodiversity Action Plan (UKBAP).
- Local Biodiversity Action Plans (BAPs) and Habitat Action Plans (HAPs).
- South West Regional Renewable Energy Strategy (RRES).
- Non-food Crops Strategy for England (Defra).
- South West Regional Biodiversity Strategy.
- Catchment Abstraction Management Plans (CAMS).
- Fisheries Action Plans.
- Landscape Character Assessments.
- Countryside Stewardship Schemes.
- Somerset Levels and Moors Water Level Management and Nature Conservation Strategy.
- System Asset Management Plans.
- Bridgwater to Burnham-on-Sea Parrett Estuary Strategy.
- Parrett Tidal Flood Defence: Sluice/Embankments Technical Review

There are also classification systems that set the context within which we develop our policies such as landscape characterisation and river habitat classification.

CFMP boundaries do not necessarily coincide with other administrative boundaries, however the Parrett CFMP falls entirely within the South West River Basin District (RBD). The CFMP will take account of the interests of a number of authorities and other groups within or overlapping the CFMP boundary.

With the above plans, strategies, programmes and studies in mind, we expect that the Parrett CFMP will be used by:

- Us, to direct our investment in activities to manage flood risk (for example strategic planning, asset management and flood event management) and support other activities within the catchment (for example river basin management planning under the Water Framework Directive);
- regional and local government authorities, to inform land use planning, sustainability appraisal/strategic environmental assessment and emergency planning;
- internal drainage boards and water companies, to help them plan in the wider context of the catchment;
- Government and government departments, to help plan future funding and policy development; and
- the public, to improve their understanding of flood risk and integrated flood risk management.

1.5 Involving others

We cannot reduce flood risk across England and Wales on our own. All main organisations and decision-makers in a catchment must work together to plan and take action to reduce flood risk.

Whilst we have taken responsibility for producing the CFMP, it has been developed with input from a steering group made up of representatives from:

- District Councils/Unitary Authorities (South Somerset, Sedgemoor District, Taunton Deane).
- Internal Drainage Board.
- Natural England.
- Somerset Wildlife Trust.
- RSPB.
- Wessex Regional Flood Defence Committee.
- Country Land and Business Association
- Defra.

The steering group has provided technical guidance on wider issues, and guided important decisions when developing the CFMP.

The Parrett CFMP was originally one of six pilot CFMPs undertaken in 2003 prior to rolling out nationally across the UK. The Pilot Parrett CFMP was delivered in September 2003, following an extensive consultation and review process. In the following years since the issue of the pilot CFMPs the format of

the document has changed and progressed; as such we considered it necessary to revise and update the findings of the earlier Pilot Parrett CFMP document. Developing a CFMP can normally take over 18 months. However, as the Parrett CFMP builds upon the foundation of the earlier study, it was not necessary to repeat some of the extensive consultation that was carried out at that time, and therefore the timescale for processing the document has been reduced. This still allows for public consultation so that we can tell people what we are doing and receive comments and suggestions on the plan.

2 Catchment overview

This section describes the main physical, biological and cultural aspects of the catchment. It also highlights features, initiatives and policies that may provide an opportunity or constraint on how we manage flood risk.

2.1 Definition and extent of the catchments

The main features of the Parrett CFMP area are shown in Figure 2.1.1 and summarised in Table 2.1.1. The CFMP boundary covers an area of approximately 1,675km^2, of which 4 per cent is urban[1] and the rest is either farmed or open countryside. It extends from the Polden Hills in the north, to the Blackdown Hills in the southwest, and includes a small area of West Dorset to the east of Yeovil. The catchment encompasses 50 per cent of the land area of Somerset and covers two-thirds of the Somerset Levels and Moors. There are several towns and economic centres within the CFMP boundary, including Taunton, Yeovil, Bridgwater, Wellington, Chard, Crewkerne, North Petherton, Somerton and Ilminster. The CFMP contains important transport links, including the M5 and two national railway lines. The CFMP area has a population of about 300,000 people, with many living in the market towns of Taunton, Bridgwater and Yeovil.

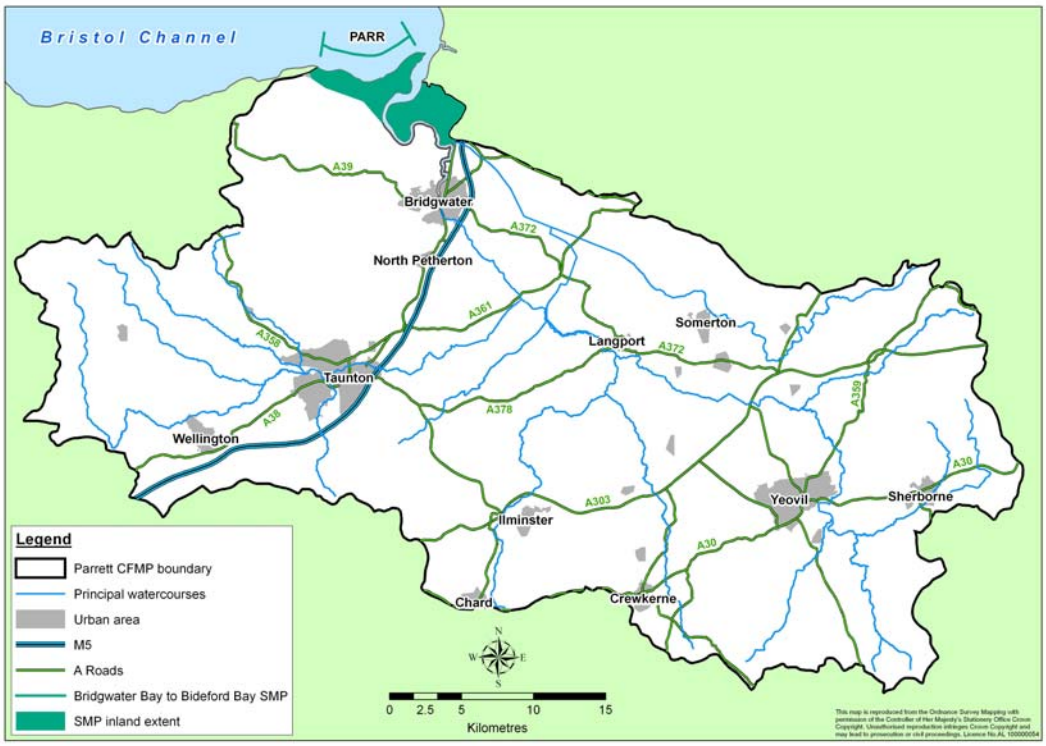


Figure 2.1.1. Parrett CFMP study overview

[1] as per SPARQ_landcover_CFMP dataset

The CFMP area is rich in biodiversity, both in terms of species and habitats and includes the Quantock and Blackdown Hills which are designated as Areas of Outstanding Natural Beauty (AONB). The CFMP contains a number of nationally and internationally important environmentally designated sites, including the Somerset Levels and Moors, which is designated as a Special Protection Area (SPA) due to the internationally important habitats and species. There are also a large number of Sites of Special Scientific Interest (SSSI), and priority BAP habitats found within the CFMP bounds. These are all described further in Section 2.8.

Table 2.1.1. Main features and assets in the CFMP

Catchment Overview	
Catchment area	1,675km^2
Key watercourses	River Tone, River Parrett, Sowy River, River Isle, River Yeo, River Cam, King's Sedgemoor Drain, River Cary
Sources of key rivers/streams	Brendon Hills, Quantock Hills, Blackdown Hills, Dorset Heights, Mendip Hills, Polden Hills
Tidal limit (and mouth)	Tidal limit of the River Parrett is at Oath Lock. Tidal limit of the River Tone is at Newbridge Sluice.
Length of main river (including tidal lengths)	502 km
Average annual rainfall	Ranges from as high as 1,325mm/year at the upstream extent of the Catchment, to around 675mm/year in the middle of the Somerset Levels and Moors.
Geology	Highly varied geology. Devonian and Carboniferous sandstone and siltstone in the west, Oolitic Limestone in the east. Extensive alluvium and river terrace drift deposits overlying mudstone across much of the lowland areas and also some large peat deposits. Towards the coast becoming increasingly dominated by estuarine alluvium drift deposits.
Urban area	4 per cent (as per our SPARQ_landcover_CFMP dataset)

Assets		***Total for catchment***
Population		300,000
Area km^2		1,675km^2
Agricultural land classification (km^2)	Grade 1	92km^2
	Grade 2	244km^2
	Grade 3	1,100km^2
	Grade 4	167km^2
	Grade 5	19km^2
Residential properties		132,631*
Commercial properties		12,389*
A-class roads (km)		246km
Railway (km)		146km
Sites of Special Scientific Interest (SSSI) (km^2)		72km^2
Ramsar Sites (km^2)		43km^2
Special Areas of Conservation (km^2)		0.8km^2
Scheduled Monuments (SAM)		112
Designated Areas of Outstanding Natural Beauty (km^2)		104km^2
National Nature Reserves (km^2)		6km^2

* Based on National Property Database (NPD 2004).

The Somerset Levels and Moors is a recognisable feature of the Parrett CFMP. The Somerset Levels and Moors are divided into a series of small fields by an extensive network of drainage ditches, known locally as 'rhynes' (pronounced “reens”). The patterns of these ditches reflect different periods of reclamation and enclosure dating back to Roman times. This man-made wetland landscape is ecologically rich, supporting a variety of species, many of which are well-known locally or nationally rare.

Water level management involves keeping water levels high in summer by using sluice gates and weirs. This is known as 'penning'. Water level management in the low-lying areas, particularly across the Somerset Levels and Moors, is extensive and a key feature of the CFMP. The activity is very important for agricultural production and the status of environmentally designated sites. Water level management is discussed further in Section 2.7.

The CFMP is aimed at developing policies to manage flooding from rivers, groundwater and surface water, but not coastal flooding (flooding directly from the sea). Coastal flooding is addressed through Shoreline Management Plans (SMPs). The coastline of the Parrett CFMP is covered by the ‘Bridgwater Bay to Bideford Bay SMP'. The length of coast covered by the SMP is shown in Figure 2.1.1.

Table 2.1.2. Shoreline Management Plan (SMP) policies

Unit	Location	Policy
Bridgwater Bay to Bideford Bay SMP		
PARR 1	Hinkley Point	Hold the existing defence line
PARR 2	Hinkley Point to Stolford	Hold the existing defence line
PARR 3	Stolford to Fenning Island	Observe and monitor
PARR 4	Fenning Island to Combwich	Observe and monitor
PARR 5	Combwich	Hold the existing defence line
PARR 6	Pawlett Hams to River Brue	Hold the existing defence line

The inland extent of the SMP boundary is usually defined as 1km from the coastline, or to the inland extent of low-lying ground. As the coastal strip of the Parrett CFMP is mostly very flat, and protected by sea defences, the SMP extents are often a significant distance inland. So, there is a significant overlap between the SMP and CFMP boundaries, and selecting CFMP policies must consider the relevant SMP policies (summarised in Table 2.1.2).

Whilst tidal flooding is not included in the scope of the CFMP, 'tidally influenced' flooding is covered. Downstream of Burrowbridge, flood risks are increasingly dominated by the large tidal range in the Bristol Channel. At Bridgwater and downstream the topography is such that significant flood risks are caused by high tides. Flooding in lowland areas of the CFMP area is exacerbated when high tides occur at the same time as high fluvial flows, which causes rivers to become ‘tide-locked’, preventing fluvial water from discharging. Flood risk is discussed in more detail in Section 2.7.

2.2 Topography

Figure 2.2.1 illustrates the topography of the Parrett CFMP area. The area is characterised by steep uplands in the south and west, forming the Quantock and Brendon Hills, Blackdown Hills and Dorset Heights. These extend down into extensive lowlands that form the Somerset Levels and Moors. The lowlands are divided from the River Brue and Axe catchments in the north by the relatively narrow and low lying relief of the Polden Hills.

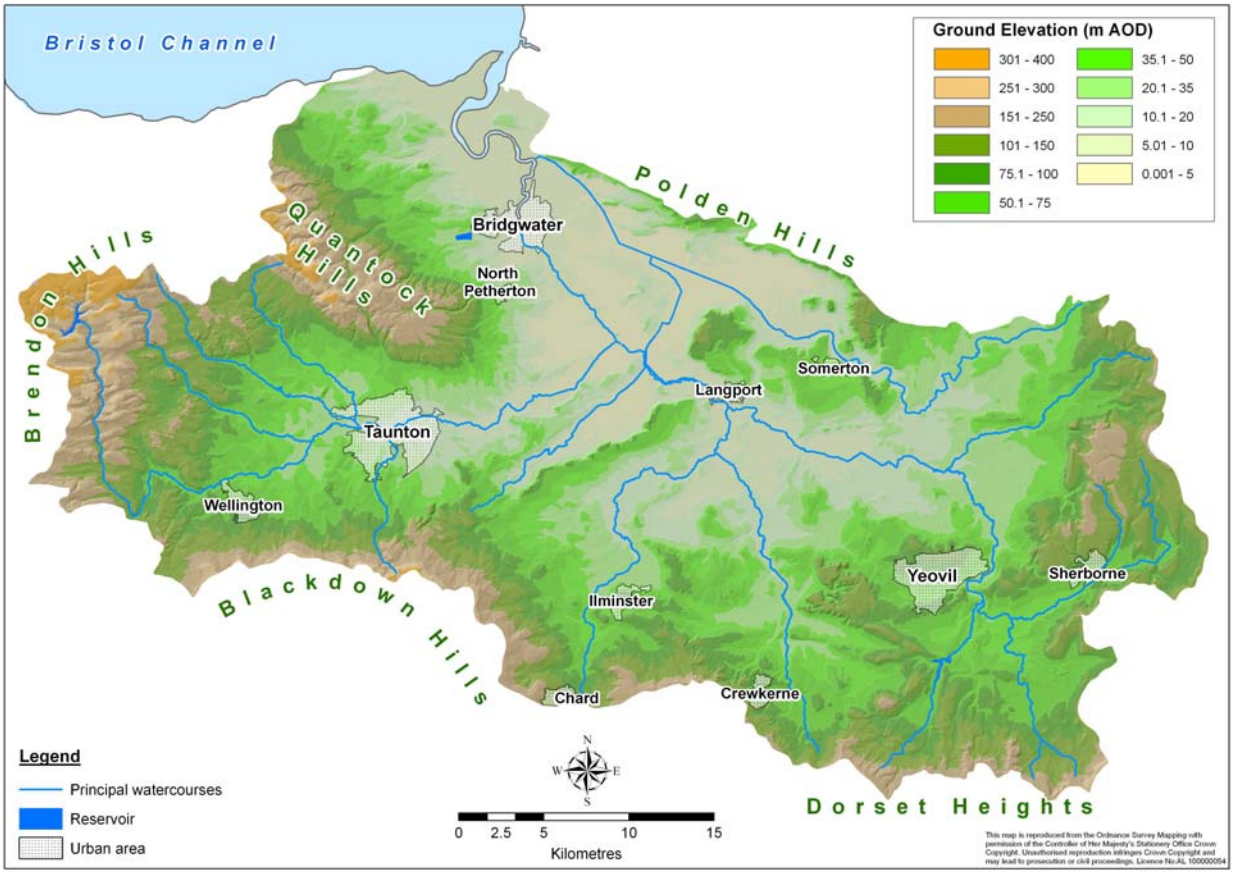


Figure 2.2.1. The topography of the Parrett CFMP area (with main rivers and urban areas)

The current topography of the CFMP area reflects both the complex geological history of the area, and then the long history of human intervention and modification of the natural drainage systems in the region. Drainage systems have been used to manage water levels throughout the Somerset Levels and Moors area. In the past this was primarily for agricultural purposes, however today, water management is equally important to achieve environmental objectives (see Section 2.7).

The CFMP area can be divided into three broad geographic regions, defined in terms of topography, geology (see Section 2.3) and hydrology (see Section 2.7). These divisions are shown in Figure 2.2.2 and described as follows:

Uplands

Make up about 71 per cent of the CFMP area and includes the upper River Tone, upper River Isle, upper River Parrett, upper River Yeo and upper River Cary. It extends from the Quantocks and Brendon Hills in the west, the Blackdown Hills in the south and the Dorset Heights in the east. The terrain is typified by rolling countryside, with some steep escarpments particularly around the Blackdown Hills. The Brendon Hills rise up to an elevation of 400m AOD and form the highest hills within the Parrett CFMP. The terrain defines the drainage in the area, which is typically characterised by meandering, mostly natural (i.e. unmodified) watercourses, which are largely confined to the floodplain. The topography of the uplands has a significant influence on the nature of flooding within the catchment and is described in more detail in Section 3.

Lowlands (Somerset Levels and Moors)

Makes up about 20 per cent of the total CFMP area. The lowlands are dominated by an area known as the Somerset Levels and Moors, which is characterised by low lying, flat topography, much of which extends down to an elevation that is below sea level. The area is intersected by a network of man-made drainage channels called 'rhynes', which being flat can flow in either direction. The tidal limit extends a considerable distance into this area, terminating at Oath Lock along the River Parrett and at Newbridge Sluice along the River Tone. The tidal influence, along with the low lying character of this area, has a significant influence on the nature of flooding. This is described in more detail in Section 3.

Estuary floodplain (outside of SMP)

Makes up about 8 per cent of the CFMP area. It is defined by low lying ground adjacent to the Parrett Estuary (left bank only), an area which is not covered by the 'Bridgwater Bay to Bideford Bay SMP'. A few minor watercourses drain into this area from their headwaters in the Quantock Hills, the most significant of which is the Cannington Brook, which flows down into the area and outfalls directly into the Parrett Estuary at Stallingtons outfall. The area is generally characterised by low lying, gently undulating topography, which, closer to the estuary, becomes predominantly flat, with an average elevation of around 5m AOD.

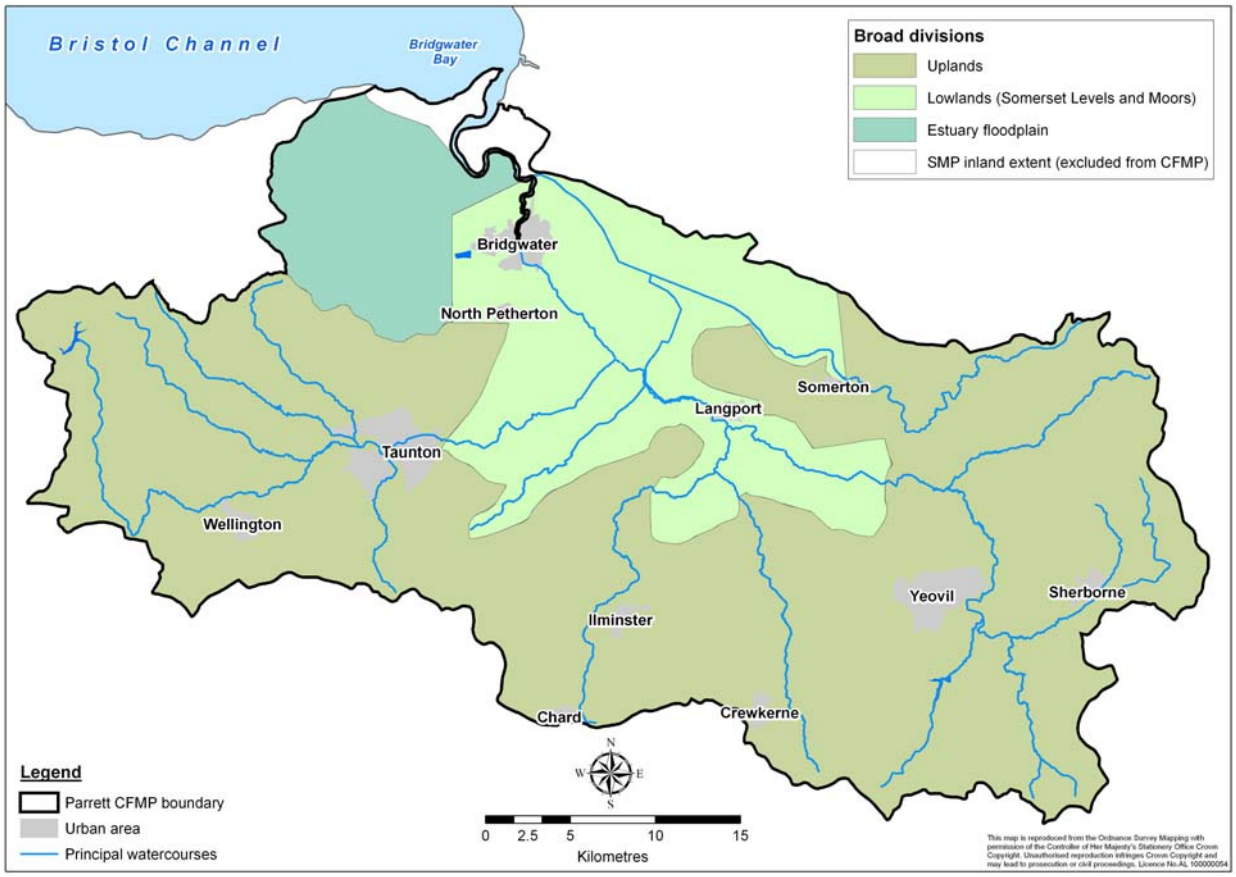


Figure 2.2.2. Parrett CFMP divisions

There are eight main rivers located within the CFMP area; five of these have their headwaters in the steep upland catchment and flow down to converge within the lowland areas of the Somerset Levels and Moors before flowing out into the Parrett Estuary in Bridgwater.

The River Tone experiences the greatest fall in elevation from headwater to lowlands, as shown in Figure 2.2.3. The River Tone channel profile also varies from convex (in the upper catchment) to a concave profile further downstream. The convex profile is characteristic of a bedrock dominated channel and reflects where the River Tone flows down through the Brendon Hills and is unable to incise down into the channel bed. Further downstream a more typical concave profile resumes, indicative of a lowland incised channel. The other six main rivers show similar channel slopes along their length. The Sowy River and King's Sedgemoor Drain are artificial watercourses and as such their channel profiles, shown in figure 2.2.3 reflect this. This figure also shows where the main urban areas are located.

The divide between the steep uplands and extensive lowlands can be seen along all the rivers, especially along the River Parrett. More than two-thirds of the length of the River Parrett extends at an elevation below 10m AOD, flowing through an extensively modified and controlled system, characteristic of the Somerset Levels and Moors area. The rivers in the Somerset Levels and Moors are mostly embanked and often perched above the floodplain.

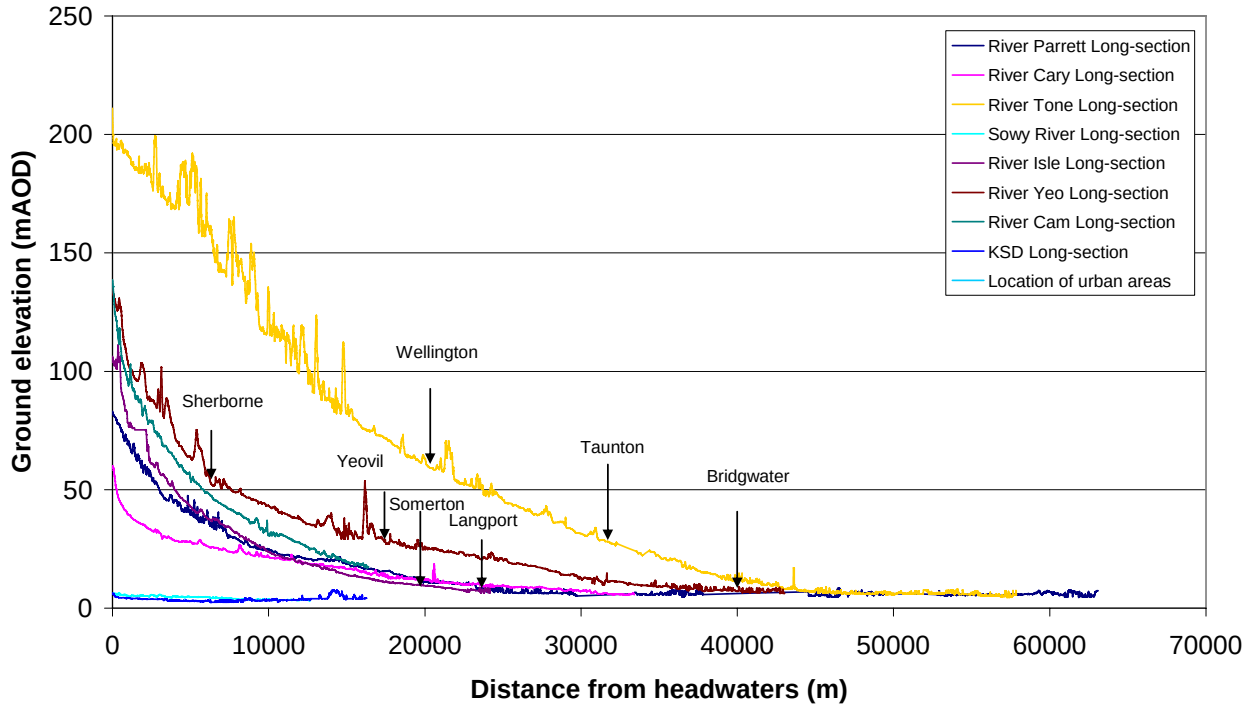


Figure 2.2.3. Channel slope of the eight major rivers in the CFMP area.

The towns in the CFMP area are located in very different places along the river lengths, and as such are affected by different sources and pathways of flooding. These sources of flooding are described in detail in Section 3.2.

2.3 Geology and hydrogeology

The geology and associated soil types are very diverse throughout the catchment. Rolling clay land, hard sandstone/siltstone, soft siltstone, fine-grained sandstone, mudstone and alluvium are all included within the catchment. The west of the catchment is generally characterised by relatively permeable upland geology, while the east of the catchment consists of more impermeable upland clay geology. Lowland areas are dominated by alluvium (fluvial and estuarine), drift deposits (clay, silt and sand), peat and marine terrace deposits. The runoff developed from the associated soils is also very different. The solid and drift geology of the catchment is shown in Figures 2.3.1 and 2.3.2.

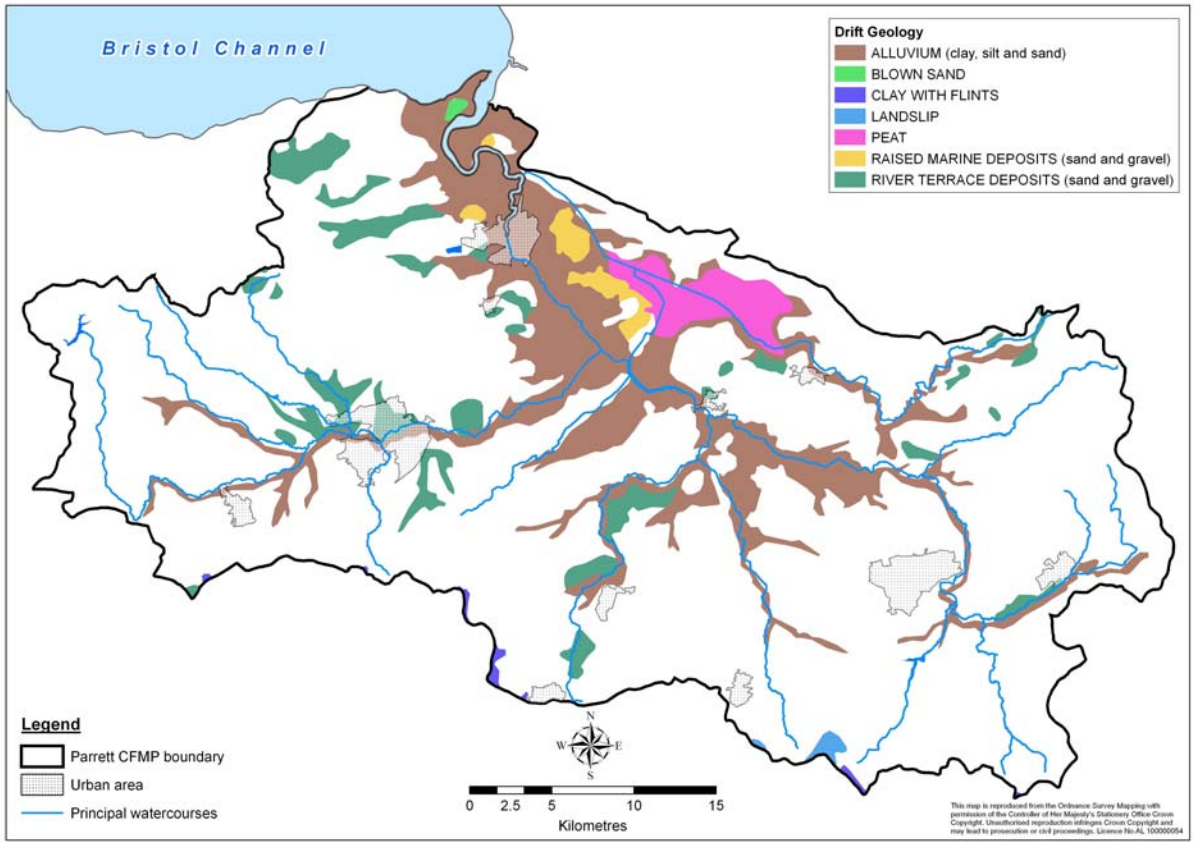


Figure 2.3.1. Drift geology of the Parrett CFMP area

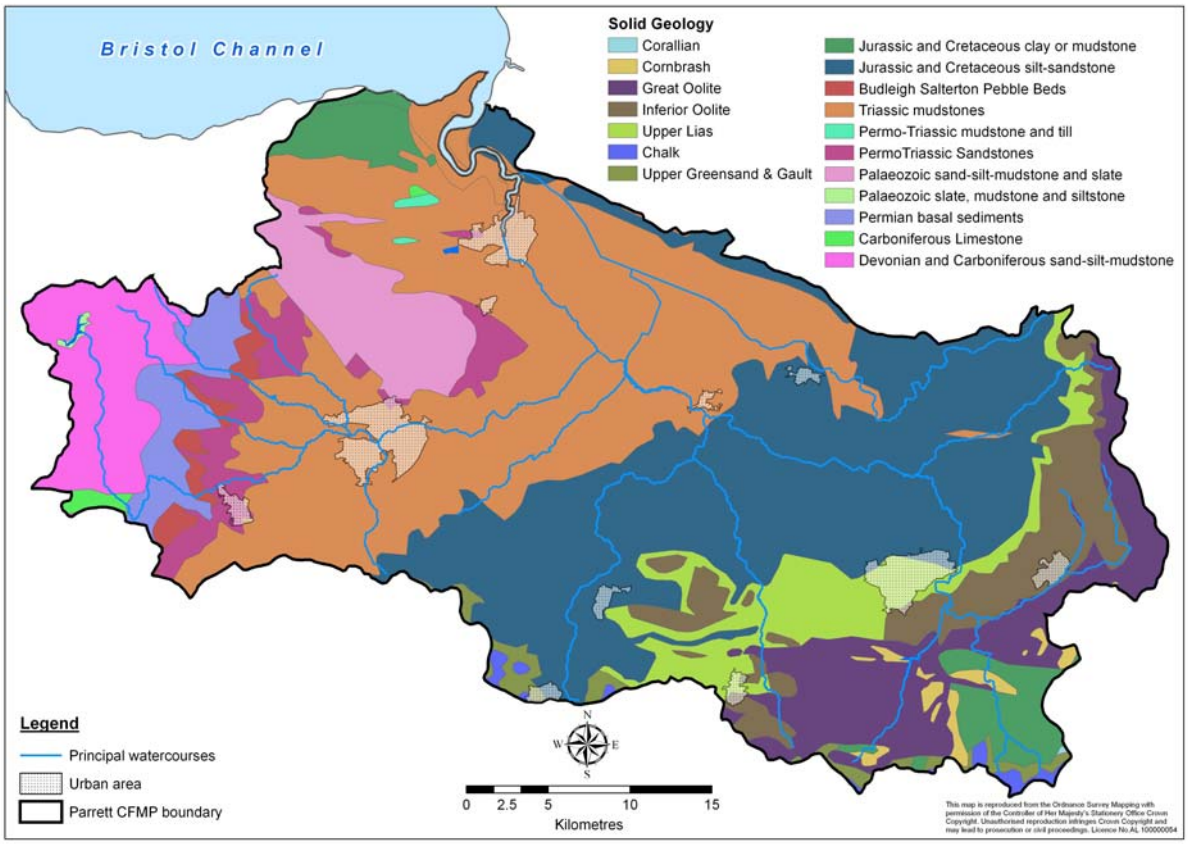


Figure 2.3.2. Solid geology of the Parrett CFMP area

Further detail on the geological character of the Parrett CFMP area, is given below:

Uplands

The oldest geological units are found in the east of the catchment, and include Devonian and Carboniferous sandstone, siltstone, mudstone and slate deposits. Further downstream the bedrock geology changes to less permeable Triassic mudstone and clay deposits. To the west, the CFMP area is characterised by Jurassic and Cretaceous deposits, including siltstone, sandstone, chalk beds and extensive oolitic limestone deposits. In the river valleys and floodplains the solid geology is overlain by alluvium (clay, silt and sand) and river terrace drift deposits (sand and gravel). The runoff developed from these areas can be quite variable due to the nature of the associated soils. Of particular concern is the soft siltstone/fine grained sandstone landscape characteristic of the Upper Tone, Isle and Parrett catchments, which is vulnerable to soil structural degradation and as such has the potential to increase flooding and also cause pollution. Surface water flooding also tends to be a problem throughout this area. The Parrett CFMP area does not include any major aquifers and therefore groundwater flooding is not considered to be a major risk within the catchment.

Lowlands (Somerset Levels and Moors)

The underlying geology is dominated by Permian and Triassic sandstone and mudstone, including the red-brown Keuper Marl (part of the Mercia Mudstone Group). There are some river terrace deposits and raised marine deposits which stretch far inland. The area is covered by thick sequences of fluvial and estuarine alluvium drift (clay, silt and sand), deposited as a result of inundation of low-lying areas by the tide and rivers. There are also peat deposits, particularly around the Sowy River and King's Sedgemoor Drain. Much of the geology of this region reflects a time when the area was covered with coastal vegetation, such as saltmarsh and was prone to frequent tidal flooding. Coastal flooding of the Somerset Levels and Moors is now limited through sea defences, and the management of river flows and water levels. The area is however, frequently waterlogged throughout the year.

Estuary floodplain

This area is underlain by Permian and Triassic sandstone and mudstone, including the red-brown Keuper Marl (part of the Mercia Mudstone Group). Parts of the area near to the coast are underlain by Jurassic and Cretaceous clay deposits. There are extensive river terrace deposits which stretch inland along the narrow floodplains of the small watercourses and streams that extend down from their headwaters in the Quantock Hills. Closer to the Parrett Estuary the geology is dominated by estuarine alluvium drift deposits (clay, silt and sand), deposited as a result of inundation of low-lying areas by the tide.

2.4 Geomorphology

An understanding of the geomorphic system of a catchment is important for sustainable river management. Geomorphological processes (such as sediment transfer, erosion, and deposition) impact on the river channel and floodplain. Problems can occur when there is a change in the balance between these processes, which can result in river management issues, for example:

- excess storage of sediments in sensitive locations/habitats;
- excess storage of sediment in the channel and impact on flows;
- water quality issues resulting from both high and low sediment loads;
- excess siltation of the channel leading to conflicts with navigational interests;
- erosion of the channel bed and banks near flood defence assets.

The geomorphic system of the Parrett CFMP area, in terms of river and floodplain and the sediments that compose it, can provide evidence of the evolution of the river system and offer a starting point from which to assess how changes may affect flooding in the future.

The following sub-section is divided into two parts; catchment characteristics (i.e. morphology) and sediment system. This provides a summary of the main geomorphological characteristics of the Parrett CFMP area and highlights the key issues which have an impact on flood risk management in the catchment.

2.4.1 Catchment characteristics (morphology)

The degree to which a channel and floodplain has been modified can have significant consequences in terms of flood risk. While modifications to the natural system may not be desirable in terms of geomorphological processes and flood risk management, many watercourses that have been modified do still support, and are valuable to, a range of wildlife.

The morphology of the Parrett CFMP area is summarised below (divided into the three broad geographic regions used in the previous section), and is also detailed in Table 2.4.1.

Uplands

The upper catchment is characterised by predominantly ‘natural’ (i.e. unmodified) meandering watercourses. Here watercourses are confined to narrow, and in some places bedrock confined floodplains. Flood risk from fluvial sources tends to be low in these areas. Further downstream, where the floodplain widens, watercourses have been increasingly modified, for example by increasing depth for drainage or by adding weirs or other structures for water level management. The degree to which channels have been modified can be inferred from the location of known channel defences and is shown on Figure 2.4.1.

Lowlands (Somerset Levels and Moors)

The drainage network of the lower catchment has been extensively modified. There are very few meandering channels in the lowlands of the CFMP area indicating that almost all of the watercourses have been modified, re-routed or constructed for flood alleviation, agriculture, summer water supply and land drainage. Many of these early modifications have formed watercourses that now flow at a higher elevation than their natural course. Development in the floodplain once occupied by the natural channel has resulted in an increase in local flood risk in some areas of the catchment. During flooding the water overspills the banks and flows into low-lying areas of the floodplain where the natural course originally flowed. This extensive modification in the lowlands of the catchment has resulted in channels, which in some cases have limited natural features, natural flows or suitable habitats for water plants and animals (see Figure 2.4.1). The Water Framework Directive (WFD) seeks to address some of these issues, and will have implications for future flood risk management strategies; capital works programmes and maintenance procedures. These issues are outlined in more detail in sub-section 2.4.3.

Estuary floodplain

Excluding the Parrett Estuary channel there is only one other main watercourse in this area of the CFMP; the Cannington Brook. This watercourse is modified along the majority of its length, and there are a number of small reservoirs (the Hawkridge and Ashford reservoirs) which further act to regulate flow in the stream. The general morphology of the area is characterised by a wide estuarine floodplain.

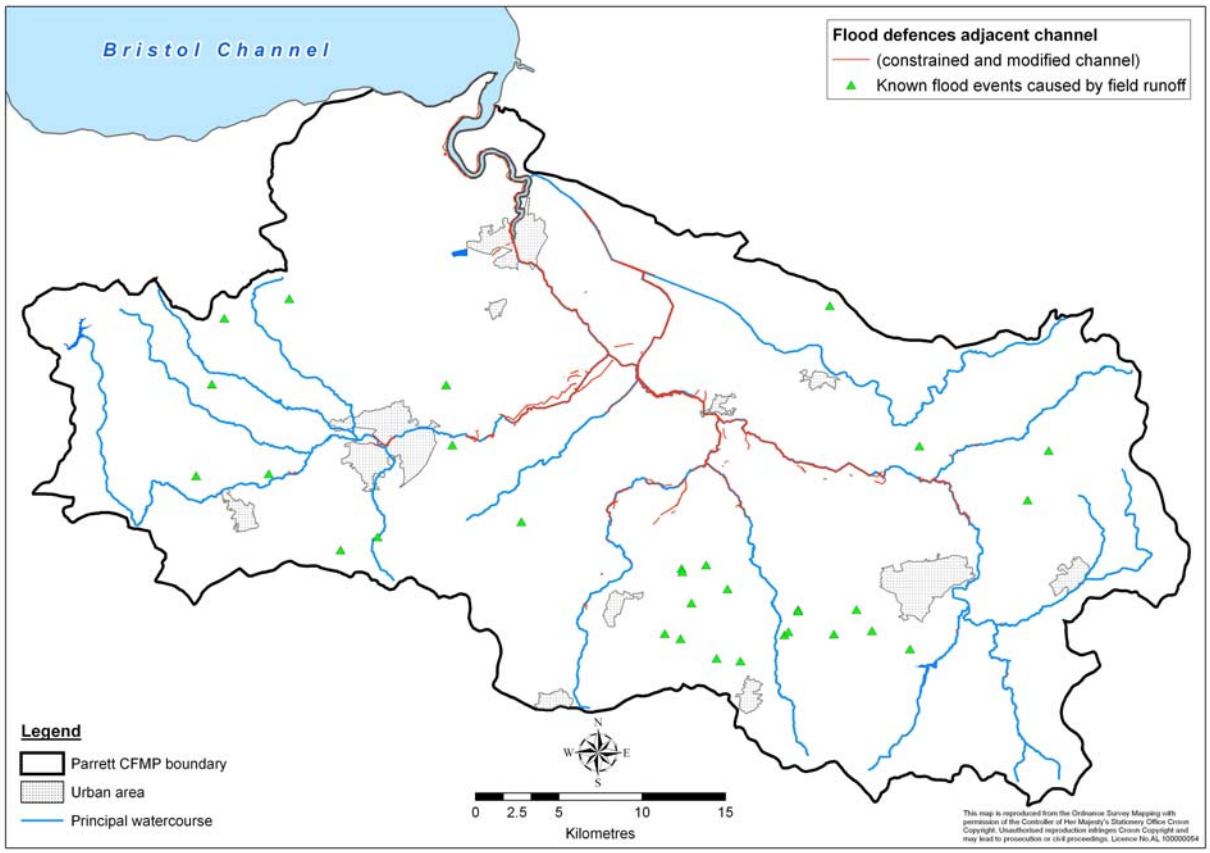


Figure 2.4.1. Catchment geomorphology

Geomorphological Characteristics											
Broad Division		**Uplands**							**Lowlands (Somerset Levels and Moors)**		**Estuary Floodplain**
CFMP Policy Unit		Upper Tone	Upper Isle	Upper Parrett	Upper Yeo	Upper Cary	Taunton	Yeovil	Bridgwater	Somerset Levels and Moors	North West Parrett
Policy Unit Area		345 km2	170 km2	159 km2	341 km2	121 km2	45 km2	26 km2	38 km2	299 km2	142 km2
Primary watercourse / catchment		River Tone	River Isle	River Parrett	River Yeo and River Cam	River Cary	River Tone	River Yeo	River Parrett	River Tone River Parrett River Yeo KSD	Parrett Estuary
Secondary watercourses		Hillfarrance Brook Halse Water Back Stream Sherford Stream	-	-	Sutton Bingham Stream Wiggle Stream Sherborne Stream	-	-	-	-	River Isle Sedgemoor Old Rhyne Sowy River River Cary	Cannington Brook
Stream order of primary watercourse (Strahler, 1964)		River Tone = 4	River Isle = 4	River Parrett = 3	River Yeo = 3 River Cam = 2	River Cary = 3	River Tone = 5	River Yeo = 4	River Parrett = 5	River Tone = 4 River Parrett = 4/5 River Yeo = 4 KSD = 3	Parrett Estuary = 5
Gradient		0.0076	0.004 (upper area = 0.0067 and lower area = 0.0015)	0.003 (upper area = 0.0041 and lower area = 0.0014)	0.006	0.0013	0.0064	0.0016	0.0002	River Tone = 0.0015 River Parrett = 0.0005 River Yeo = 0.0009 KSD = 0.0001	-
Potential for sediment transport (based on gradient and known sources)		High	Medium (High - upper region, Low - lower region)	Medium (Medium - upper region, Low - lower region)	High	Low	High	Low	Low	Low	-
Potential for sediment deposition (based on gradient and known sources)		Low	Medium	Medium	Low	High	Low	High	High	High	-
Soil Type		permeable brown loamy soils	surface water gleys (seasonally waterlogged impermeable soils) and in some areas brown loamy soils	surface water gleys (seasonally waterlogged impermeable soils) and in some areas brown loamy soils	shallow, slowly permeable calcareous soils	shallow, slowly permeable calcareous soils	permeable brown loamy soils	shallow, slowly permeable calcareous soils	deep stoneless clayey soils characteristic of river alluvium	deep stoneless clayey soils characteristic of river alluvium	deep, stoneless calcareous clayey soils
Soil vulnerability to erosion		High	High	High	Low	Low	Low	Low	Low	Low	Medium
Geology	**Drift**	Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)	Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)	Alluvium (clay, silt and sand)	Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)	Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)	Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)	Alluvium (clay, silt and sand)	Marine Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)	Alluvium (clay, silt and sand) Raised Marine Deposits (sand and gravel) River Terrace Deposits (sand and gravel) Peat	Alluvium (clay, silt and sand) and River Terrace Deposits (sand and gravel)
	Solid	Sandstone, siltstone and mudstone	Siltstone and sandstone	Oolite, lias, siltstone and sandstone	Clay, mudstone, oolite, siltstone and sandstone	Mudstone, siltstone and sandstone	Mudstone	Lias and oolite	Mudstone	Mudstone, siltstone and sandstone	Siltstone, mudstone and clay
Land Use		Managed Grassland = 55% Arable = 39%	Managed Grassland = 44% Arable = 51%	Managed Grassland = 49% Arable = 48%	Managed Grassland = 34% Arable = 63%	Managed Grassland = 23% Arable = 70%	Managed Grassland = 20% Arable = 36% Urban = 43%	Managed Grassland = 31% Arable = 23% Urban = 42%	Managed Grassland = 33% Arable = 44% Urban = 22%	Managed Grassland = 70% Arable = 29%	Managed Grassland = 36% Arable = 54%

Table 2.4.1. Summary of geomorphological characteristics

2.4.2 Sediment system

The fluvial sediment system involves a complex balance between source, supply and transport processes. Any imbalance between these elements of the sediment system can lead to instability in the channel, resulting in either excessive rates of erosion or deposition in the channel, which has significant consequences for flood risk management.

Sediment sources, transport and storage in the Parrett CFMP

Sediment in the rivers of the Parrett CFMP is derived from the following sources and processes:

- erosion of channel bank and bed sediments;
- sediment derived from runoff from adjacent agricultural land;
- tidal sediments.

There are instances when certain factors can result in either an increase or decrease in sediment supply. These factors are referred to as Potentially Destabilising Phenomena (PDP). The PDP within the Parrett CFMP sediment system; divided into catchment and reach scale factors, are outlined below.

Table 2.4.2. Potentially destabilising phenomena (PDP)

Scale	Increase sediment supply	Decrease sediment supply
Catchment Scale	Agricultural practises	Catchment sensitive farming
	Land use changes	Climate change*[1]
	Climate change*	New woodland/plantations
	Soil erosion	Urbanisation
	Deforestation	Tidal exclusion structure
	Urbanisation	
Reach Scale	Channel straightening	Bank protection
	Agricultural runoff	Dredging
	Bank erosion/collapse	Structures along the watercourse
	Poaching by livestock	Riparian vegetation
	Supply from upstream tributaries	Channel widening causing deposition upstream
		Engineered livestock watering points

* increased frequency and / or intensity of rainfall

*1 reduced frequency and / or intensity of rainfall

There are significant local and regional variations in sediment supply and transport within the Parrett catchment. These are summarised below:

Uplands

Sediment in upland watercourses of the Parrett CFMP area is characterised by coarse bedload; gravel and sand, becoming increasingly fine and silty fine further downstream. Some of the gravel beds in the upper catchment are locally important for spawning salmonides. Sediment is delivered to watercourses through erosion of channel banks and through incision of bedrock or bed sediments. Sediment is also

derived from sediment laden runoff from adjacent agricultural land. Sediment delivery through runoff is a major issue in some areas of the upper catchment, particularly the Upper Tone, Parrett and Isle catchments, where soils are characterised by fine-textured sandy silts. This type of soil is particularly vulnerable to erosion through runoff, a process that is sometimes exacerbated by the land-use practice in the catchment and erosion of channel banks during high flow events. Evidence from previous flood events has shown that under heavy rainfall, under certain agricultural regimes, large quantities of soil can be mobilised in the upper catchment. This, in turn, can cause the blocking of local smaller watercourses, culverts and deposition of silt on roads and occasionally to properties. The location of known flood events that were directly caused by field runoff is shown on Figure 2.4.1.

Lowlands (Somerset Levels and Moors)

The Somerset Levels and Moors essentially form a large basin through which the watercourses in the upper catchment drain before flowing out to sea through the Parrett Estuary. The Moors are crossed by very low gradient watercourses and rhyne systems. As a result of the shallow gradient of many of the watercourses in this area (shown on Figure 2.2.3), the potential for deposition in this region of the Parrett CFMP is very high, (see Table 2.4.1 for further detail). Sediment in the lowland watercourses is characterised by fine sand and silt, much of which is kept in suspension by fluvial and tidal flows. Sediment load is particularly high in the channels that are dominated by tidal processes, such as below Oath Sluice on the River Parrett, and Newbridge sluice on the River Tone in the lower catchment. A significant silt load is brought up into the fluvial system from the Bristol Channel during high tides and this forms a major control on the capacity of the River Parrett. Fluvial floods act to scour silt and are an important influence on the natural channel shape. Sedimentation is the key issue when considering sustainable river management in the area.

Estuary floodplain

Sediment load in the Parrett Estuary is dominated by sand, silt and clay material that is brought up into the system from the Bristol Channel during high tides. Much of the fine sediment load is deposited at the flanks of the channel forming wide mudflats, and where space allows, saltmarsh habitat. Both are recognised as national and internationally important habitats and are protected under a number of statutory designations, see Section 2.8 for details. The landward extent of mudflat and saltmarsh is limited in this region due to location of flood embankments along much of the length of the estuary. There is evidence that some stretches of the estuary are experiencing erosional pressures due to coastal squeeze caused by location of the flood embankments. This has caused a number of fluvial outfalls to be at risk of erosion and collapse, which could have consequences in terms of potential for fluvial flooding upstream if this occurred. Urban, agricultural and environmental systems in the Parrett CFMP rely heavily on these flood defences; therefore there is limited opportunity to re-establish natural processes that previously existed when undefended, however there may be the potential to re-align defence embankments to improve the natural processes between the river and floodplain.

2.4.3 Implications of the Water Framework Directive

The Water Framework Directive (WFD) is EC legislation which aims to ensure that waters are managed to achieve good quality across Europe. The WFD requires each member state to identify the extent and characteristics of water bodies and carry out an initial risk assessment of those waters which takes into account the impact on aquatic ecosystems of a much wider range of pressures than previously considered, and as such includes factors such as:

- physical and morphological alteration, and
- diffuse pollution from sediment delivery.

The WFD requires surface waters to meet 'good ecological and chemical status' and groundwater to meet 'good chemical and quantitative status' by 2015. Watercourses that are identified as Heavily Modified Water Bodies (HMWB) and Artificial Water Bodies (AWBs) must achieve 'good ecological potential' by 2015 (recognising that changes to morphology may make good ecological status very difficult to meet). In addition the WFD also requires that no deterioration in water status takes place.

This means that any activities that lead to biological changes e.g. morphological impacts (altering the physical shape of water bodies), changes in rates or volumes of flow (e.g. physical structures in the river channel or abstraction) or the introduction of alien species must be taken into account. Also, activities and practices that lead to diffuse water pollution (both urban and rural) will also need to be tackled if we are to improve our waters to meet the environmental objectives of the Directive.

In March 2005 we reported back to the Commission regarding which of our water bodies have initially been assessed as 'at risk' or 'not at risk' of failing to meet the environmental objectives of the Directive by 2015, see Figure 2.4.2. The degree of risk relates to the degree of physical alteration to the watercourse, extent of urbanisation, and degree of flood defence management. Therefore, all rivers which were classified as 'heavily modified' have been set as High Risk, while those that are 'non-heavily modified' are set as Low Risk.

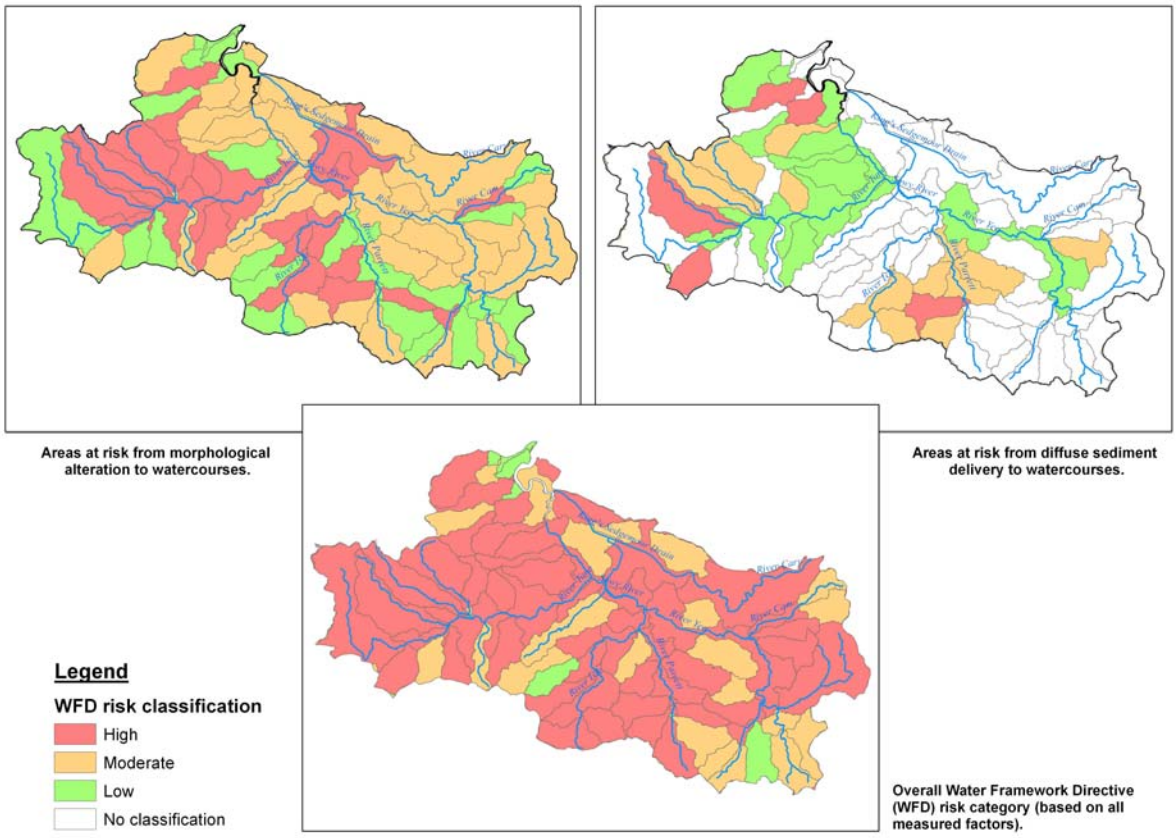


Figure 2.4.2. Water Framework Directive classifications.

Within the Parrett CFMP area, approximately 73% of all river basins have been classified as being 'at risk' (of not meeting the 2015 WFD target) based on all the measured factors (biological, ecological and physical). In terms of risks from morphological alteration, 29% of the CFMP area is classified as 'at risk' (see Figure 2.4.2), including parts of the Upper Tone catchment; Upper Isle and Upper Parrett areas. Watercourses at risk from diffuse sediment pollution have also been categorised (see Figure 2.4.2). Within the Parrett CFMP area 7% are considered 'at risk', including watercourses within the Upper Tone catchment (particularly along the Hillfarrance Brook), watercourses within the Upper Parrett and also watercourses that drain into the estuary floodplain within the North West Parrett area (particularly the Cannington Brook).

WFD targets therefore have a direct bearing on the development of flood management policies within the Parrett catchment. Flood management policies will need to ensure they do not lead to any further deterioration in the existing status of watercourses within the Parrett CFMP, and if possible should seek to provide improvements to help meet the WFD targets.

2.5 Soils

The CFMP area shows different types of soils that reflect the underlying geology. The geology and associated soil types are very diverse throughout the catchment. The runoff developed from these soils is very different. Of particular concern is the soft siltstone/fine-grained sandstone landscape, which is vulnerable to soil structural degradation, which has the potential to increase flooding and cause pollution.

The Spatial Pressures Analysis of River Quality (SPARQ) soils dataset is based on information supplied by the National Soil Resources Institute (NSRI). The SPARQ soils data for the CFMP is shown in Figure 2.5.1.

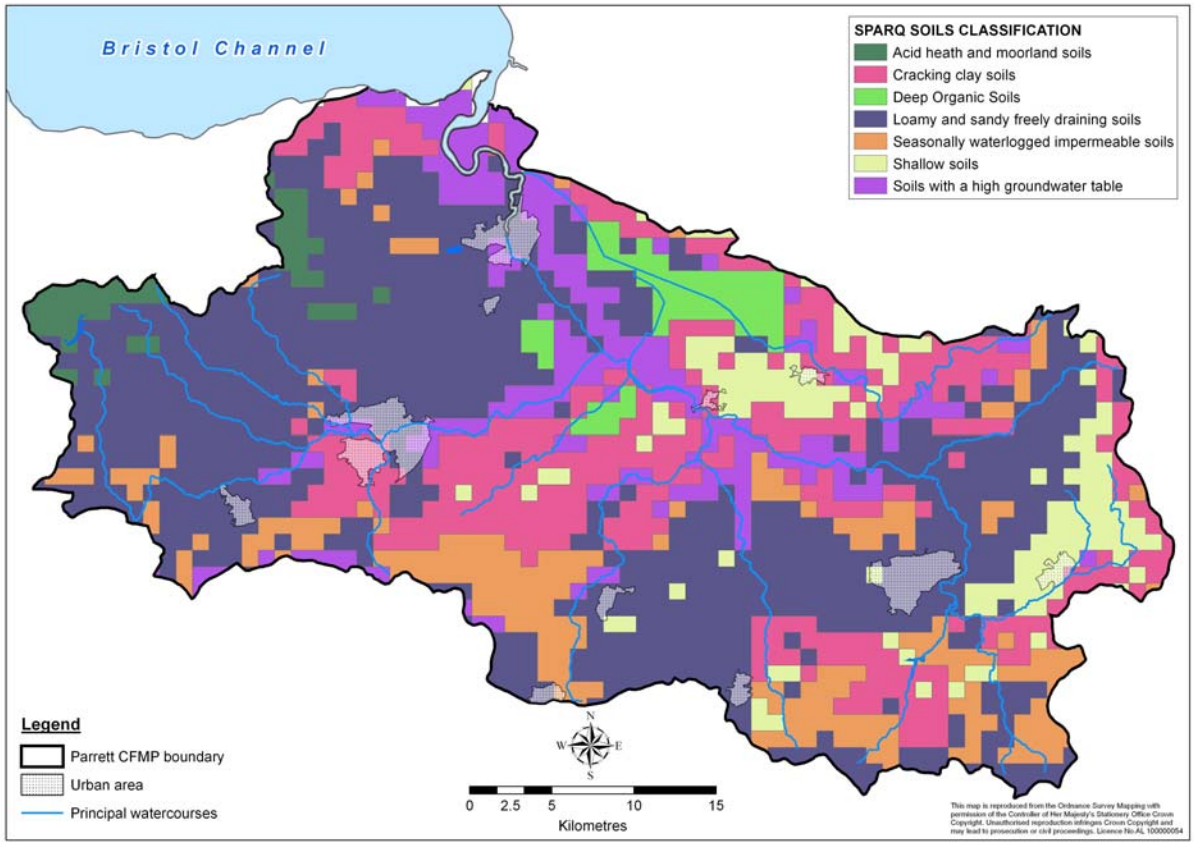


Figure 2.5.1. Soil types in the Parrett CFMP (based on SPARQ soils data)

In 2002, a R&D project was carried for the Environment Agency by Cranfield University to look into the prediction of sediment delivery to watercourses from land. From this research a series of plans have been developed to be used by river managers to help determine where the greatest risk from erosion and sediment delivery to watercourses is likely to occur. The plans illustrate the risk of annual erosion vulnerability and sediment delivery to watercourses.

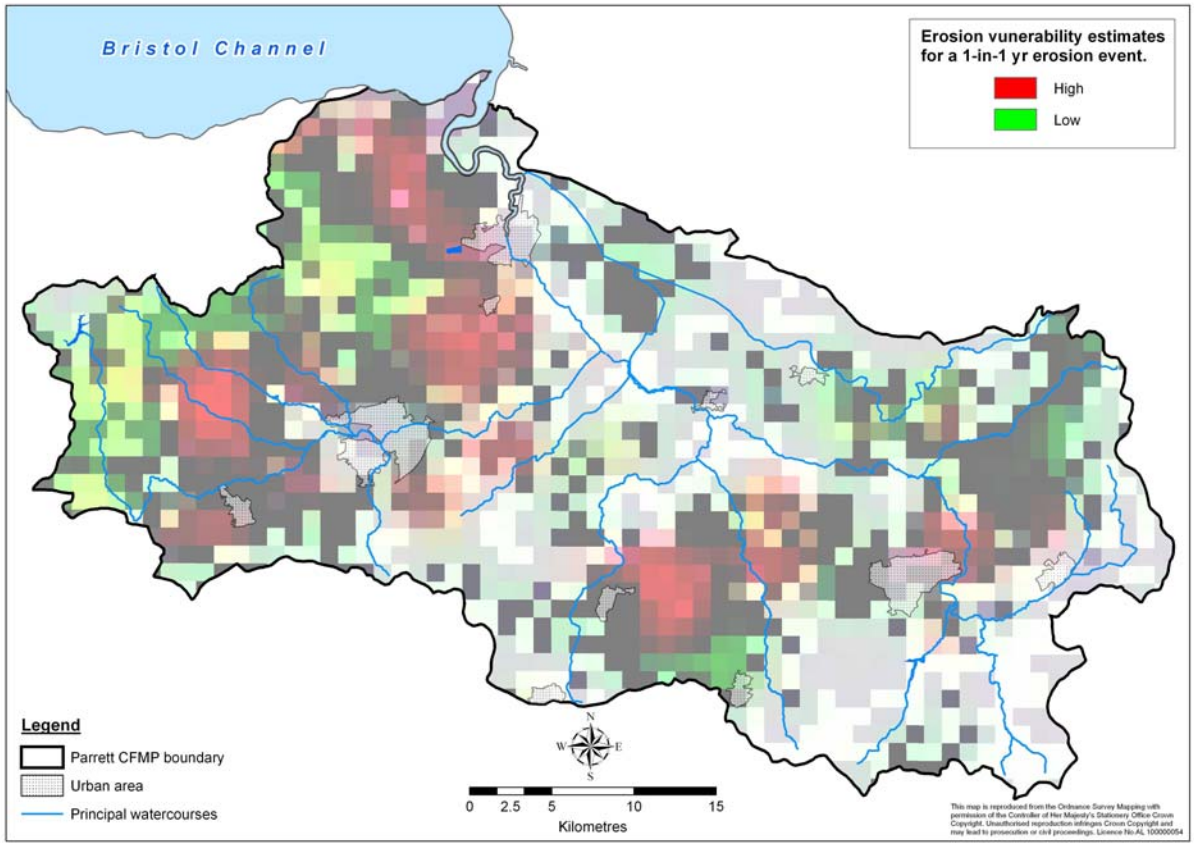


Figure 2.5.2. Areas at risk from soil erosion (described as erosion vulnerability during 1in1yr erosion event). **Source: R&D Technical Report No. P2-209**

This data has been used to identify the areas most at risk of erosion and sediment delivery to watercourses in the Parrett CFMP, see Figure 2.5.2. The greatest risk of erosion and diffuse pollution associated with sediment is shown to occur across areas with arable land use, where the soils are largely brown earths and brown sands with sandy loam, loamy sand and silty textures, see Figure 2.5.3.

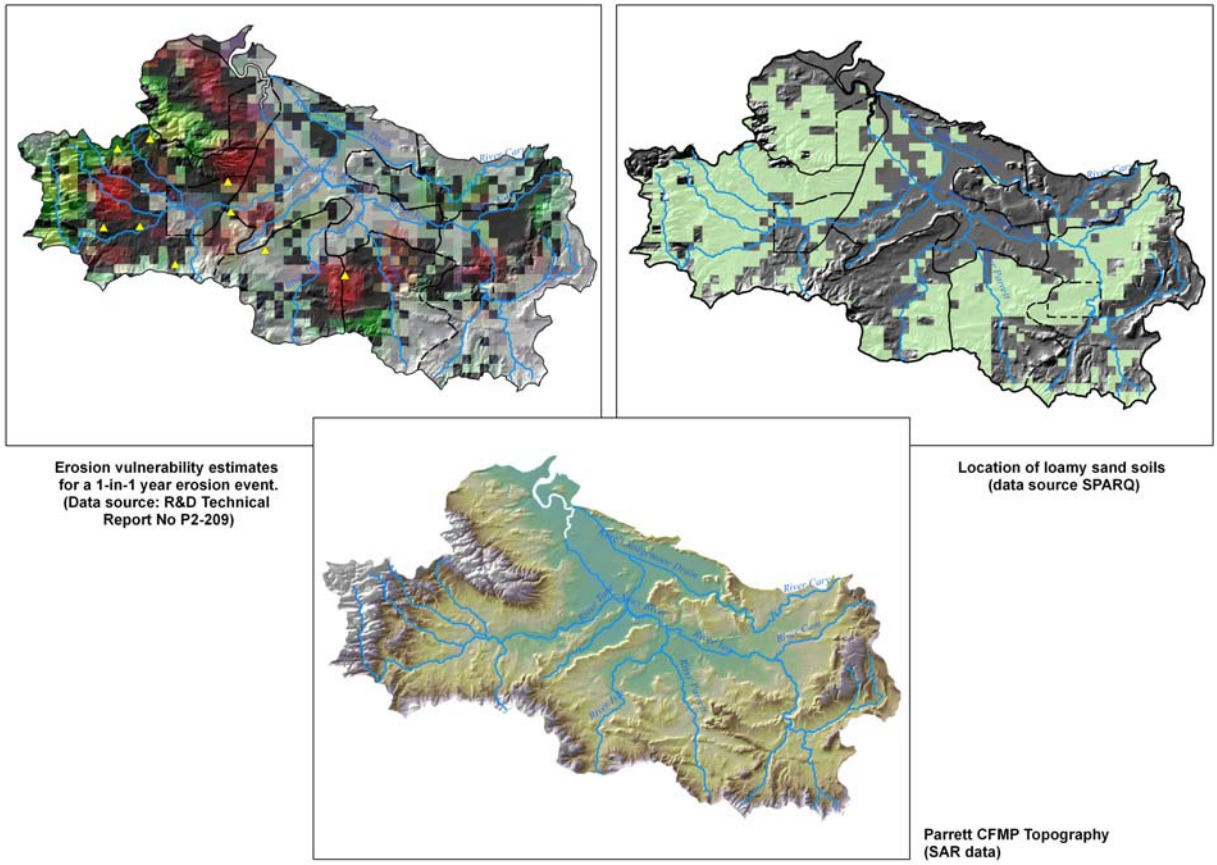


Figure 2.5.3. Soil erosion vulnerability, soil type and topography

Soils in the CFMP area can be broadly described in the three following geographic divisions:

Uplands

The Quantocks and much of the Vale of Taunton (the area to the north and north-west of Taunton) is characterised by slowly permeable brown loamy soils and clay soils (Whimple 3, Curtisden and Bromsgrove), which are prone to seasonal waterlogging and, in places, are at risk of water erosion (particularly within the Bromsgrove loamy soils in the upper Tone). The chance of soil erosion is high in these areas particularly on steep slopes and where soils are not well managed. The Blackdowns are characterised by a mix of surface water gleys (seasonally waterlogged impermeable soils) and in some areas brown loamy soils. Further east, soils are characterised by shallow, slowly permeable calcareous soils (Sherborne, Evesham 1 and Denchworth) typical of those overlying limestone geology. Runoff characteristics in the uplands vary considerably but runoff is typically fairly rapid.

Lowlands (Somerset Levels and Moors)

Consist of deep stoneless clayey soils characteristic of river alluvium (Midelnay and Fladbury 1) and deep peaty soils (Altcar 1). These soils are variably affected by groundwater and as such runoff rates tend to be high. The vulnerability of the soil to erosion is low in this area of the Parrett CFMP (see Figure 2.5.2).

Estuary floodplain

Low-lying areas of the estuary floodplain are characterised by marine alluvium, consisting of deep, stoneless calcareous clayey soils (Newchurch 2). Further inland there are pockets of stoneless mainly reddish clayey river alluvium soils (Compton). Runoff rates tend to be high in this area due to high groundwater table, though soil erosion potential is low. Further away from the estuary, soils are characterised by well drained fine loamy reddish soils (Milford and Whimple 3), that are particularly vulnerable to erosion in steep slopes off the Quantocks (see Figure 2.5.2).

2.6 Land use and land management

The CFMP catchment has a highly modified landscape, which has resulted from a history of modifying watercourses and water levels to create and maintain agricultural land and provide flood defence (both coastal and fluvial). Agriculture and the local environmental concerns in the area now rely heavily on this man-made/artificial system. The area is mainly rural, with four per cent of the land classified as urban[2]. The main urban areas include Taunton, Bridgwater, Yeovil, Wellington, Chard, Langport, Sherborne, Crewkerne, Somerton, North Petherton and Illminster.

There are several sources of information used to estimate different land uses in the CFMP area. We have used two of these methods, the Spatial Pressures Analysis of River Quality (SPARQ) land cover classification and the Agricultural Land Classification (ALC). As each uses a different method to estimate the percentage of urban area, the figures vary slightly between datasets.

2.6.1 SPARQ land cover classification

The SPARQ land cover types within the CFMP area are shown in Figure 2.6.1 and the proportion of each land cover type is presented in Figure 2.6.2 and Table 2.6.1.

[2] as per SPARQ land cover dataset

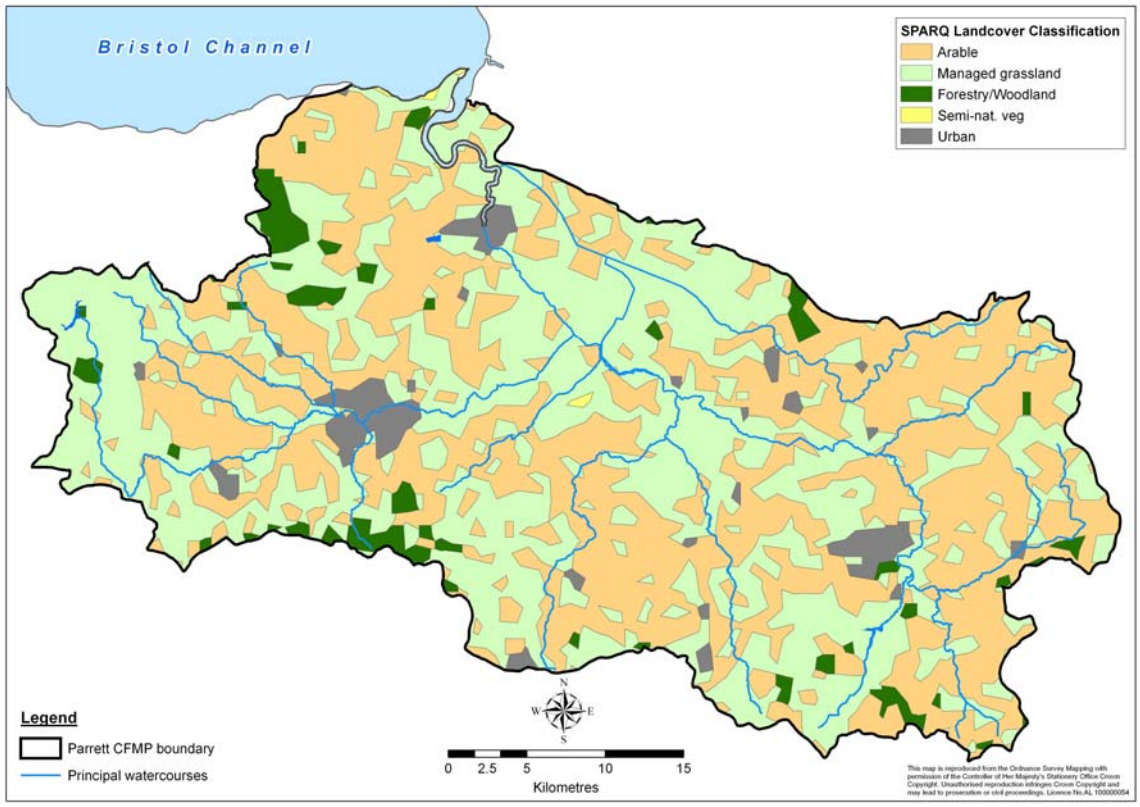


Figure 2.6.1. SPARQ land cover classification

Over ninety per cent of the CFMP area is managed grassland and arable. Three per cent is forestry/woodland and less than one per cent is semi-natural vegetation.

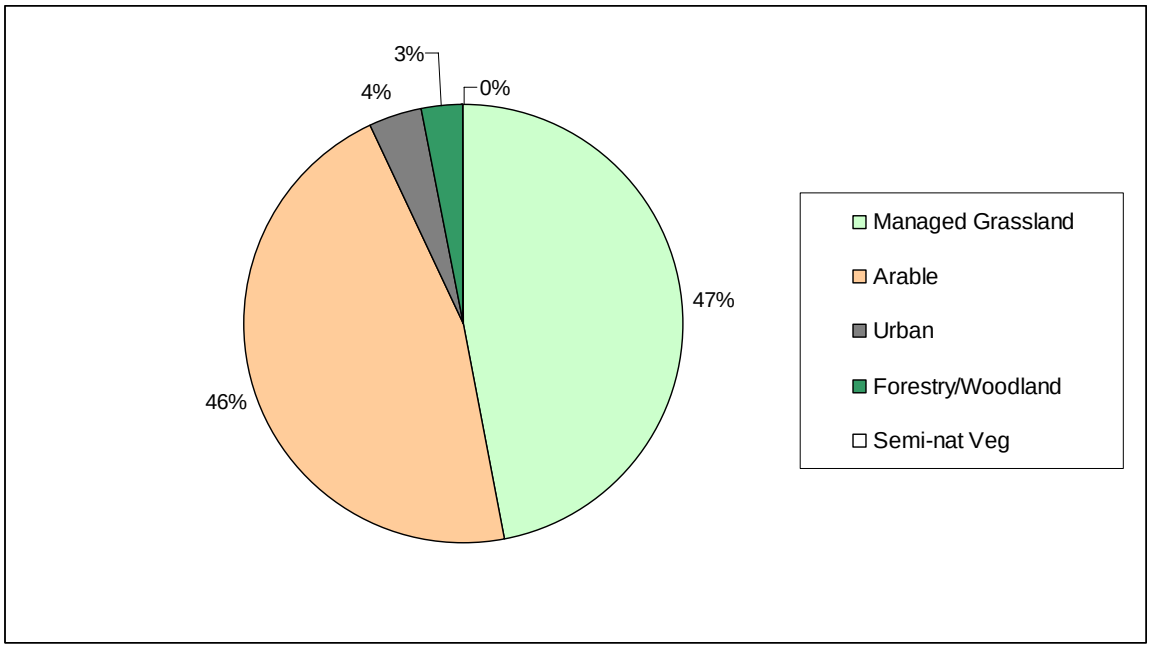


Figure 2.6.2. Proportion of SPARQ land cover types

Table 2.6.1. SPARQ land cover classification

SPARQ land cover classification	Area (km^2)	% CFMP area
Managed grassland	716	47%
Arable	702	46%
Urban	54	4%
Forestry/woodland	40	3%
Semi natural vegetation	1	0.001%
TOTAL CFMP AREA	*1513**	*100.0*

** Total area differs to estimates for the total CFMP as it excludes data covered by the SMP.*

2.6.2 Agricultural Land Classification (ALC)

The Agricultural Land Classification (ALC) provides a method for assessing the quality of farmland to help make informed choices within the planning system about how it will be used in the future. Grades are related to climate, topography, drainage, soil characteristics and other site factors. The 'best and most versatile land' is defined as Grades 1 and 2. Grade 3 is considered moderate for agricultural production, and Grades 4 and 5 are poor (ODPM 2003).

Figure 2.6.3 illustrates the ALC in the CFMP. Most of the CFMP is classified as Grade 3 showing that it is moderate grade agricultural land. Those areas with higher classifications include some of the environmental designations in the lowlands. Table 2.6.2 and Figure 2.6.4 show the amount of land for each ALC grade.

Table 2.6.2. Summary of Agricultural Land Classification (ALC)

Agricultural Land Classification	Area (km^2)	% CFMP area
Grade 1	92	5
Grade 2	244	15
Grade 3	1099	66
Grade 4	170	10
Grade 5	19	1
Non-agricultural	7	0
Urban	43	3
TOTAL CFMP AREA	*1672*	*100*

The poorest agricultural land is typically located in the upland areas, though there are also some areas classified as Grade 4 in the Mid Parrett area of the Somerset Levels and Moors. High rainfall, steep slopes, vulnerable soils and poor soil structure are likely to affect classification in the CFMP area. The State of the South West Report (South West Observatory 2005) notes that poor soil structure was particularly acute on the sandy and silty soils in Somerset, Dorset and Wiltshire. Poor soil quality can lead to more runoff and more soil erosion, which can reduce the quality of water and the flow capacity of rivers.

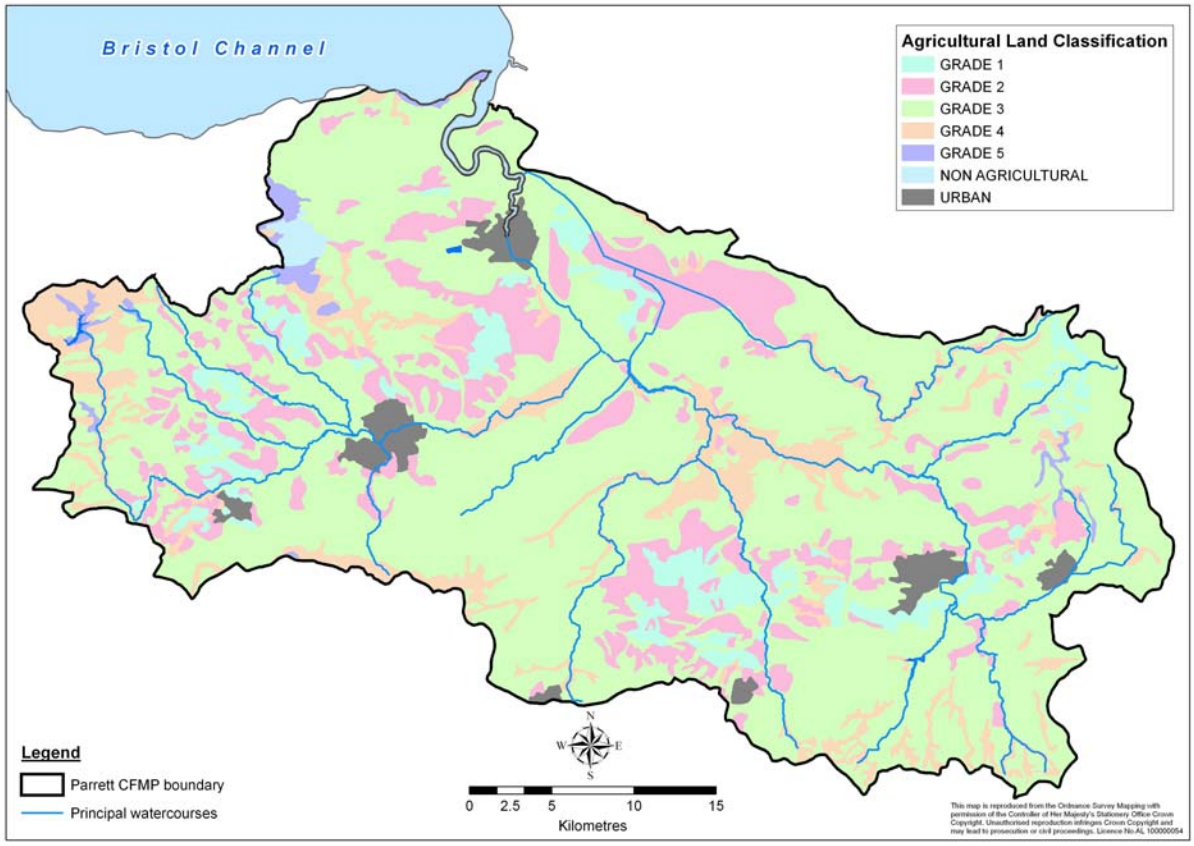


Figure 2.6.3. Agricultural land classification in the Somerset area

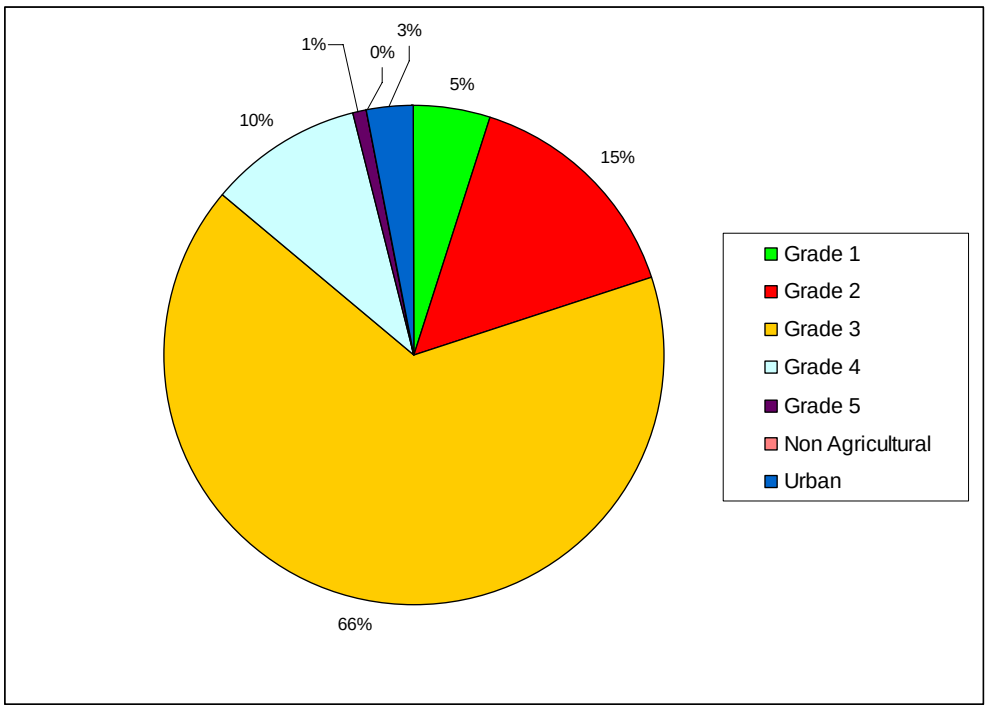


Figure 2.6.4. Proportion of land under each ALC grade

2.6.3 Changes to land use management practices

As agriculture is an important part of the area, the CFMP objectives and policies must consider the effect they will have on agriculture and rural business. Any changes in the way land is used, such as creating an additional wetland area for flood storage, would need thorough environmental, social and economic impact assessments, to determine the most appropriate locations, and address any land loss compensation issues with landowners.

The SWRSS recognises the flood risks in the region and the many ways in which careful land use management could be used to help reduce these risks and benefit the environment. The strategy, along with the recent reform of the Common Agricultural policy (CAP) (see Table 2.6.3), are likely to produce significant changes in land management that will affect many aspects of planning as well as flood risk management.

Table 2.6.3. Land management initiatives

Common Agricultural Policy (CAP) reforms & land management initiatives
Defra Single Payment Scheme
Replaces previous production-related payments with payments related to holding size and meeting cross compliance requirements. This involves following 17 standards of good agricultural and environmental condition and eight additional statutory management requirements. The major part of this scheme reinforces existing legislation for environmental protection and is likely to encourage more take-up of land management schemes.
Environmental Stewardship
New Environmental Stewardship Schemes, including Entry Level Stewardship (ELS), are also set up by the CAP reform and may help reduce flood risk. The ELS scheme target resource protection and diffuse pollution through management of soil, cropping and stocking rates. These are likely to have an impact on runoff rates. Reducing runoff by, for example, ELS buffer zones and winter soil management can lower peak flows in rivers. Creating/restoring of wetlands (Higher Level Stewardship) as flood storage areas and the re-creating of floodplain grasslands may also help reduce flood risk.
Forestry Commission English Woodland Grant Scheme
Provides grants to create new woodlands and manage existing woodlands appropriately.
Biodiversity Action Plans
Biodiversity Action Plans (BAPs) provide national and regional frameworks to protect important habitats and species, although they are not statutory documents. BAPs are acknowledged in development planning documents and have been central to a number of our projects in the CFMP area.
Defra Catchment Sensitive Farming Delivery Initiative
This scheme was launched at the beginning of 2006/7 and identifies parts of the upper Tone and Parrett as priority catchments for reducing diffuse pollution, silt runoff to sensitive sites within the lowlands of the Somerset Levels and Moors.

Ways in which runoff can be reduced through improved land management practice has been well researched in the catchment, particularly through the work of the Parrett Catchment Project (PCP). Evidence shows that there are a number of land management practices which can have a beneficial impact on reducing runoff to watercourses within the catchment (reported in R&D Technical Report P2-261/10, 2000), these include:

- increasing the roughness of the soil surface by using mouldboard ploughing;
- shallow ploughing the soil to intercept the runoff from wheel marks and redistribute the water to surrounding field areas and away from adjacent watercourses;
- controlling the grazing location of livestock to areas of the filed higher up the field slope to allow runoff to infiltrate into non-compacted areas of the field lower down the slope;
- improving crop rotations; and
- applying surface litter (mulch) to protect the soil from capping.

The upland areas would benefit most from improved land use management.

2.7 Hydrology

2.7.1 Key rivers in the Parrett CFMP catchment

The key rivers within the Parrett CFMP area are shown in Figure 2.7.1.

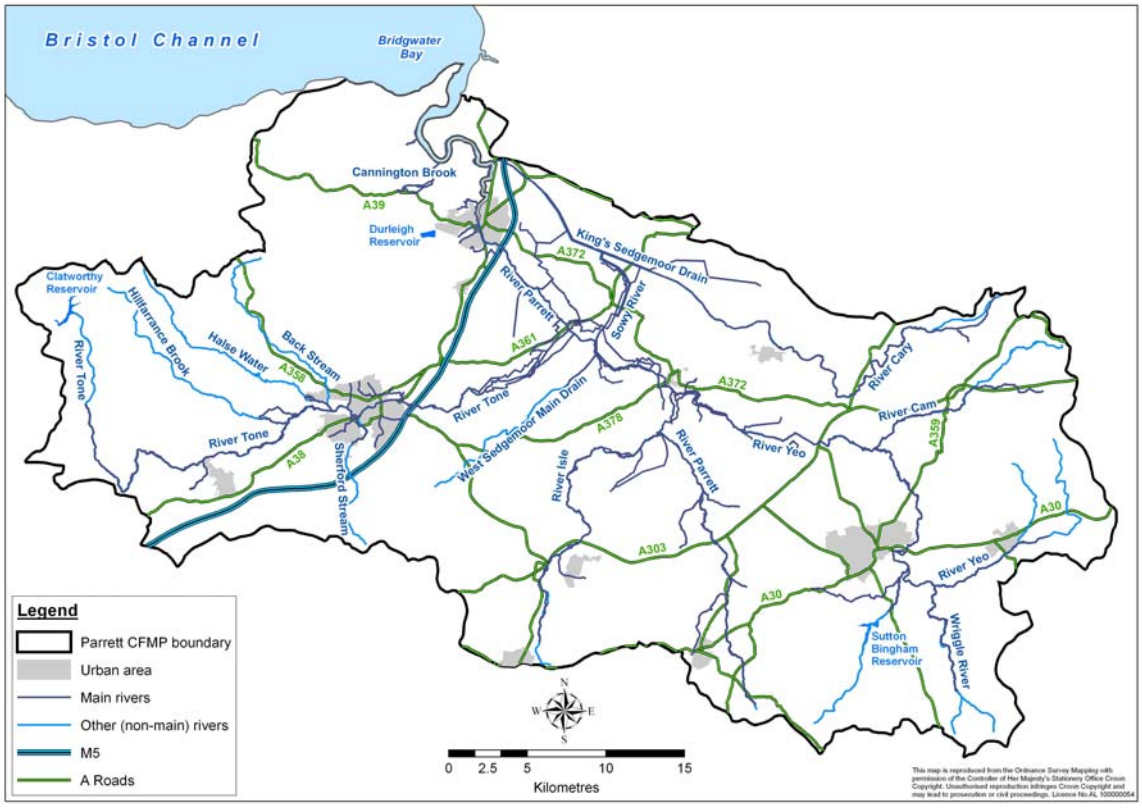


Figure 2.7.1. Main rivers within the Parrett CFMP area

The major rivers in the Parrett catchment are the River Parrett, Tone and Yeo. The River Parrett forms in the hills around Chedington in Dorset and flows west through the Somerset Levels and Moors to its mouth in the Bristol Channel. The Parrett is tidal below Oath Lock. The River Tone rises in the Brendon Hills in the southwest of the catchment. It flows down through Clatworthy Reservoir (constructed in 1961) and continues east through Wellington and Taunton to converge with the Parrett at Burrowbridge. The

River Tone is tidal up to Newbridge Sluice and contains some significant tributaries including Hillfarrance Brook, Halse Water, Back Stream, and Sherford Stream. The River Yeo, another tributary of the Parrett, has its source in the North Dorset Downs. The river flows around the east side of Yeovil and is joined by the River Cam further downstream. The Yeo flows west, to the south of Yeovilton, through the town of Ilchester and continues to join the River Parrett at Langport. No part of the River Yeo is tidal. These divides are based on topography and mark the limit of the area where water lying on the ground will flow downhill toward the streams that drain the catchment. It follows that any rain falling on the CFMP area that runs off the ground will eventually (apart from losses, for example to water supply abstractions, evaporation or storage) drain out through the Parrett Estuary and into the Bristol Channel.

The Rivers Parrett and Tone are embanked through the Somerset Levels and Moors, such that the channels are perched above the surrounding floodplain. Water is transported from the upper catchment through the lower Moors within this contained bank system.

As well as these major watercourses, a number of other main rivers and rhyne networks also feature in the catchment. It is these extensive mostly man-made rhyne networks that feature water level management infrastructure and form the character of much of the lowland areas within the catchment. These networks are used for irrigation and drainage. As the low-lying areas are very flat, some of the rivers can flow in both directions, depending on water levels in the rivers to which they are connected. These networks of rhynes and control structures are very important for maintaining the diverse and valuable environmental designated areas.

Flood levels in the Moors depend on how each Moor is fed from the main rivers. Water that enters the Moors via spillways or from the catchment areas of the Moors in some cases discharge via gravity outfalls back into the main rivers. However, during flood conditions, when the level in the rivers is too high or where the gravity system is ineffective, pumps are required to evacuate water.

Flood levels in the Somerset Levels and Moors are determined by a complex combination of operating rules involving flood flows, bank levels, tidal conditions, available moor storage and pumping capacity. On some Moors these operating rules are driven by environmental objectives (e.g. favourable conditions) as well as flood control. Elsewhere in the Parrett catchment, flood levels are generally derived from flood flows from the upper catchments, which depend on the capacity of the channel and relevant structures along the watercourses.

2.7.2 Hydrological response

The way that water runs off the land (hydrological response) varies throughout the catchment. This is because the hydrological response is determined by the underlying geology, soils, rainfall and topography in a particular location. For this reason, the hydrological response of the catchment can be divided into the same three distinct categories as used in the previous sections:

Uplands

There is a large range of hydrological responses within the upland areas of the Parrett catchment; however these areas are generally dominated by fairly quick runoff from small steep catchments. Flooding tends to occur during short intense rainfall events both in the summer and winter. Flooding can occur from high river levels or from direct runoff.

Lowlands (Somerset Levels and Moors)

The hydrological response through the Parrett catchment varies significantly between the upland areas and lowlands. Storms that cause flooding in the upland areas often have little impact in the lowlands and vice versa. To cause flooding in these lowland areas requires longer duration storm or series of storms. The wetness of the catchment prior to the event and the volume of rainfall are more important than the intensity of the rainfall. This is due to the flat nature of these catchments combined with the artificially regulated storage areas. The lowland areas act to attenuate peak flood flows passing downstream to the Bristol Channel, although they do also result in high river flows continuing for significant periods following an event.

Estuary floodplain

The estuary floodplain areas have two hydrological/hydraulic functions. The first concerns the direct catchments feeding these floodplain areas. There are a series of smaller watercourses passing through these catchments before discharging into the River Parrett. These watercourses have their sources as natural streams in the Quantock hills where there is rapid runoff similar to the upland areas described above. As the watercourses get closer to the Parrett they reach the flatter lowland areas and become more artificially managed. Flooding here is dependant on longer duration storms similar to the lowland areas described above. Flooding is also a function of the river level in the Parrett with flapped outfalls from these watercourses restricting outflow during high tides. The second function of these areas is to take floodwater during extreme tidal events when the banks of the Parrett overtop.

A storm event can be described by the length of time that rain falls and the average intensity of the rainfall during that time. The length of storm that causes the most flooding at a particular location is called the 'critical duration' and is different throughout the catchment. For example, in some locations, a short period of heavy rainfall will cause the most flooding; however, in other locations a longer period of lighter rainfall will cause the most flooding. In general, the critical duration for flooding increases as you travel down the catchment.

Due to the broad scale nature of the CFMP, it is necessary to choose only a few critical storm durations to indicate flooding across the whole CFMP area. Up to six different storm durations were considered at any point within the catchment varying from 13 hours to 120 hours. The following figures detail the flow hydrograph responses at three locations within the catchment (River Tone upstream of Taunton, River

Yeo at Ilchester and River Parrett at Langport) during the 25 hour, 55 hour and 120 hour storms for the 1% annual exceedance probability event.

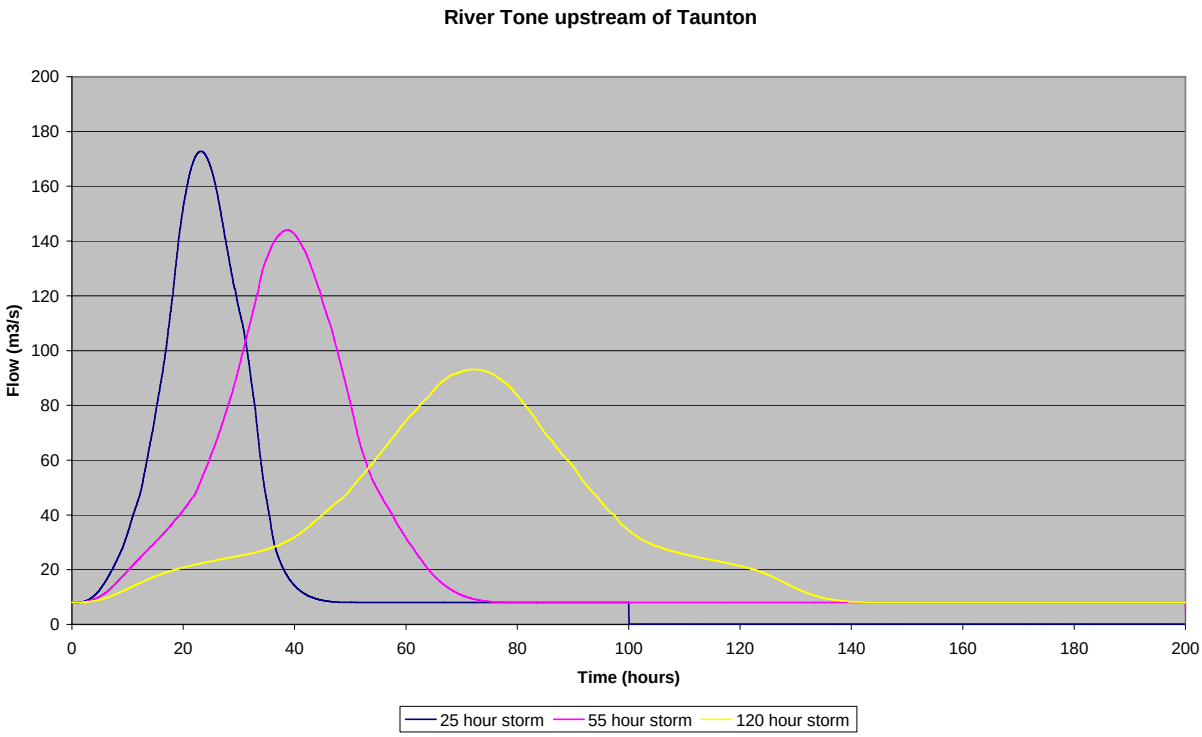


Figure 2.7.2. Flow hydrographs for the River Tone upstream of Taunton

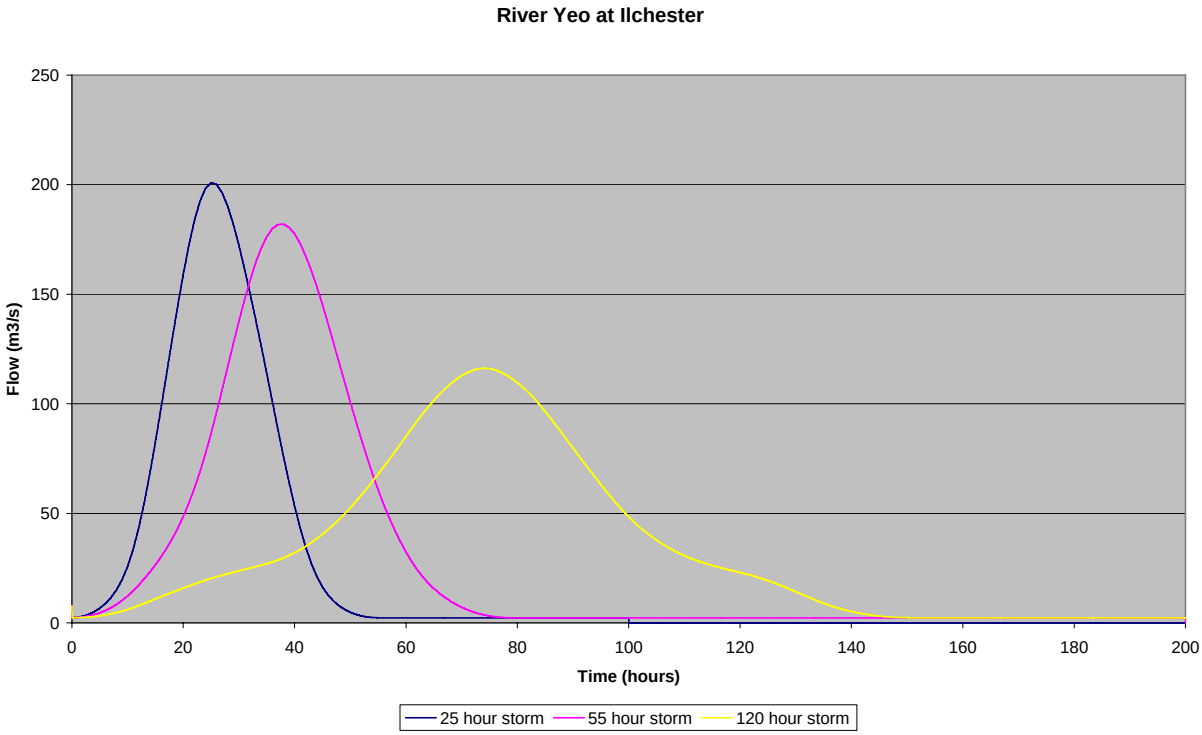


Figure 2.7.3. Flow hydrographs for the River Yeo at Ilchester

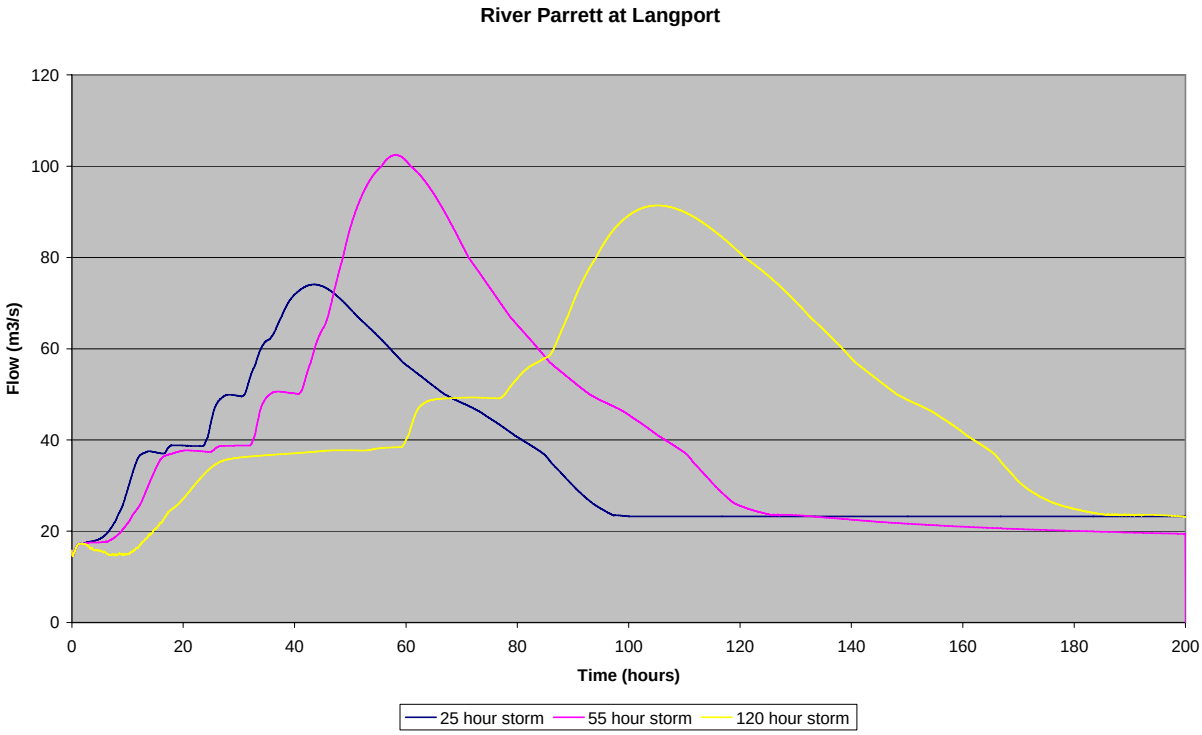


Figure 2.7.4. Flow hydrographs for the River Parrett at Langport

These figures show how differing parts of the catchment react to different duration storms, and also how significant the attenuation effect of the Somerset Levels and Moors is with the peak flows on the Parrett at Langport being significantly reduced from the flows further upstream.

2.7.3 Rainfall and flow measurement

The annual rainfall varies across the catchment, from as high as 1,325mm each year at the upstream extent of the Catchment, to 675mm each year in the Somerset Levels and Moors. The difference in rainfall is strongly related to topography of the catchment, as illustrated in Figure 2.7.5. The annual rainfall in the Somerset Levels and Moors is the lowest in the southwest of England.

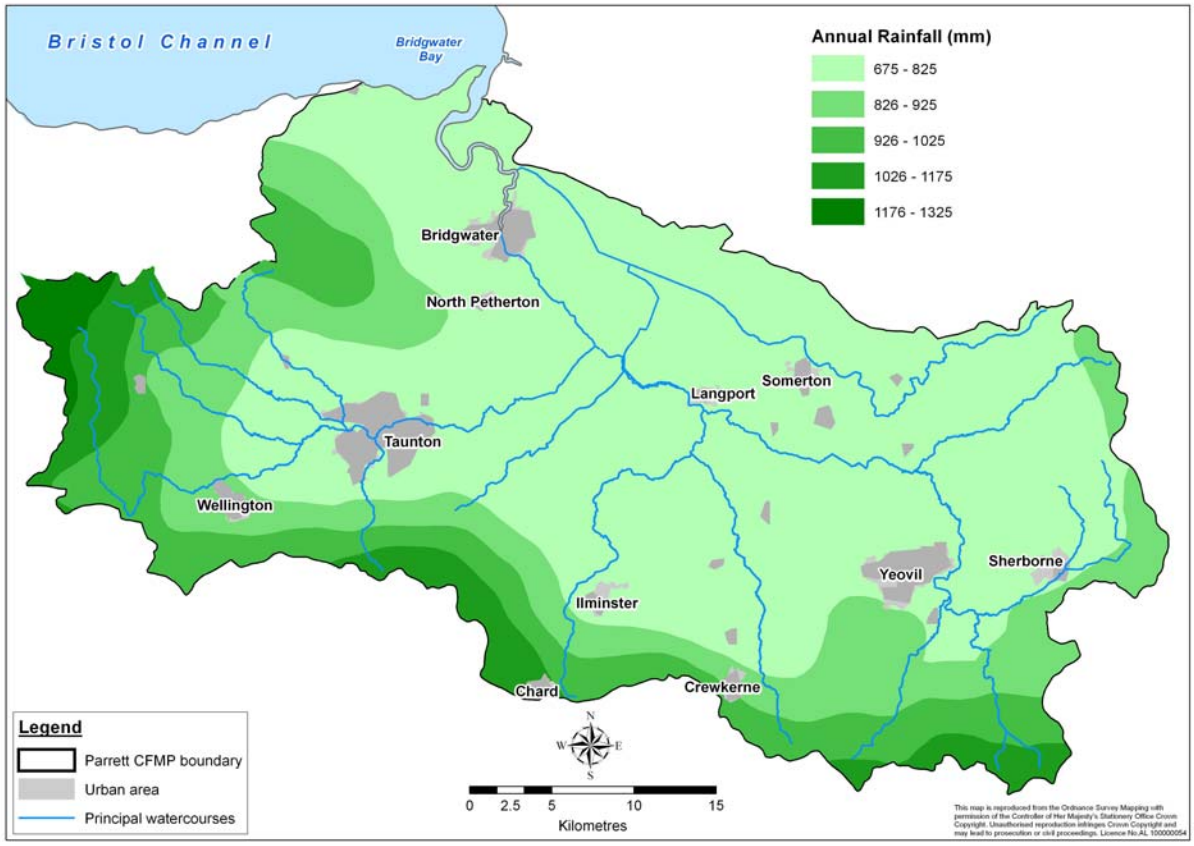


Figure 2.7.5. Average annual rainfall in the Parrett CFMP

To measure rainfall we use data from a number of rain gauges throughout the CFMP area. We also operate flow and water level gauges that we use to monitor runoff in the main watercourses. Figure 2.7.6 shows the location of the rain gauges in this catchment with the gauges divided up into autographic gauges (where readings are taken every 5-15 minutes) and daily gauges (where readings are taken on a daily basis).

Figure 2.7.6 also shows the locations of the main flow gauges within the catchment. This figure also details our current estimate for the 1% annual exceedance probability event at these stations. There are additional gauges within the catchment used for flood warning, low flows, or water resources purposes which have not been included on this figure.

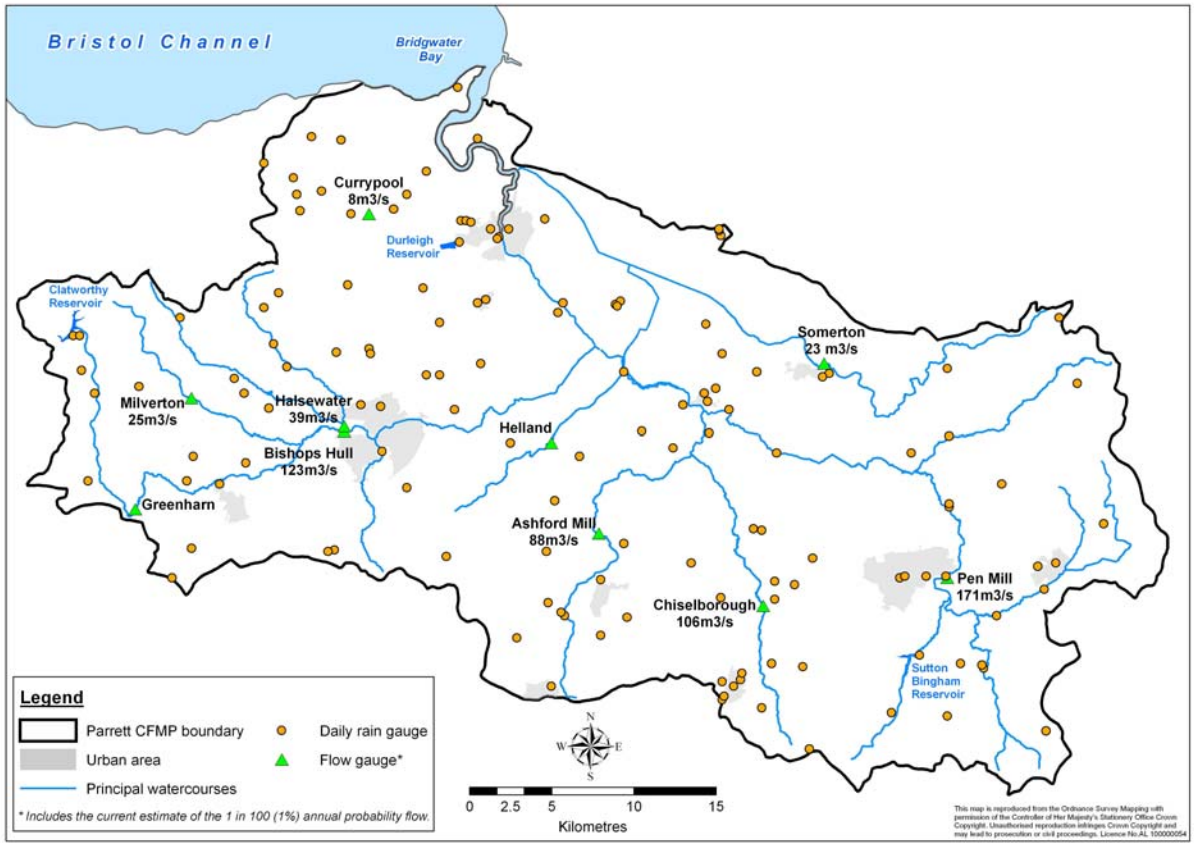


Figure 2.7.6. Main flow measurement and rainfall stations

2.7.4 Water level management

The landscape of the lowland areas of the Parrett CFMP has been highly modified over time, mainly due to the construction of sea and flood defences and an artificial system originally designed to drain the Levels for food production. The current agricultural, environmental and social features in the area now rely heavily on this system. The options for managing water levels are limited by topography, sea levels, river levels, as well as a need to balance conflicting demands on the landscape.

The current water level management system consists of an extensive network of man-made drainage ditches known locally as 'rhynes'. The rhynes are artificially fed with water by control structures (including penning hatches and sluice gates) on the major watercourses, operated by the Operating Authority (which is either the Environment Agency or the Parrett Internal Drainage Board).

Maintaining water levels to suit agriculture and the environment is complicated due to the different needs and sometimes conflicting views, which is further complicated by natural flooding. The way that water is distributed and controlled (particularly in the Somerset Levels and Moors), has a fundamental influence on the ability to support environmental objectives. Water Level Management Plans (WLMPs) are a key instrument in ensuring that SSSIs, in particular those within the SPA, have adequate water supplies of an appropriate quality to meet conservation objectives (see Section 2.8).

The appropriate use, distribution and management of water resources is vital if environmental objectives are to be achieved while ensuring sufficient resources are available for public water supply and other uses. The Parrett CFMP addresses this important issue where flood management has a direct bearing on water resource availability and quality, but does not aim to provide a general basis for water resource management within the catchment, which is covered in the Catchment Abstraction Management Strategies (CAMS).

2.7.5 Groundwater and abstraction

Water for public water supply (the main consumptive use of water) is obtained from a combination of ground water and surface water resources. Generally the geology of the catchment is such that opportunities for ground water abstraction are limited and this only supplies less than one third of the total requirement. The majority of the remaining requirement is delivered by impounding reservoirs including the Durleigh, Sutton Bingham and Clatworthy Reservoirs (see Figure 2.7.1). There is, however, a net shortfall of available water resource within the catchment, and a limited import of water for public water supply is required from outside of the catchment. With the possible exception of land management changes (which could reduce or increase infiltration through the soil to the available aquifers), it is unlikely that flood management will have a significant impact on water supply issues.

High groundwater levels are not a major cause of flooding in the Parrett CFMP.

With potential future climate changes, drought management is likely to become more important. Increased storage within the catchment will be an important way of managing drought and presents an opportunity for the CFMP.

Abstraction within the Parrett CFMP area provides an important source of water for public water supply, industry and agriculture. So, we need to recognise the need to maintain both the quantity and quality of groundwater resources when developing flood risk management options.

2.8 Environment and heritage

2.8.1 Designated sites

The CFMP area is rich in biodiversity, both in terms of species and habitats, and contains a number of nationally and internationally important environmentally designated sites. These are summarised in Table 2.8.1 and illustrated in Figure 2.8.1.

National and international nature conservation designations (Sites of Special Scientific Interest (SSSI), Ramsar sites, Special Protection Areas (SPA) and Special Areas of Conservation (SAC)) are described in the following paragraphs. These must be recognised when looking at ways of managing flood risk in

the catchment so that flooding does not damage the sites and so that opportunities for improving the sites through flood management are identified.

Other environmental designations (e.g. for landscape) are discussed in Section 2.8.2.

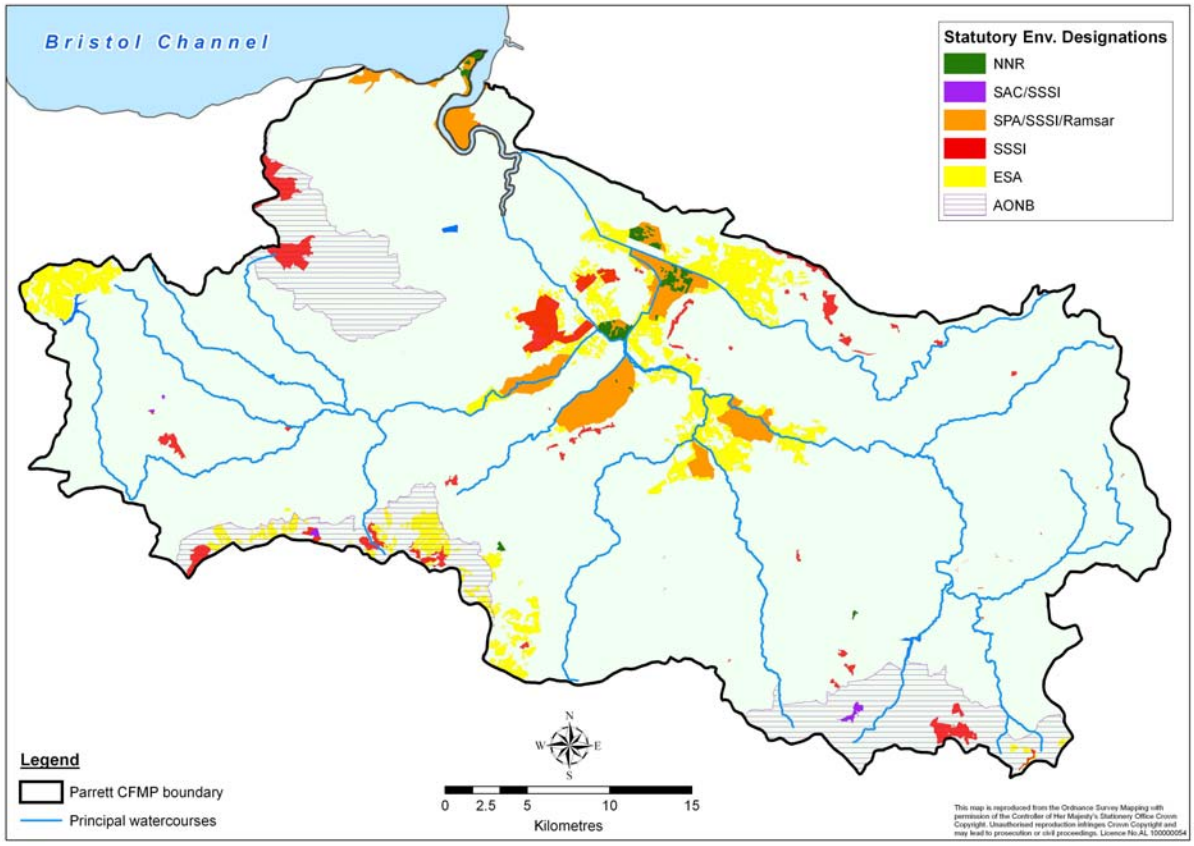


Figure 2.8.1. Special Protection Areas and Special Areas of Conservation within the CFMP area

Table 2.8.1. Environmental designations within the CFMP area.

Designation	Status	Sites
Ramsar	International	2
Special Area of Conservation (SAC)	European	4
Special Protection Area	European	2
Area of Outstanding Natural Beauty	National	3
National Nature Reserves	National	4
SSSI	National	59
TOTAL		**79**

Sites of Special Scientific Interest

The 59 SSSIs which lie within or partially within the CFMP area support a range of habitats as summarised in Table 2.8.2. Of these 59 sites, 18 are designated for their geological interest, chosen for their past, current and future contributions to the science of geology, with the overall aim of preserving England's geological heritage. Only one of these sites (Greylake) is thought likely to be affected in any way by alterations to flood management.

Table 2.8.2. Sites of Special Scientific Interest (SSSI) within the CFMP area.

Predominant interest/ habitat	Number of sites	Ha of land included
Geological	20	115
Arable	1	11
Fen/ wet woodland	1	11
Grassland (various types)	16	3,548
Heathland	2	219
Mixed	5	2,627
Woodland	9	678

Figure 2.8.2 provides an indication of the condition of SSSIs in the CFMP area, as assessed by Natural England. The Government's Public Service Agreement (PSA) target is to have 95 per cent of SSSIs in 'favourable' or 'unfavourable recovering' condition by 2010.

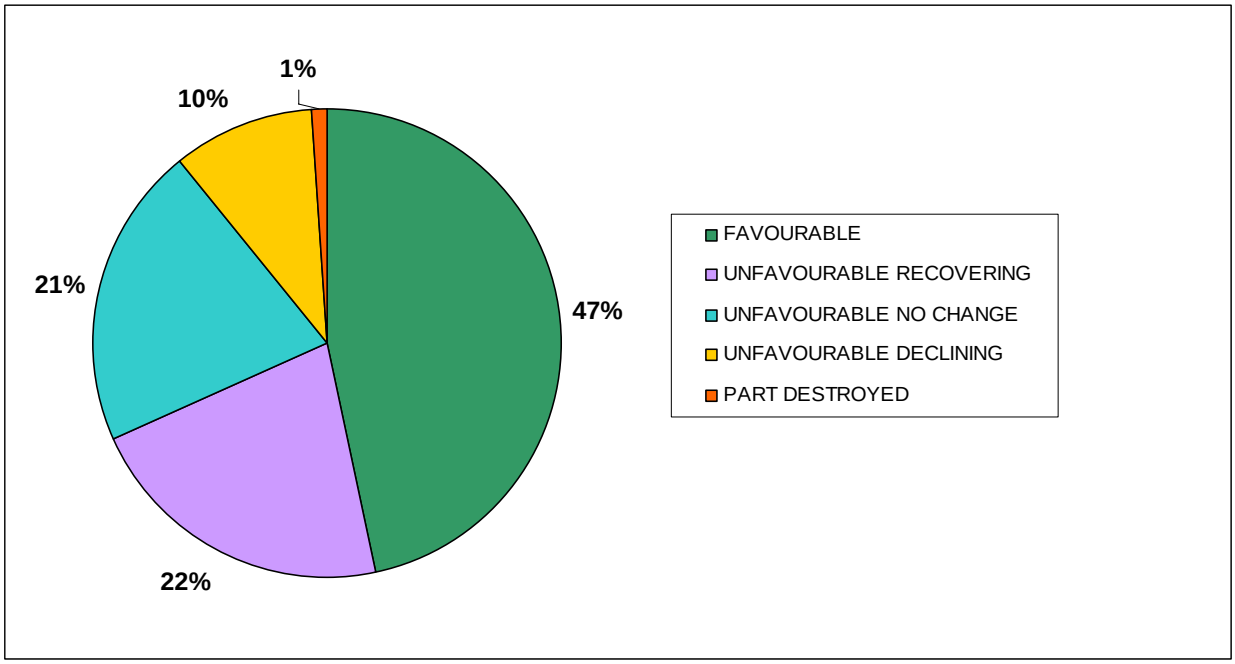


Figure 2.8.2. Condition of SSSI within the CFMP area (percentage of sites)

In terms of area, 47% of SSSI-designated land in the CFMP area is in favourable condition (6,634ha), with a further 22% classified as 'unfavourable-recovering' (2,336ha). However, this leaves just over a quarter of the SSSI area in the catchment not meeting the government PSA target. Reasons cited for adverse condition of SSSI in the CFMP area are not generally related to flooding or flood management (See Table 2.8.3), and there is limited opportunity for flood management to help improve SSSI status throughout much of the CFMP area. However for SSSIs in the floodplain, flood risk management may provide an opportunity to help improve their condition. Of the land currently classified as not meeting the government PSA target (4,249ha), approximately 3,277ha is grassland found in the Somerset Levels and Moors area where flooding and water level management may be a factor affecting condition.

Table 2.8.3 provides examples of specific SSSI, providing PSA status, site conditions and reasons for adverse conditions.

Table 2.8.3. Examples of SSSI habitats and PSA status

SSSI habitats and PSA status within the CFMP area				
SSSI name	**Main habitat**	**PSA status**	**Condition**	**Reason for adverse condition**
Curry and Hay Moors	Neutral grassland - lowland	2%	95% unfavourable no change	Drainage, Fertiliser use, Inappropriate water levels, Water pollution - agriculture/run off
East Polden Grasslands	Calcareous grassland - lowland	95.6%	63% unfavourable recovering	Unfavourable because frequency of indicator species is much too low
Moorlinch	Neutral grassland - lowland	70%	68% unfavourable recovering	Unit now part of RWLA. Some concerns with under-management of rush
Melbury Park	Broadleaved, mixed and yew woodland - lowland	78%	59% favourable	-
Greylake	Earth heritage	100%	100% favourable	-

Opportunities for enhancement associated with flood management

Table 2.8.4 summarises likely opportunities associated with flood management depending on the broad location of sites.

Table 2.8.4. Condition of SSSI in each broad division

Condition of SSSI in each broad division						
Location	**Number of SSSI**	**Area of SSSI (km^2)**	**Types of SSSI**	**Condition**	**Water and/or flood related reasons for adverse condition**	**Opportunity to improve status with CFMP**
Uplands (including sites in the Mendips, Quantocks and the Blackdown Hills)	43	13 (16%)	Woodland, grassland, heathland and fen.	Favourable or recovering	Water level may be a defining feature of some habitats (e.g. fenland)	Limited or none for most sites. Where water levels are important, they tend to be determined by behaviour of small watercourses and local geomorphology, rather than the main rivers in the catchment.
Lowland floodplain sites (Somerset Levels and Moors)	14	44 (54%)	Predominantly neutral grasslands on floodplains close to main rivers. Condition and status is dominated by water level and appropriate water level management is a necessary part of them achieving favourable condition.	Favourable	Flooding not a key documented factor in determining achievement of favourable condition	Some opportunity for flood management options which improve water quality or the distribution or duration of flooding and are consistent with water level management targets
Estuary floodplain	1	25 (30%)	Salt marsh, other inter-tidal habitats.	Favourable	Site is outside the CFMP area but could be affected by flood management within it.	Improvements to water quality through CFMP measures could benefit these SSSIs
TOTAL	58*	82	-	-	-	-

** One SSSI site was located in the coastal area and is therefore covered in the SMP rather than the CFMP.*

Somerset Levels and Moors

There are a variety of reasons for SSSI citation, some more closely related to water (and consequently sensitive to flooding) than others; those SSSIs located in the Somerset Levels and Moors represent features very closely related to water level management e.g. wintering wildfowl, breeding waders, ditch and rhyne flora and invertebrate fauna, and botanically rich meadows.

Flooding can be beneficial or damaging, depending on the interests represented on sites and the flooding regime to which they are adapted. Winter flooding is generally beneficial for feeding wildfowl communities, but prolonged deep flooding can cause some damage to grassland communities (e.g.

MG8) and reduce the invertebrate biomass on which some species feed. Prolonged summer flooding can also pose a significant threat to ground nesting birds.

However, most SSSIs in the Somerset Levels and Moors are more dependent on appropriate water level management than on manipulation of flooding. The CFMP can have a positive role in facilitating an improvement in the condition of these SSSIs by reducing risks associated with major flood events, whilst supporting necessary water level management. A number of SSSIs in the Somerset Levels and Moors were found to be below favourable condition when last reported in 2001, primarily due to low winter water levels and lack of appropriate water level management. This has since been redressed through the Somerset Levels and Moors Action Plan for Delivering Favourable Condition, which culminated in a programme of works undertaken by the Environment Agency to improve penning structures in the area, allowing more flexible water level management. A list of these works is given in the appendix; some are complete and others currently underway. For example, they include a new twin tilting weir at Greylake Sluice to provide a summer and winter feed into Moorlinch SSSI and providing summer pen in the Kings Sedgemoor Drain to feed into Kings Sedgemoor SSSI. Works are currently underway to replace Blind Man's Gate tilting weir and refurbish Langacre Sluice, Beer Wall and Clyse Sluice to facilitate achievement of favourable condition on Kings Sedgemoor SSSI.

The CFMP must take account of and help to facilitate the sensitive water level management plans developed for these SSSIs by ensuring that flood alleviation measures do not negatively interfere with the penning regimes.

Bridgwater Bay

Bridgwater Bay SSSI covers a reasonable proportion of SSSI area within the CFMP area (3,500ha out of the total 11,000). Although located within the CFMP boundary, it is essentially controlled by tidal influences. However reasons cited for both adverse and 'unfavourable recovering' conditions include water quality and water level, including unfavourably low winter water levels. However, the site will be covered by the Shoreline Management Plan and as such; an assessment of the potential to improve the status of these SSSIs will not be given here.

2.8.2 European designations

Several sites within the catchment are designated for their wildlife at a European level. Particular requirements relate to these designations, including a requirement for appropriate assessment under the Birds and Habitats Directives for any proposal not required for their management, including flood management proposals such as this one.

Ramsar Sites

The Somerset Levels and Moors and the Severn Estuary are designated as Ramsar sites under the Ramsar Convention for Wetlands of International Importance.

Designated features include:

- Internationally important populations of Bewick's Swan *Cygnus columbianus*, Common Teal *Anas crecca* and Northern Lapwing *Vanellus vanellus*
- A bird assemblage of international importance
- Populations of 17 UK Red Data Book invertebrate species

All of these depend to some extent upon flooding. Wintering bird populations are highly dependent on a mosaic of floodwater and grassland, with a variety of flood conditions each suiting different species. The neighbouring Severn Estuary Ramsar site is also likely to be affected by activities within the catchment, although to a limited extent.

Special Protection Areas for Birds (SPA)

The Somerset Levels and Moors is designated as an SPA under the European 'Birds Directive' (79/409 EEC). Designation rests on the following:

- Internationally important populations of Bewick's Swan, Common Teal, Northern Lapwing and Golden Plover *Pluvialis apricaria*
- An internationally important assemblage of wintering waterfowl

High water tables and frequent flooding are also fundamental to the SPA designations; a range of flood conditions suiting different species within the assemblage. The Severn Estuary is also designated as an SPA and could be affected to some extent by the CFMP, although it is not included within the CFMP area.

Special Area for Conservation (SAC)

There are three Special Areas of Conservation (SAC) within the CFMP designated under the European 'Habitats Directive' (92/43 EEC): Hestercombe House, and Holme Moor and Clean Moor in the Taunton area, and Quants in the Blackdown Hills. The Severn Estuary cSAC could also be affected by management within the CFMP area though it is not included within it.

Holme Moor and Clean Moor are designated as an important outlier of calcareous fens in south-west England, where *Cladium* is a local and rare species. The site occupies an unusual ecological situation on a spring line and at the foot of a scarp slope. It has very high species diversity and, although designated for fen habitats, only 11% of the site is fen, the rest being mainly broadleaved woodland.

Quants is primarily mixed woodland, with dry grassland on approximately 15% of the site. It is designated for populations of marsh fritillary butterfly (*Euphydryas aurinia)*; the damp and sheltered spot is placed within the centre of a grassland/fen mosaic supporting a much larger metapopulation of the species. Hestercombe House has been designated for a large maternity roost of lesser horseshoe bat *Rhinolophus hipposideros*. The bats roost in the roof void of part of a large building.

Flood risk will affect the environmental condition of each of these sites in a different way depending on the local setting (factors affecting flooding) and the requirements of the specific niche habitat (factors affecting survival of key species).

2.8.2 Other designations

There are four National Nature Reserves in the CFMP area: Hardington Moor, Barrington Hill, Bridgwater Bay and the Somerset Levels and Moors. The latter two are in the lowland grazing marsh and floodplain of the CFMP. Hardington Moor and Barrington Hill are meadows surrounded by well established hedges on gently sloping clay-rich soils. This habitat represents a large area of species-rich unimproved neutral grassland, which is now rare nationally and home to scarce species, such as French oat-grass and adder's tongue and a number of butterfly species. They are located in the hills of the Blackdowns and Wessex Vales respectively. Again, these grasslands may respond in a markedly different way to the lowlands of the levels and moors, not to mention tidal-influence at Bridgwater Bay.

Due to its unique landscape and the fact that it is the largest lowland grazing marsh system in Britain, The Somerset Levels and Moors were designated as an 'Environmentally Sensitive Area' by Defra. This designation is now superseded by Environmental Stewardship Agreements through which landowners can be compensated for undertaking management that will deliver environmental benefits, for example providing flooded land in winter for water birds.

The Quantock Hills, Blackdown Hills and the Dorset section of the catchment are designated as Areas of Outstanding Natural Beauty (AONB). These are unlikely to be significantly affected by flooding, due to their natural topography.

2.8.3 Biodiversity Action Plans

Not all biodiversity in the CFMP area is confined to designated sites. Local councils, working in partnership with organisations such as Local Wildlife Trusts, have developed Local Biodiversity Action Plans (LBAPs). These plans show the priorities for local habitats and species and show the contribution they can make to the national Species and Habitat Action Plans (UKBAP). The National Action Plan (UK BAP) is made up of 391 Species Action Plans, 45 Habitat Action Plans, and 162 Local Biodiversity Plans. Figure 2.8.3 shows the distribution of priority BAP habitats found in the CFMP area.

Each BAP plan has costed actions and targets to create new wildlife habitats and restore species, reporting on the targets completed on a three to five year cycle. Approximate numbers of species and habitats located within the CFMP area are set out in Table 2.8.5. Water-related species include:

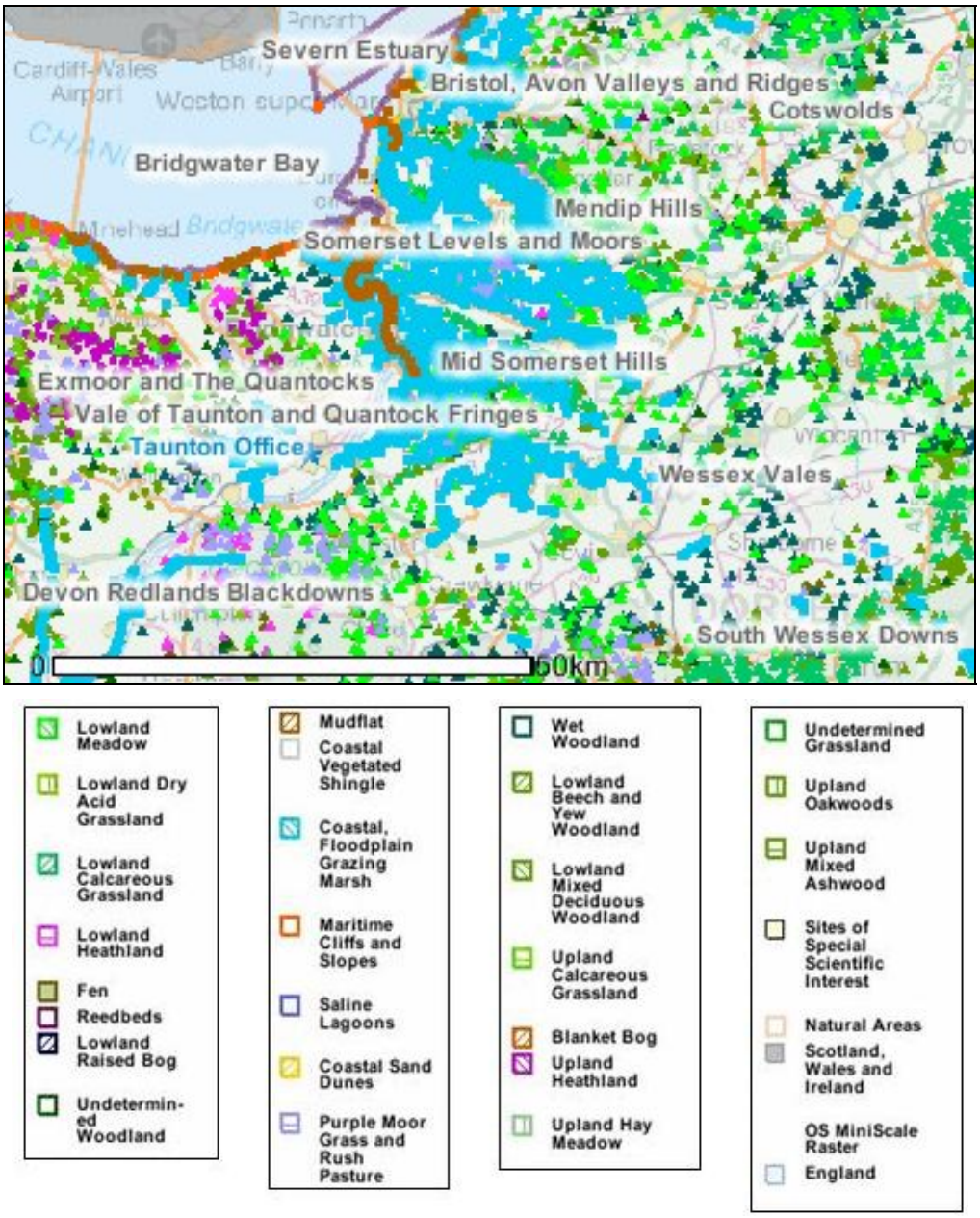
1. Lesser silver water beetle: breeding in peaty, often woody border ditches. In the Levels and Moors, this species is confined to peat areas;
2. Marsh Fritillary Butterfly: found in damp neutral or acid grasslands. Colonies are often small and prone to extinction, so extensive networks of habitat patches are essential;
3. Freshwater White-clawed Crayfish: found in clean, calcareous streams, rivers and lakes. The only native freshwater crayfish species in the UK;
4. Green-winged Orchid: found on grassland habitats of ancient hay meadow and unimproved pasture, on rare occasions in coastal and floodplain grazing marsh;
5. Southern Damselfly: breeds in heathland streams and runnels and, more rarely, rhos pasture, chalk streams and calcareous mires. The species only occurs on the periphery of the catchment;
6. Barn Owl: attracted to vole rich grassland and semi-natural habitat along rivers and streams.
7. Water Vole: confined mainly to lowland streams, canals and ditches. Water voles are undergoing the most significant decline of any British mammal;
8. Otter: the rivers, streams and wetlands of the south-west are a stronghold for Otter populations in the UK (effectively gone from the midlands and south-east).

Table 2.8.5. Local district LBAP breakdown

Local district LBAP breakdown		
District	**Species (Number)**	**Habitats (Number)**
Mendip	11	6
Sedgemoor	3	4
South Somerset	3	5
Taunton Deane	5	4
Dorset*	8	17
West Somerset	3	5
Devon *	20	17

** note these BAP species and habitats do not fall within the CFMP area*

None of the damage to LBAP habitats and species is related to flooding. However, much of the damage is related to management of the water environment. The CFMP may be able to help meet or improve LBAP and UKBAP aims and targets. Table 2.8.6 shows potential opportunities associated with the CFMP flood risk management options.



Source: http://www.natureonthemap.org.uk/ (visit this website for more maps and information on BAP habitats).

Figure 2.8.3. Priority BAP habitats.

Table 2.8.6. Potential policy opportunity areas for BAP species/habitats in the CFMP area

Potential policy opportunity areas for BAP habitats		
LBAP species/habitat	**Water related factor/s causing decline**	**CFMP policy opportunity**
Water Vole	Habitat destruction	In suitable areas, reduce flood management to restore active floodplain and create areas of permanent standing open water
Lowland Meadows	Reduced frequency and duration of flooding.	Restore areas of active fluvial floodplain
Otter	Loss of habitat due to development close to river banks.	Guide development away from riverbanks
Fen, marsh and swamp	Water abstraction, pollution of freshwater, lack of management.	Restore natural river processes and riparian vegetation
Reedbeds	Inappropriate ditch management and excessive water extraction	Reduce ditch maintenance and restore natural river and floodplain processes in selected areas
Greater water parsnip	Inappropriate ditch management and excessive water extraction	Managed reduction in ditch management and restoration of natural river and floodplain processes in selected areas
Coastal and floodplain grazing marsh	Changes in agricultural practices and drainage. New developments causing loss of habitat and hydrological discontinuity, such as land to the east of Weston-super-Mare.	Encourage appropriate development and good agricultural practices.
Standing open water	Loss through infilling, inappropriate land drainage, over abstraction, pollution.	In suitable areas, reduce flood management to restore active floodplain and create areas of permanent standing open water
Rivers and streams	Pollution, abstractions reducing flow, engineering works and new development on floodplains, poor management.	Encourage habitat restoration and water treatment (i.e. wetlands) where appropriate.
Estuary	Pollution, high nutrient levels, development pressure.	Encourage water treatment (i.e. wetlands) where possible, and guide development.
Lesser silver diving beetle	Inappropriate ditch management, cropping of grazing marsh, infilling of ponds.	Encourage suitable management of waterways/ ditches. Reduce management in suitable areas to restore natural processes.
Large marsh grasshopper	Drainage of wetlands for land reclamation and peat extraction. Pollution.	Reduce management to restore areas of wetland, which provide suitable habitat.
Wet woodland	Reduced frequency and duration of flooding.	Restore areas of active fluvial floodplain

2.8.3 Landscape

Landscape features of significant local importance vary in scale. Large topographical features, such as the isolated hill of Burrow Mump, provide distinctive profiles visible across a wide surrounding area. Smaller scale natural or man-made features are also important.

The CFMP area features three 'Areas of Outstanding Natural Beauty' (AONB): including the Quantock Hills, Blackdown Hills and the Dorset section of the catchment. These are unlikely to be affected significantly by flooding due to their natural topography

The Countryside Agency has assessed the character of the landscape throughout England and Wales. This Landscape Character Assessment (LCA)[3] (see Figure 2.8.4) provides individual descriptions, explaining what makes one area different from another, and showing how that character came about and how it is changing. The description of the landscape in the CFMP area is based on the LCA and other landscape character assessment reports, such as the Sedgemoor Landscape Assessment and Countryside Design Summary.

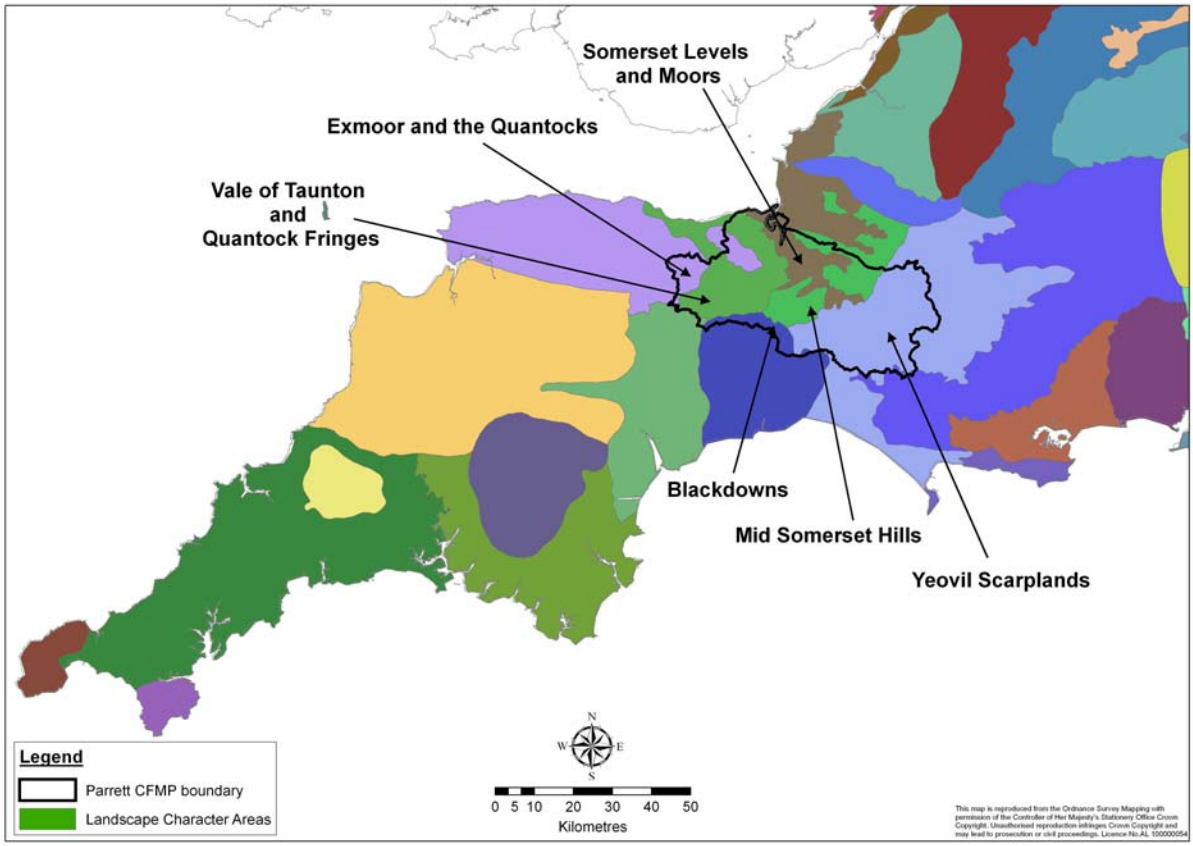


Figure 2.8.4. Joint Character Areas (JCA) of South West England

As landscape is a feature of topography, geology and ecology, it is convenient to describe it in terms of the four distinct divisions in the CFMP area (see Section 2.2).

Uplands

Includes the Yeovil Scarplands (JCA 140) in the east, the Mid Somerset Hills (JCA 143) and the Vale of Taunton and Quantock Fringes (JCA 146) in the west. The CFMP also extends into a small area of the Exmoor and the Quantocks (JCA 144), as well as the Blackdowns (JCA 147) in the very south of the catchment.

The Yeovil Scarplands (JCA 140) is characterised by a very varied landscape of hills, wide valley bottoms, ridge tops and combes united by scarps of Jurassic limestone. The area is dotted with remote rural villages, with high church towers. There are also a number of small manor houses and large mansions sitting within large landscaped parks. A wide variety of local building material has been used including the predominantly Ham Hill Stone. The land use is typically arable in low lying areas, and woodland along the steep ridges and deep combes.

The Mid Somerset Hills area is closely linked with the Levels and Moors, although the ecological character is distinctly different. The hills form islands, ridges and promontories extending into the Levels and Moors, and provide a backdrop to the extensive wetlands between. Woodland is found on the steep ridges and deep combes. Species rich ancient woodlands are scattered throughout the area together with frequent hedgerows and trees, creating a well-wooded landscape character. Settlements in this area are typically located on hills, ridges and islands.

The Vale of Taunton and Quantock Fringes (JCA 146) is characterised by lowland, mixed farming landscape, with dense hedges, sparse woodland and frequent settlement. The area is dotted with numerous farmsteads, hamlets and rural villages, which are linked together by winding rural lanes. The buildings are typically built from red sandstone material, derived from the local hills.

Lowlands (Somerset Levels and Moors)

Consists mainly of the Somerset Levels and Moors (JCA 142). The Somerset Levels and Moors is characterised by open landscapes of wet pasture, arable fields, and wetlands divided up by wet ditches or ‘rhynes’. The land is mainly used for grazing. Fields in the area are mainly rectangular, as shaped by the rhynes that drain the land. The area is characterised by some dramatic and prominent hills such as the Burrow Mump, which rises above the Somerset Levels and Moors. On the Levels the main tree and shrub cover is from a few shelterbelts of poplar. Withies are cultivated, along with reed beds. Settlements in this area are sparse.

Estuary floodplain

The estuary floodplain is mostly considered part of the Somerset Levels and Moors (JCA 142), but extends further inland up into the Vale of Taunton and Quantock Fringes (JCA 146) and into Exmoor and the Quantocks (JCA 144). This area is characterised by high heathland, irregular field patterns and scattered farmsteads.

The CFMP area is a developing region with significant pressures for development, especially within the main urban centres of Taunton and Bridgwater.

[3] http://www.countryside.gov.uk/LAR/Landscape/CC/index.asp.

2.8.4 Heritage

The CFMP area is rich in archaeological sites, monuments and historic landscapes, which cover all periods of human activity from the earliest prehistoric times to the present day.

Deep deposits of waterlogged clay and peat within the lowlands have developed over thousands of years. These soils are thought to contain a large amount of preserved archaeological material, as the lack of oxygen in the soils (due to them being waterlogged) means that remains such as wood and leather have not decayed over time.

Existing levels of maintenance and management practices are key to retaining the waterlogged soil essential for preserving the archaeological features.

Figure 2.8.5 shows the distribution of SAM sites within the CFMP. Throughout the CFMP area there are 112 SAM sites. 31 per cent are shown to lie within the 0.1 per cent AEP floodplain (Flood Zone 2 map). Many of these sites lie underground and are not affected by flooding. In some cases, there may be some opportunity for flood risk management to prevent these sites from being damaged by flooding; however, management of groundwater levels is likely to be of greater importance.

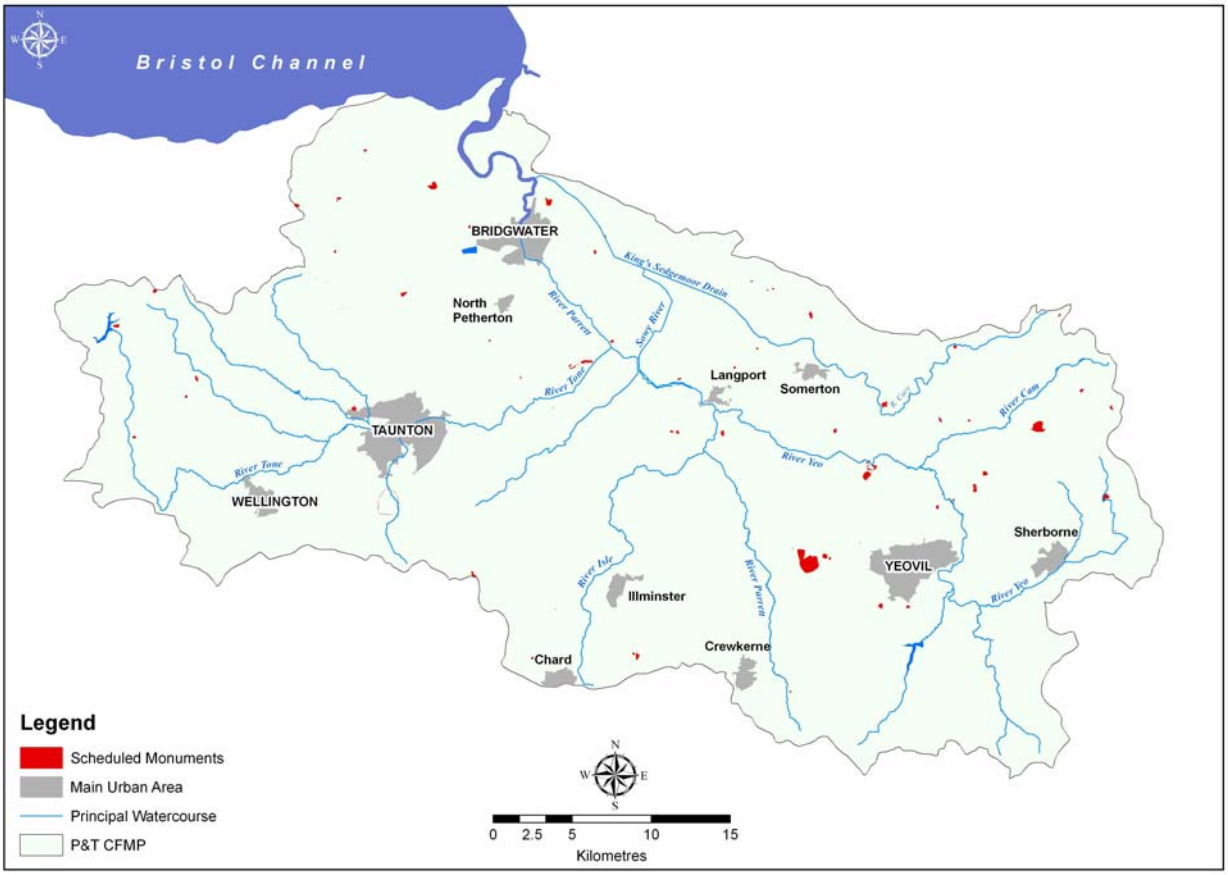
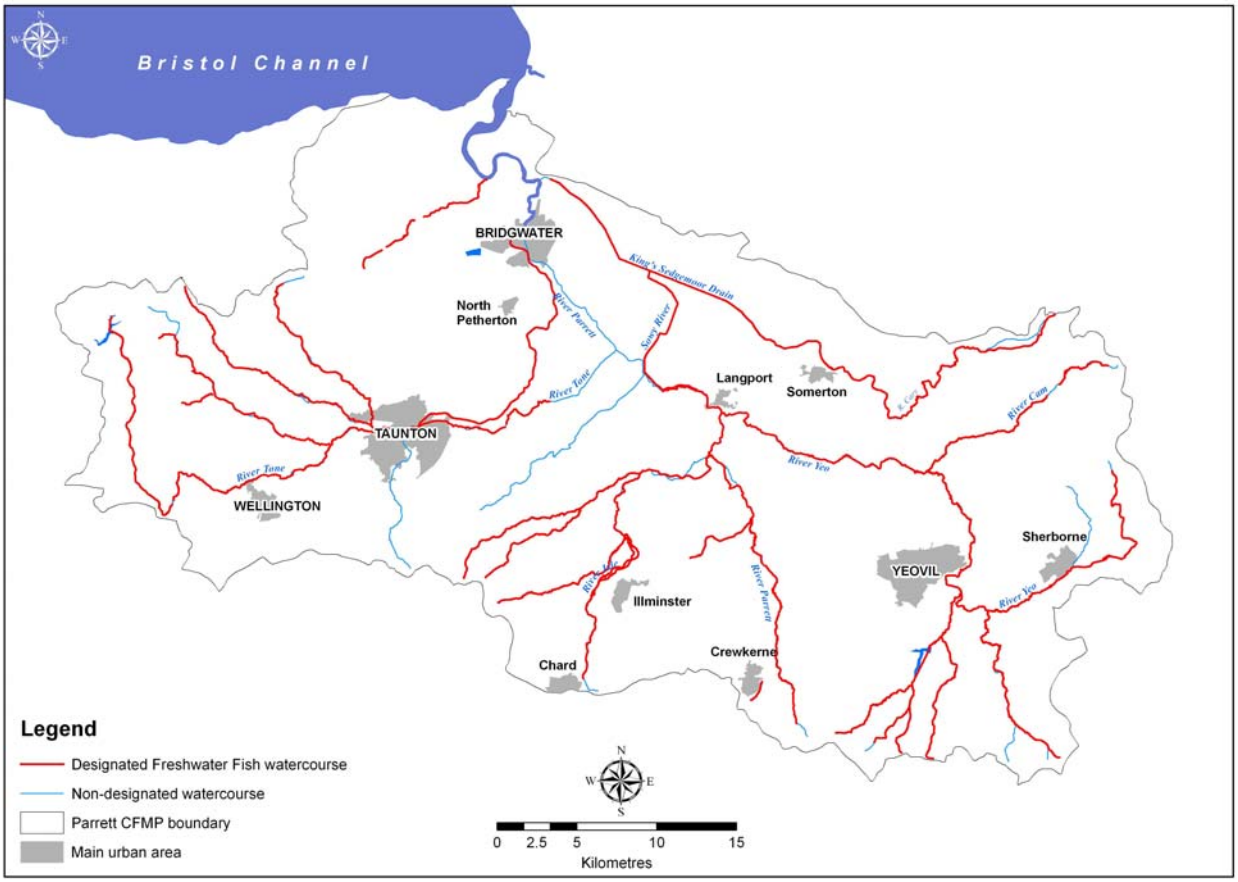


Figure 2.8.5. Location of scheduled ancient monuments (SAM) in the CFMP.

2.8.5. Fisheries

Directives regarding Freshwater Fish (Directive 78/659/EEC) and Shellfish Waters (Directive 79/923/EEC) require certain designated stretches of water (rivers, lakes or reservoirs) to meet quality standards that should help fish and shellfish to live and breed. These directives are recognised under the Water Framework Directive, which will replace them in 2013. Much of the freshwater river within the catchment is designated under this directive, including the majority of the Rivers Parrett and Tone, see Figure 2.8.6.



Source: http://www.defra.gov.uk/environment/water/quality/fwfish/index.htm

Figure 2.8.6. Designated Freshwater Fish Directive stretches in the CFMP.

The CFMP area is also highly valued by anglers. There is regular angling on many of the major watercourses. The coarse fishery on the River Parrett varies to well above average for Chub, Roach and Pike at Thorney Moor, to only minor populations of fish species and poor habitat at South Petherton. The survey of the River Tone shows that Eel, Chub and Brown Trout feature significantly, although other species were also found such as Dace and Salmon Par. Roach is the predominant species within the River Yeo, most originating from Sherborne Lake in the headwaters. The River Isle has populations of Chub, Dace and Common Bream, but only in minor numbers due to the predominantly low water levels.

Water levels, and thus their management, have significant impacts on annual fish populations, although the effect on populations through increased flood storage is uncertain. A key constraint is interruption of migratory pathways of certain species (e.g. eel, Atlantic salmon) through the creation of flood control structures, particularly penning structures, which are common in the Parrett and Tone catchments. Somerset's Eel population is nationally significant, with a number of fisheries occurring; the species is, however, declining rapidly across the UK and the fishery has recently been recommended for closure (EC Council Regulation 1100/2007[4]).

Flood risk management options, in particular those which aim to protect and increase flood storage, provide an opportunity to preserve both fisheries and environmental features for which the Parrett catchment is considered important.

2.8.6 Water quality

Water quality is a central theme in many current plans and policies that affect the Parrett CFMP area. We seek to improve water quality where possible and the CFMP must make sure that the plan or subsequent flood risk management options do not adversely affect water quality. There is some opportunity for flood risk management to include options that both improve water quality and manage flood risk. Such options include reinstating river and stream-side wetlands throughout much of the upper and middle catchment.

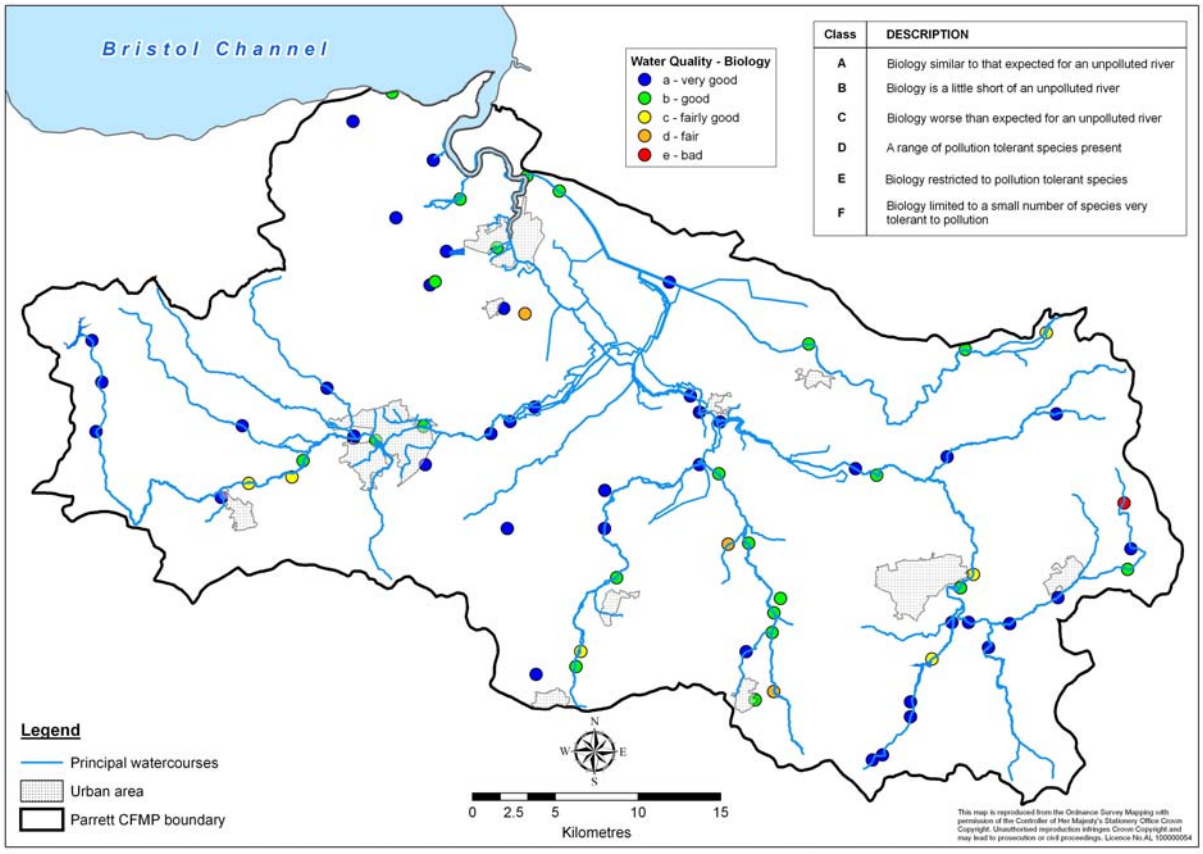
Water quality must comply with the targets set out within the Water Framework Directive (WFD), which aims to ensure that waters are managed to achieve good quality across Europe. The WFD requires surface waters to meet 'good ecological and chemical status' and groundwater to meet 'good chemical and quantitative status' by 2015 (see section 2.4.3 for further details on the WFD legislation).

Watercourses within the catchment are assessed for quality in terms of their biological, chemical and nutrient status, see Figure 2.8.6. The quality of water within the catchment, taken from data collected in 2005, is good to very good. However, there are several outstanding surface water quality issues that affect the CFMP area. These are summarised below:

- summer flooding can lead to changes in dissolved oxygen levels in watercourses within the Somerset Levels and Moors. Summer flooding over the moors can cause grass kill. As grass decomposes it removes oxygen from the standing floodwater and as the water flows back into the river it can be responsible for local fish kills in the area.
- diffuse pollutants from urban areas and roads entering the watercourses also affect water quality. With increasing urbanisation, it is going to become more important to manage pollution better;
- much of the CFMP area is agricultural land, which is closely linked with water level management through an extensive network of drainage rhynes. As such, agricultural inputs (such as fertilisers, herbicides and pesticides) have a significant impact on the nutrient levels in the surrounding watercourses.

[4] http://ec.europa.eu/fisheries/press_corner/press_releases/archives/com05/com05_54_en.htm

Water quality can also be affected by how floods are managed. Parts of the catchment are vulnerable to erosion and to nutrient-loading in field runoff (diffuse source). Flooding can also release pollutants from point sources (e.g. from flooded waste water treatment works or industrial sites). In general the river quality objectives (River Ecosystem (RE) classification) are higher for the upper catchment and lower for the Somerset Levels and Moors. This reflects the low hydraulic gradient of the Somerset Levels and Moors, which is not conducive to high water quality. Changes to retained water level within the Somerset Levels and Moors, may impact on water quality. Other operations that temporarily or permanently mobilise silt (often containing high levels of nutrients) may also be detrimental to water quality.



Source: Environment Agency GQA 2005 data.

Figure 2.8.7. Quality of river water in the Parrett CFMP.

Groundwater quality has not been assessed as groundwater flooding is not considered a significant issue. Groundwater quality is unlikely to be affected by river or surface water flooding (see Section 3.2).

2.9 Communities and the local economy

2.9.1 Population

The Parrett CFMP area is covered by seven district councils. Sedgemoor, Taunton Deane and South Somerset Districts cover most of the CFMP. The uplands of the River Yeo are covered by part of the

West Dorset District, and there are some very small areas covered by West Somerset, Mendip and the Mid Devon District (see Figure 2.9.1).

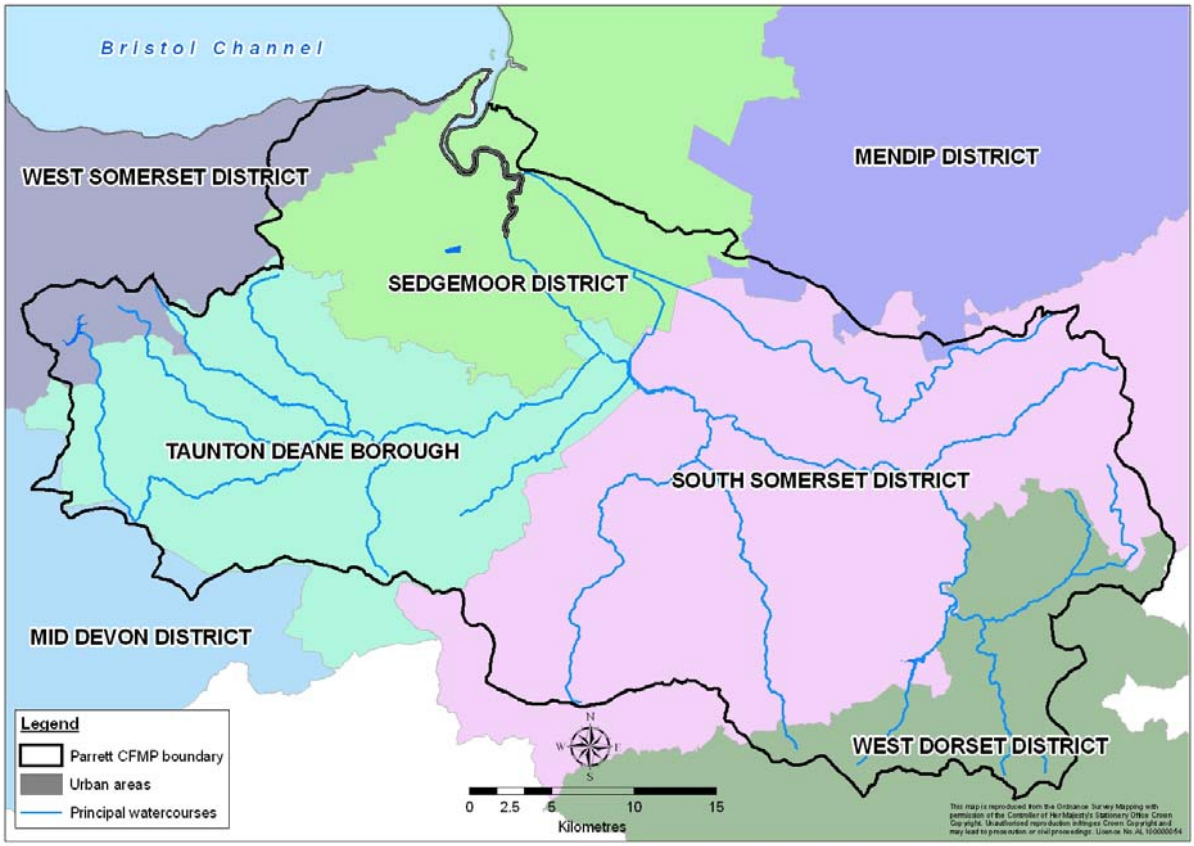


Figure 2.9.1. District councils covering the CFMP area

The main town in the Sedgemoor District within the study area is Bridgwater. Yeovil is the main town within the South Somerset District. Taunton is the main town in the Taunton Deane Borough Council area and it is designated as a ''Principal Urban Area' in the Regional Planning Guidance for the South West (RPG10) It is also a 'Strategically Significant City or Town' along with Bridgwater, Yeovil and Wellington, as classified within the draft South West Regional Spatial Strategy (draft SWRSS, June 2006).

Table 2.9.1 shows the current population of each district, and changes in population size since 1991. Assuming equal distribution within the districts, the population of the Parrett CFMP was approximately 300,000 in 2001. In terms of age distribution within the CFMP area, the population is well distributed, with the highest population of all districts falling into the 20-45 year age groups. The vulnerability of this population to flooding is described further in Section 3.3.

Table 2.9.1. Census 2001 population size data

Population distribution				
District council	**Proportion of CFMP area (%)**	**2001 Census Population***	**Change Since 1991 (%)**	**Number of people per ha**
Sedgemoor	16	105,881	+ 7.4%	1.9
South Somerset	42	150,969	+ 5.8%	1.6

Taunton Deane	25	102,299	+ 7.4%	2.2
West Dorset	11	92,360	+7.1%	0.8
West Somerset	4	35,075	+ 9.9%	0.5
Mendip	1	103,869	+6.6%	1.4
Mid Devon	1	69,774	+7.9%	0.8

** Census 2001 population for entire District.*

We have also assessed how vulnerable the population is to incidents such as flooding, using data derived from the 2001 census. Factors used to determine the degree of social deprivation include an assessment of average household income, health factors and employment status. Figure 2.9.2 shows that within most of the CFMP there is an average, to lower than average vulnerability across all the categories measured. The most vulnerable areas are Bridgwater and Taunton, and therefore the consequence of flooding in these areas (in terms of the effect on the local population) is likely to be high.

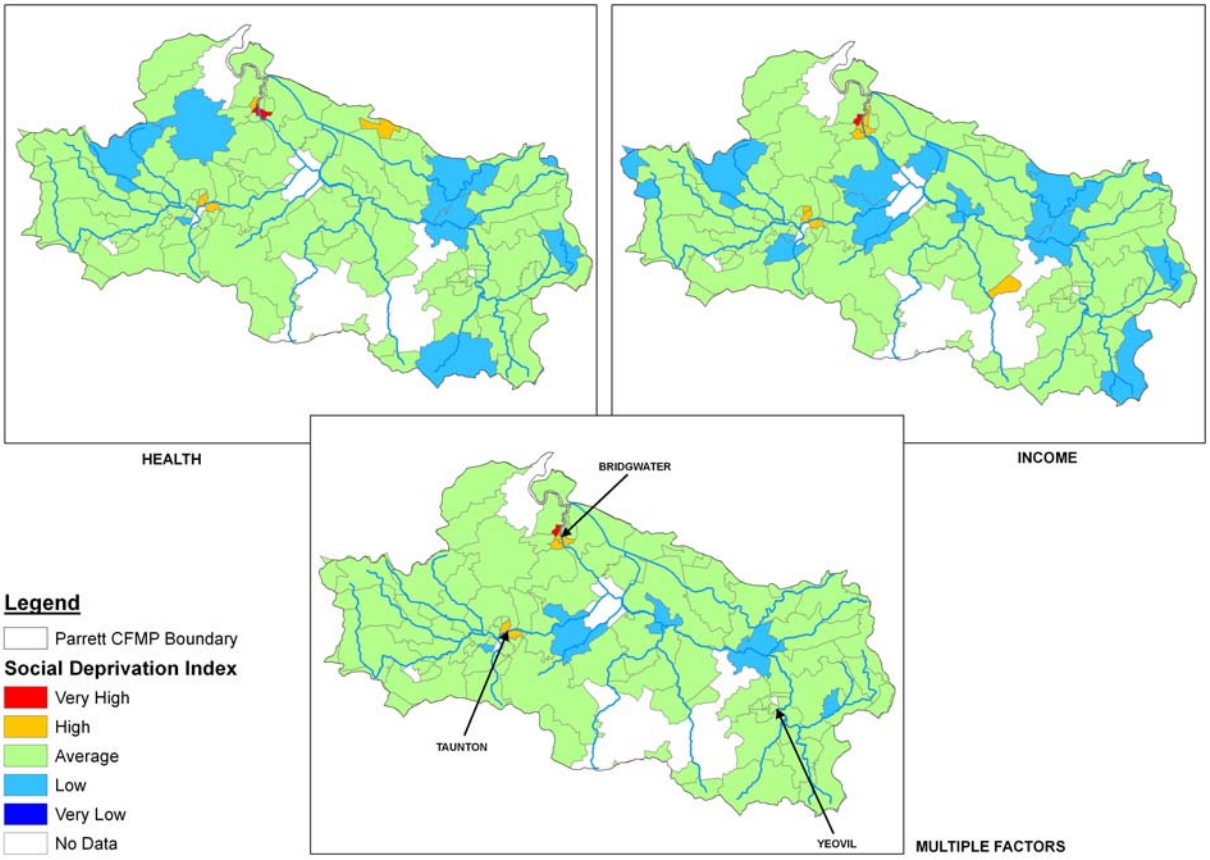


Figure 2.9.2. Index of Social Deprivation within the Parrett CFMP area.

2.9.2 Local industry

Within the CFMP area there is a significant concentration of industrial and service related employment, particularly in the large urban centres of Bridgwater, Taunton and Yeovil.

Manufacturing is an important industry within the CFMP area, particularly in Bridgwater where heavy engineering, manufacture of electrical equipment, brick and tile making and brewing is important to the local economy. Up until very recently, British Cellophane was one of the largest manufacturers and employers in the local area. However, the company was forced to close its operation in Bridgwater in 2005, resulting in the loss of over 250 jobs.

In recent years, Bridgwater has moved from being dominated by two or three major employers, to a situation where several large companies are represented including a number of major manufacturing firms in food, packaging and other industries. There are also major new employment development sites at Express Park to the north of the town and at Huntworth Business Park to the south.

Other towns within the CFMP, such as Taunton and Yeovil, are more dependent upon the service industry for employment, including shops, retail and local government sectors.

Rural business is also important and there is a high dependency on agriculture and agricultural related industries within the catchment.

2.9.3 Transport

The CFMP area contains several main transport links. These are shown in Figure 2.1.1 in Section 2.1. The largest is the M5, which crosses the CFMP and provides a convenient divide between the broad lowlands to the east and the estuarine floodplain to the west. Several other important roads cross the area, such as the A303, A38, A372, and A30.

The area is crossed by two major railway lines, the Bristol-to-Exeter line and the Westbury to Taunton line. The railway is generally at a lower level than the M5 and therefore at greater risk of flooding.

Local transport authorities submit local transport plans (LTP) every five years. These plans form an integral part of the Government's integrated transport policy. The first LTP covered the period April 2001 to March 2006. The LTP is a useful source of trends in transport for the Somerset and South West region as a whole over the last 20 years.

Flooding can cause temporary loss of transportation links during a flood event, or loss for a longer period of time if the road or rail line is damaged. Transportation routes can make flooding worse in areas upstream if culverts are too small or become blocked.

2.9.4 Recreation and tourism

Tourism within Somerset attracts 2.5 million staying visits each year (Somerset Structure Plan). Tourism tends to be seasonal, predominately in the summer. The total average spent in the county per annum by day visits is £86million whilst the total spent by staying visitors is £300million. The main proportion of

visitors tends to be concentrated in West Somerset, Sedgemoor and the coast. In rural areas numbers are lower.

Despite 17 separately identifiable tourist attractions within the study area (principally the Somerset Levels and Moors flood plain) defined by Cheltenham and Gloucester College in their report on the Socio Economic Profile of the Southern Catchment, tourism is "underdeveloped and recognition of the area as a tourist destination is low". The report finds that provision of footpath and bridleways within the Somerset Levels and Moors is poor for historic reasons compared to the remaining southern catchment area and it estimates that the total visitor spend within the study area is only £2 million per annum. Sedgemoor District Council states that the area tends to attract visitors with specialist interests in walking, cycling, fishing or nature conservation. South Somerset District Council and partners have initiated an 80 km walking route along the River Parrett designed to be a sustainable tourism route.

3 Current flood risks & management

This section explains the main causes and effects of flooding across the catchment, and gives a summary of current ways of managing flood risk.

3.1 History of flooding

The recent summer 2007 floods have been some of the worst on record since the snow melt generated floods of March 1947, although the Parrett Catchment avoided the worst of this event. Flooding was caused by intense summer rainfall, and from overflowing surface drainage and as a result affected fairly localised parts of the UK. The last major flood event to affect much of the UK occurred over the fourteen weeks beginning in mid-September 2000, which resulted in extensive fluvial flooding across many parts of the UK. Both these flood events caused significant damage to property and loss of life.

In the context of flooding on the Parrett Catchment the Autumn/Winter flooding of 2000 was the worst since October 1960. Flood defences built in Taunton and elsewhere since 1960 have reduced the risk of flooding. Despite these works approximately 350 properties were flooded in the River Parrett catchment and extensive flooding of the Somerset Levels and Moors occurred. The approximate location of recorded property flooding in Autumn/Winter 2000 is shown in Figure 3.1.1.

However in historical context, the flood damage that occurred in 2000 was just one in a long record of flood events. We have records of flood events from 1600 onwards, as well as further historical information from the British Hydrological Society's Chronology of British Hydrological Events[5]. Table 3.1.1 gives a summary of some of the major flood events recorded within the Parrett CFMP area since 1607, and includes a brief summary of the consequences.

Table 3.1.1. Summary of historic flood events

Summary of historic flood events in the CFMP area	
Event Date	**Details**
1607	Tidal event. "At Bridgwater two villages near thereabouts and one market town overcome and report of 500 persons drowned besides many sheep." (Walter Younge diary)
1872-1873	Fluvial event (many of the issues raised in 1873 are still relevant today). "…are well aware that very great difficulties have arisen in dealing, on a general plan, with the arterial drainage in the valley of the River Parrett…." (Report on the Flooding, Somersetshire in 1872-73 [Presented to the House of Commons, July 16th 1873])

[5] www.dundee.ac.uk/geography/cbhe

1889	Fluvial event. "Half Taunton was flooded by the overflow of the River Tone and North Town to Albemarle Road and street resembled a sea of rushing waters." (Somerset County Herald, 9th March 1889)
12 March 1894	Flooding of the railways in the Parrett Catchment used to be relatively common. "A train going to…Yeovil….. the line was under water …. engine being derailed and tumbling into the ditch. The passengers and stoker were not badly hurt, but the driver was scalded." (British Rainfall for 1894, p[146])
7 December 1929	Bank collapse after a long event was major cause. "River Tone bursts its right bank…. ..disaster unpreventable and complete, fell upon the village of Athelney as the bank gave way…. Every house in Athelney, Stathe and Carload had water in it." (Sutherland, P. and Nicolson, A. (1987) Wetland Life in the Somerset Levels)
27 October 1960	Most severe fluvial flooding in the latter half of the 20th century in Taunton. "A survey this week of the effects of the floods in the Taunton [confirm] at least 298 houses and 150 shops and business premises suffered damage." (Somerset County Gazette, Saturday November 5th 1960)
13 December 1981	Most severe tidal event in the 20th Century in this area. "Tidal Levels were the highest this century and overtopping of sea defences took place….some 3,570 Ha were inundated and 1072 dwellings and commercial properties flooded [in the then Somerset Land drainage District]." (Report to the Flood Defence Committee in 1981/82)
August 1997	Summer flooding causing serious pollution on the Somerset Levels and Moors. "…dramatic summer flooding as not seen in Somerset since July 1968. Curry, Hay and West Moor…….suffered damage to grassland. Trapped floodwater caused vegetation to rot resulting serious pollution." (Somerset Levels and Moors Partnership Newsletter November 1997)
30 October 2000	Most severe fluvial flooding since 1960 "Crowds gathered on the Bridge…as the River Tone rose to within inches of over flowing into Bridge street. Police barred traffic from the town centre." (Somerset County Council Gazette, Friday November 3rd 2000)

The history of flooding is crucial to understanding the future risks within the catchment. Flooding in Taunton and the Somerset Levels and Moors is often noted in the record and confirms that the recent flooding problems are not unique and that flooding has been caused by tidal and fluvial events in the past. Of particular concern are records of bank failures in the Somerset Levels and Moors, which can cause rapid and dangerous floods. Flooding of the railways within the catchment is now less common than in the past, although some particular lines are still at risk. The greatest risk to life today probably comes from those travelling during major floods.

Flood risk management infrastructure and management has changed considerably over the last 100 years or more and particularly from 1960. New flood defence schemes, pumping stations and flood warning systems have all contributed to a reduction in flood risk, particularly from the more frequent events.

A database of flood events has been compiled from our own Flood Risk Incident System (FRIS), from Wessex Waters Flood Incident Records and data gathered for the Taunton Strategic Flood Risk Assessment (SFRA). This combined database contains records of 2583 flood incidents within the CFMP area recorded from 1900 to 2007. Of these flood events; 34% were from river flooding and 22% were caused by surface water flooding. In many cases the exact source or cause has not been recorded. The location of these recorded flood incidents is shown on Figure 3.1.1.

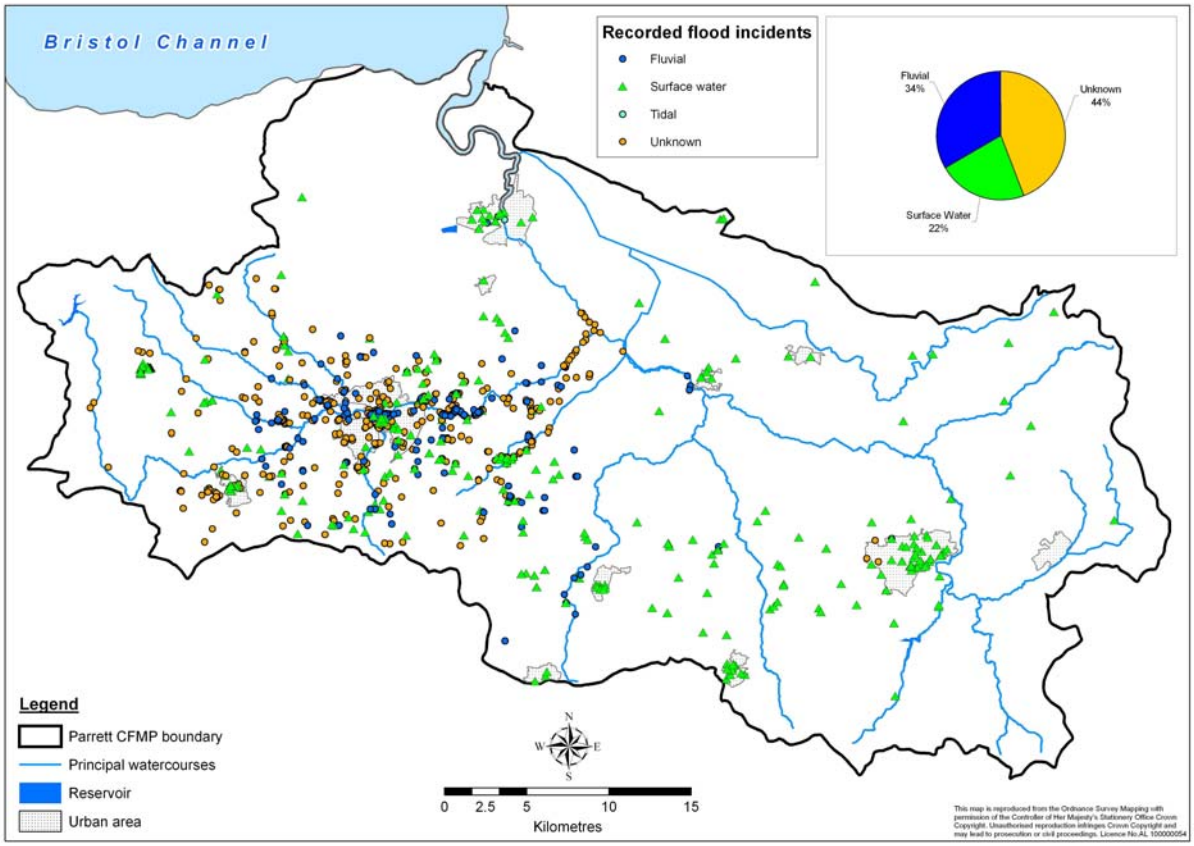


Figure 3.1.1. Recorded flood incidents within the Parrett CFMP boundary.

There is a significant cluster of data in the Taunton Deane Borough area; this is because more data was available in this part of the CFMP. We can also see from the figure that surface water flooding tends to be scattered across the catchment with some clusters in the towns such as Yeovil. In some cases the unknown flooding will be caused or exacerbated by high tides, this is evident by some of the records in the Somerset Levels and Moors. Conversely some of the unknown property flooding will be caused from field runoff.

A high proportion of the known flood events recorded within the catchment were caused by surface water. These events were caused by the following reasons:

- runoff from steep hills;
- inadequate capacity (or lack) of road drainage; and
- water collecting in isolated pockets of low-lying ground.

No groundwater flood incidents are recorded in our FRIS dataset, although some of the river and surface water flooding in the upper catchment may be due to flow from springs. However historically it is not a significant issue.

3.2 Sources and probability of flooding

There are a number of different ways that flooding can occur. These different ways reflect the source of the floodwater and how it moves across the landscape. These different types of flooding can happen on their own or together. For example, an intense storm may cause a river to rise and overtop flood defences, and may, at the same time, exceed the capacity of a sewer system in an urban area. The different types of flooding we have considered in the CFMP are:

- river flooding: occurs when high water levels in rivers and rhynes cause floodwater to spread out across the floodplain and in some cases overtop flood defences along river banks. High water levels may be caused by large flows in the river (due to a big storm), and/or from under-sized or blocked, culverts or bridges. We discuss this type of flooding in Section 3.2.1;
- tidal flooding: occurs when the sea levels (Bristol Channel in this case) increase during high tides and when there is a storm surge. The CFMP area is protected from tidal flooding by sea defence embankments. CFMPs do not cover the management of tidal flooding. This type of flooding is covered by the 'Bridgwater Bay to Bideford Bay Shoreline Management Plan'.
- River Parrett tidal estuary flooding: When high tides occur during storm surges, water levels rise along the River Parrett Estuary. Because of the flat topography of the Somerset Levels and Moors and the high tidal range the tidal influence extends approximately 18Km inland.
- surface water flooding: can happen throughout the catchment and is caused by certain topographical, geological and hydrological conditions. For example, water may collect alongside a road that does not have a drainage gully, flow across a field causing soil erosion, or flow down a road into properties. See Section 3.2.3 for more details;
- sewer flooding: flooding from urban sewer systems depends on a number of factors, such as network capacity, system blockages and water levels at their outlets. Sewer flooding is made worse by a number of combined sewers (foul and surface water) throughout the CFMP area. These factors are local scale and so cannot be addressed completely within the CFMP. We recognise that District Councils, Parrett Internal Drainage Board and Wessex Water will need to work in partnership to address this type of flooding at a more detailed level
- reservoir flooding: occurs when there is overtopping or breach of a reservoir.
- groundwater flooding: happens when groundwater levels are very near to the surface. We have not identified this as a major type of flooding in this CFMP and so we have not looked at it further.

Flood risk is made up of two parts: the chance (or *probability*) of a particular flood event and the impact (or *consequence*) that the event would cause if it happened. Flood risk management can reduce the chance of flooding happening by managing land, river systems and flood defences. It can also reduce the impact of flooding by influencing development in flood risk areas, implementing flood warning systems, and developing flood emergency response procedures.

The probability of the different types of flood events occurring is discussed in Sections 3.2.1, 3.2.2 and 3.2.3. The consequences of flooding are discussed in Section 3.3.

The probability of a flood event occurring is presented in this CFMP as the percentage chance of a flood of that size happening in any one year. We call this the probability of occurrence or annual exceedance probability (AEP). For river flooding, we mostly discuss the one per cent AEP flood, which means that there is a one per cent chance that a river flood of that size will occur in any one year. We use the 0.5 per cent AEP flood for tidal flooding and 0.1 per cent AEP flood from either source to represent an extreme event.

The one per cent AEP flood is sometimes referred to as the 1 in 100 year return period flood. This means that on average the flood of this magnitude would occur every 100 years. However there is evidence that severe flood events tend to cluster, so it is quite possible to get two '1 in 100 year return period' floods in say a five year period. The 0.1 per cent AEP flood is sometimes referred to as the 1 in 1000 year return period. We prefer using the percentage chance rather than return period method of describing floods to avoid the possible misunderstanding that 1 in 100 year events occur reliably every 100 years.

We have produced flood risk maps for the whole of England and Wales and you can access these through our website. They show the extent of land with a high chance of flooding (Flood Zone 3) and land with a medium chance of flooding (Flood Zone 2). Land outside of these areas is considered to have a low chance of flooding. Flood Zone 3 is defined as the land with a one per cent or higher annual probability of flooding from rivers or a 0.5 per cent or higher annual probability of flooding from the sea. Flood Zone 2 is defined as land with a 0.1 per cent or higher annual probability of flooding from rivers or the sea.

The map shows flooding from rivers and the sea, which are the two main types of flooding throughout the country. It does not include information about flooding from surface water (water collecting on or flowing over the surface before infiltrating into the ground or entering a watercourse). It is reasonable to assume that flooding from a river or the sea outside of Flood Zone 2 is extreme. However, flooding may still happen beyond Flood Zone 2 from other types, such as surface water. Detailed maps showing the Flood Zones can be seen on our website (www.environment-agency.gov.uk and follow directions for flood risk).

It is easy to be misled by the apparent accuracy of the flood maps and data produced. We know that our understanding of flooding is far from complete. Flooding is generated by a complex and continually changing interaction between meteorological and hydrological processes. Natural systems are inherently difficult to model, and the science which underpins the analysis continues to evolve.

3.2.1 River and Estuary flooding

To understand the frequency, depth, and extent of river flooding within the CFMP, we need to look at a range of different size flood events. Although our Flood Zone maps provide outlines for river flooding with a one per cent and 0.1 per cent AEP, they do not provide information for more frequent smaller events.

When we were developing this CFMP, we built a broad scale hydraulic model to simulate flooding within the catchment. This model represents current conditions within the catchment and provides flood outlines, flood depths and flood velocities for the main rivers for a number of different probability flood events.

From the analyses, we have estimated flood extents, depths and velocities at main places of risk across the catchment. The results from the hydraulic model have been used with our Flood Zone maps and other historic flooding information to develop our understanding of flood risk in the CFMP area. In this way, we have used all of the best information available to make the most appropriate flood risk management policies.

We must stress that although the hydraulic model gives results that can appear to be very accurate; the modelling includes a number of assumptions and is based on fairly raw data. Records of flooding have been used to verify results. This means that although the results give a good indication of how the catchment as a whole is likely to respond to flooding, they often do not represent the details particularly well.

Our hydraulic modelling and Flood Zone maps shown here, **do not take into account existing flood defences and therefore the flood outlines are larger than reality.** The actual flood risk will be significantly reduced due to the presence of existing flood defences. This is not a concern for the CFMP, given its scope and objectives, but we should not place too much confidence in the results for specific places. **The real value of the maps is that they allow us to assess relative change, and how sensitive the catchment is to that change**. The broad scale maps do not replace the Flood Zone maps available on our website. We have other more detailed models in the catchment which we have used to adjust the broad scale estimates to improve the accuracy where necessary.

The extents of river flooding for the one per cent and 0.1 per cent AEP flood event for the CFMP area are shown on Figure 3.2.1. They only show areas at risk of river flooding (see Section 3.2.2 for areas at risk of tidal flooding). These outlines include the impact of sea defences, but do not include the impact of river flood defences.

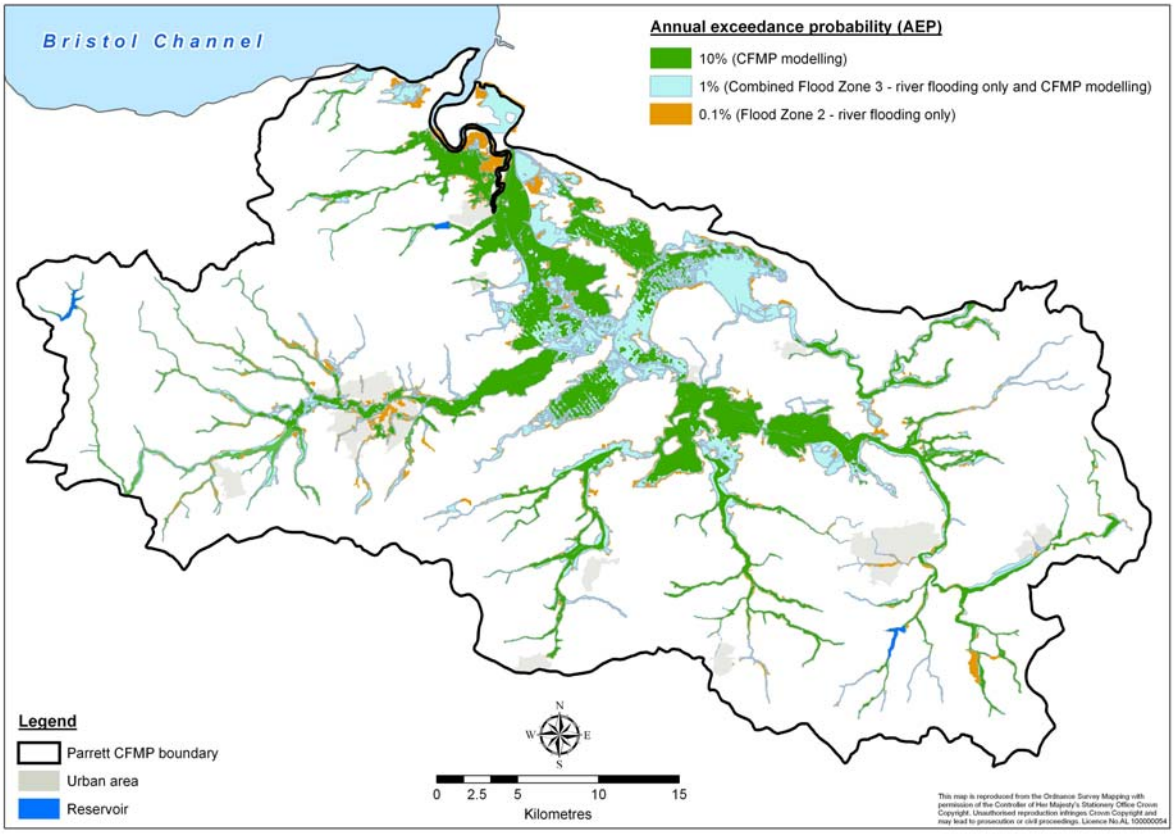


Figure 3.2.1. Extents of river flooding for a 10 per cent, 1 per cent and 0.1 per cent AEP flood

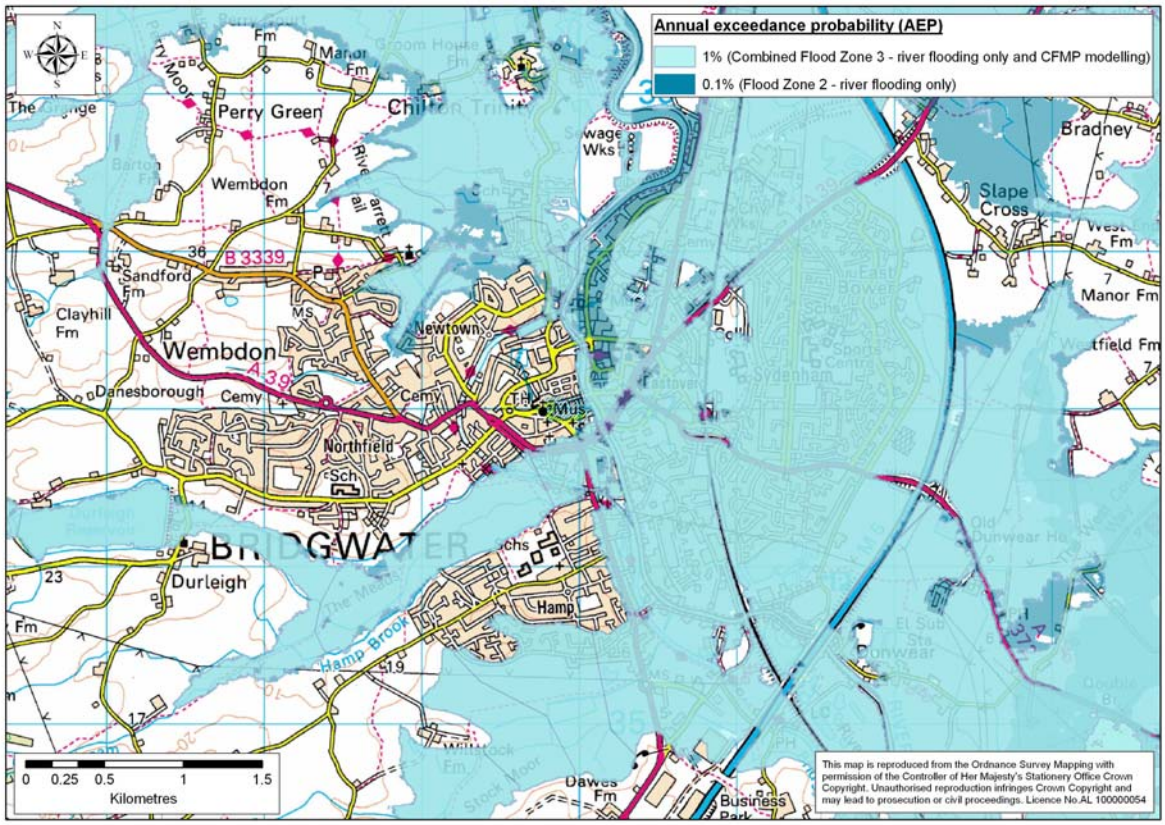


Figure 3.2.2. Extents of river flooding for a 1 per cent and 0.1 per cent AEP flood in Bridgwater

(modelled extent does not account for areas protected by existing flood defences)

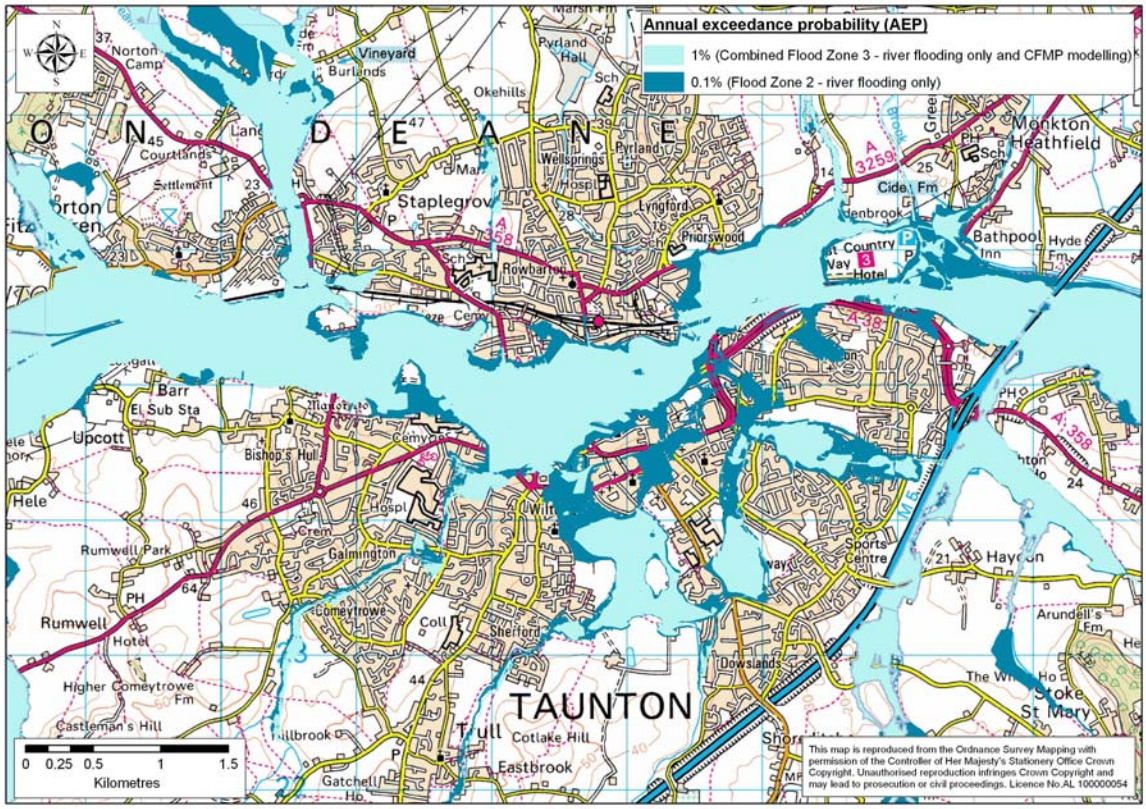


Figure 3.2.3. Extents of river flooding for a 1 per cent and 0.1 per cent AEP flood in Taunton *(modelled extent does not account for areas protected by existing flood defences)*

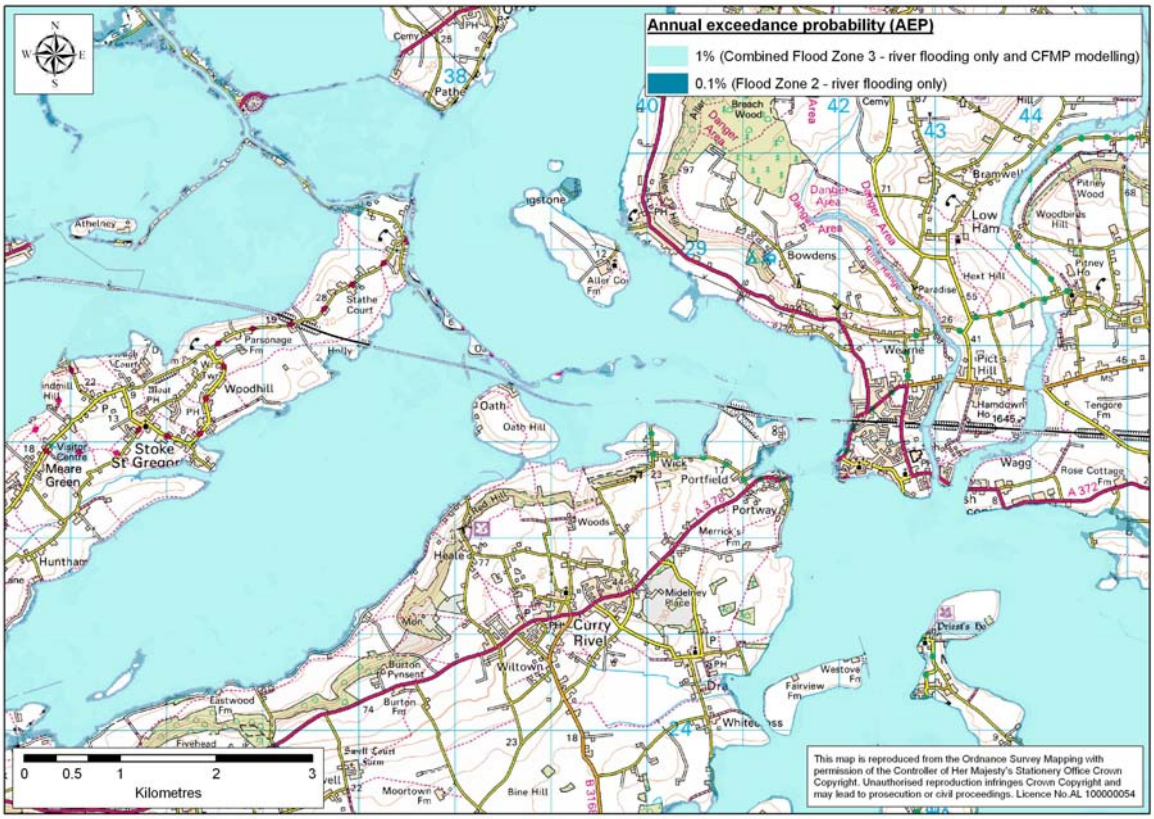


Figure 3.2.4. Extents of river flooding for a 1 per cent and 0.1 per cent AEP flood in the Somerset Levels and Moors *(modelled extent does not account for areas protected by existing flood defences)*

Figure 3.2.5. Extents of river flooding for a 1 per cent and 0.1 per cent AEP flood in Yeovil
(modelled extent does not account for areas protected by existing flood defences)

The extents, depths, duration, velocities and frequency of river flooding are a function of topography, geology and hydrology.

- The extent of flooding is related to flow and the shape of the river valley, with the greatest extents in the lowlands area, particularly the Somerset Levels and Moors.
- The depth of flooding is related to the flood flows in the channel, the shape of the river valley and any structures that may cause water to back-up.
- The velocity of floodwater is controlled by the channel and floodplain slope (see Section 2.2), shape and roughness. Local variations in velocity occur where flow paths encounter natural or artificial features that either constrict or expand areas of flow. Flood depths and velocities vary across the floodplain, with deeper, fast-flowing waters in the river channel and shallower, slower waters towards the outer edge.

These factors have been explained in Chapter 2 by dividing the CFMP into three broad areas. We can use these divisions to divide the catchment into areas that show similar characteristics of river flooding:

1. Uplands
2. Lowlands
3. Estuary Floodplain

Table 3.2.1. Summary of river flooding and its characteristics

Summary of the source of flooding and its characteristics			
Descriptor	**Uplands**	**Lowlands**	**Estuary Floodplain**
Source (major rivers)	Upper reaches of the Rivers Tone, Parrett, Isle, Yeo, Cam, Cary and tributaries	River Parrett, River Tone, Sowy River and King's Sedgemoor Drain within the Somerset Levels and Moors	Lower Reach of the River Parrett
Pathway	Capacity of channel exceeded, backwater from bridges and culverts	Capacity of channels constrained by low gradients and geomorphological constraints	Estuary floodplain at risk from high tide levels in the Bristol Channel
Area of 1% AEP flood (km^2)	75km^2	250km^2	11km^2
Area of 0.1% AEP flood (km^2)	100km^2	290km^2	15km^2
Average flood depths during a 1% AEP flood (m)	0 to 2.5	0 to 4.0	0 to 0.5
Average velocities during a 1% AEP flood (m/s)	High	Low (unless breach of flood defences occurs)	Low (unless breach of flood defences occurs)
Indicative duration of a 1% AEP flood	Up to 24 hours	Weeks or in some places months	Up to 24 hours
Indicative frequency of flooding	Relatively frequent flooding of narrow floodplain	Frequent and extended flooding of lowland areas is common	Infrequent
Response	Quick: responds quickly to intense storms	Slow: responds slowly to long duration winter or multiple storms	Quick: in the event of overtopping or breaching

Notes: indicative values of:

Depth [shallow < 0.5m < deep < 2.0m < very deep]

Response [quick < 3 hours < moderate < 8 hours < slow]

Duration [short < 12 hours < moderate < 8 hours < long]

Velocity [low < 1m/s < medium < 2m/s < high]

Table 3.2.1 contains a summary of river flooding and its characteristics.

- The fastest flowing floodwaters in the CFMP area are in the uplands, reflecting the steep topography. Towns and villages along the watercourses are at risk from flooding
- The lowland areas are generally associated with long duration flooding often caused by multiple storms. The capacity of the watercourses across the Somerset Levels and Moors is severely constrained by the low gradients and high sediment loads. This makes the area vulnerable to long periods of heavy rain
- Risks in the estuary floodplain are limited today because of the considerable investment in tidal defences. There remains a risk of overtopping of the tidal embankments and the small additional risk of breaching. These risks can lead to rapid (and often unexpected) flooding in areas in the immediate vicinity of the overtopping or breaching.

3.2.2 Surface water flooding

The likelihood that an area will be affected by surface water flooding is related to soil type, land use, topography and rainfall. These datasets have been analysed to show the areas that are most likely to experience surface water flooding. Figure 3.2.2 shows the results of this analysis and the places where surface water flooding has happened in the past. We define surface water flooding as flooding which occurs before water has a chance to enter streams and rivers.

In urban areas, paved surfaces prevent rainfall soaking into the ground, resulting in increased runoff and a greater capacity for ponding in low-lying ground (sewer flooding which is closely related is discussed further below).

There is a growing realisation that agricultural land use and management can have a significant impact on flood flows. The science of surface water runoff associated with land use is still in its infancy, and we are undertaking research now to improve our understanding. Some modern farming practices can lead to reduction in soil water storage and infiltration capacity, particularly within the soft siltstone/fine-grained sandstone landscape, which dominates much of the upland catchment. Evidence both nationally and locally indicates that the largest impact of agricultural land use on flooding is likely to be on surface water runoff from fields at a local scale, rather than on the wider river flooding.

Despite certain areas being more vulnerable to surface water flooding, historic records show that surface water flooding can happen anywhere in the catchment. This is because surface water flooding is often the result of inadequate local drainage and so is made worse if drainage systems anywhere in the catchment (ditches, culverts, pumping arrangements) are not kept clear, are undersized or do not operate properly.

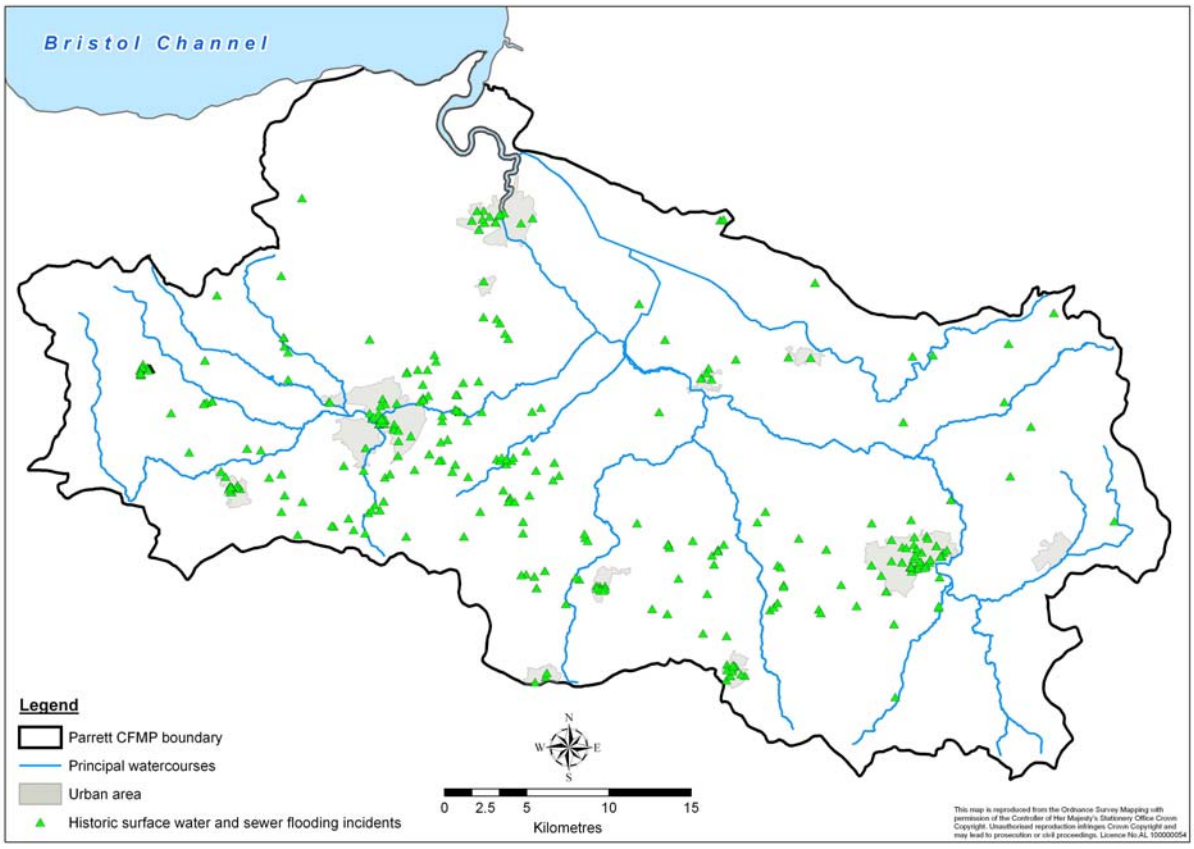


Figure 3.2.2. Likelihood of surface water flooding

3.2.3 Sewer Flooding

The flooding in Hull in 2007 has highlighted to us again the importance of sewer flooding. The effects of sewer flooding can be extremely unpleasant in places where the foul and surface water sewer systems are combined. If the system is overwhelmed untreated sewage can flow out of manholes and gullies and contaminate floodwaters.

We have discussed with Wessex Water (who are responsible for the public sewers system in the catchment) the scale and severity of flooding problems associated with the sewer systems across the catchment. In broad terms most of their improvement works undertaken by Wessex Water are directed at relatively localised problem areas dispersed throughout the catchment. The main urban areas, and in particular Taunton, have received considerable investment over a number of years and the focus today is generally on the localised problems outside of the main urban centres. However Yeovil is an exception where we understand that there have been problems in recent years, and further investment has been made in the town in response to this.

Our broad scale modelling work does not include for sewer flooding, because problems are generally caused by localised deficiencies which cannot be modelled at this scale. However we have reported our understanding of Wessex Water's priorities based on their capital programme.

3.2.4 Reservoir, Groundwater and Other Flood Risks

We have generally not considered risks associated with reservoirs or groundwater further within the CFMP, but these risks are briefly discussed below.

There are several water supply reservoirs in the CFMP, including Durleigh Reservoir, Clatworthy Reservoir and Sutton Bingham Reservoir. Whilst a breach in these reservoirs is highly unlikely, this flooding should be considered when assessing flood risk at a more detailed level than is appropriate for a CFMP, such as Strategic Flood Risk Assessments (SFRA) and Flood Risk Assessments (FRA). There are also a number of flood detention reservoirs in the catchment which store flood water with the aim to reduce peak flows and reduce flood risks downstream. Most of these are quite small, but the recently constructed Norton Fitzwarren dam is of considerable size (700,000m^3) and will reduce flooding in that area. Curry Moor also acts as a detention reservoir and can hold up to 10,000,000m^3 of water which spills from the River Tone downstream of Taunton.

Groundwater flooding has not been identified as a significant issue in the catchment and has not been taken further.

There are a number of other potential flood risks which we consider to be very rare, for example:

- Tsunami in the Bristol Channel. There is speculation that the severe floods in 1607 in this area may have been caused by a tsunami, but the risk is considered low.

- Flooding can be caused or exacerbated by major structural collapse of buildings or movement of caravans, cars or other vehicles which obstruct watercourses. Movement of any material stored in the floodplain can pose a risk (e.g. tyres, barrels, pallets etc).
- Accidental or deliberate damage to existing flood defences (perhaps by damage by vehicles to embankments).

3.3 Consequences of flooding

3.3.1 Context

In Section 3.2 we looked at the probability of flooding. To find out the risk flooding poses, we must look at its consequences. We determine the consequences by looking at what is being flooded, known as the 'receptor', and how vulnerable that receptor is to flood damage. Receptors can be:

- society (people, social infrastructure, community);
- the economy (property, agricultural production, tourism, local business); and/or
- the environment.

Within the CFMP area, there are many receptors on low-lying land at risk of flooding. The proportion of main receptors that lie within the 0.1 per cent river flood event has been summarised in Table 3.3.1.

Table 3.3.1. Main receptors at risk of flooding

Receptor		***Total for catchment***	***Receptors that lie within the 0.1 per cent AEP river flood outline (Non-tidal Flood Zone 2 map)***	
			Number	***Percentage***
Population*		275,000	44,000	16%
Area km^2		1,675km^2	274	16%
Agricultural land classification (km^2)	Grade 1	92km^2	3	3%
	Grade 2	244km^2	53	22%
	Grade 3	1,100km^2	148	13%
	Grade 4	167km^2	58	35%
	Grade 5	19km^2	1	5%
Residential properties		132,631	17,297	13%
Commercial properties		12,389	2,815	23%
A-class roads (km)		246km	42	17%
Motorway (km)		38km	11	29%
Railway (km)		146km	53	36%
Sites of Special Scientific Interest (SSSI) (km^2)		72km^2	44	61%
Ramsar sites (km^2)		43km^2	36	84%
Special Areas of Conservation (SAC) (km^2)		0.8km^2	0.04	5%
Schedule Ancient Monuments (SAM)		112	35	31%
Areas of Outstanding Natural Beauty (AONB)		167km^2	1.4	1%

(km^2)			
Essential Infrastructure**	48	11	23%

* based on the 1991 census data

* includes hospitals, emergency services and government buildings

We can separate the main receptors into the three broad divisions of the CFMP area. Within the uplands, the main receptors of flood risk are urban infrastructure and assets (such as properties, roads and bridges). In the lowlands and estuary floodplain, agricultural land, small settlements and environmentally designated sites are mainly affected, although Bridgwater is the exception.

The following section describes the methods used to determine the consequences of flooding in each of the three broad divisions first introduced in Section 2.2. The methods involve breaking down flooding into the following parts: flood frequency, depth, extent, velocity and duration, so that we can assess the hazard and disruption it causes. It is difficult to measure some of these terms accurately, so we use a range of terms from high to low. These terms relate to this CFMP only.

The consequences of flooding in smaller more specific areas (policy units) are provided in the policy unit summary tables in Chapter 6 and in the policy appraisal tables in Appendix B.

3.3.2 Flood risks to society

Flooding can have major effects on households and neighbourhoods. It can cause severe personal distress, have a bad effect on people's health; disrupt transport, as well as damaging property and possessions. The overall vulnerability of the community is also affected by the extent of the damage to infrastructure and services. We have assessed the consequences of flooding to people and community in terms of number of properties and people affected, flood hazard, social vulnerability, scale of public disruption and disruption to transport links. Table 3.3.2 contains a summary of results.

We often use the one per cent AEP flood event when considering flood risk. However due to the importance of the receptor (people), we also consider a larger flood event (0.1 per cent AEP).

The magnitude of flood hazard is an important factor in determining flood risk to people. Flood hazard is related to a number of factors, including depth of floodwater, velocity of flood water and water-borne debris. Risk to life becomes significant when flood depths exceed 0.5m, although shallower depths can be threatening if they are associated with very high velocities. We have used our catchment understanding and the chart in Figure 3.3.1 to identify a representative flood hazard rating for each division. The flood hazard rating quoted is that which is representative for most of the division. However, in reality there will be pockets of low (class 1), medium (class 2) and high (class 3) velocity floodwater throughout each broad division.

Table 3.3.2. Risks to people and community

Division	Population				Assessment of flood hazard	Scale of public disruption during a one per cent AEP flood	Disruption to transportation links during one per cent AEP flood
	Residential properties		People				
	1 % AEP	0.1 % AEP	1 % AEP	0.1 % AEP	Class and description	Score and description	Disruption Severity
Uplands	1,950	6,229	6,952	14,111	HIGH Deep fast-flowing floodwaters are very hazardous to people, property and infrastructure	MEDIUM / HIGH Severe damage to a small proportion of the area. 4 schools, 8 medical practices and 1 police station and an ambulance station affected. Parts of Taunton flooded	MEDIUM Some transport links cut for short period. Travel within Taunton disrupted by flooding.
Lowlands	1,009	10,718	9,531	28,825	MEDIUM Low hazard due to slow moving, shallow floodwaters. Failure of river embankments would increase flood hazards considerably.	MEDIUM Damage and loss of access to isolated properties and small communities for a long period of time. Bridgwater flood risk generally low but some surface water problems	LOCALLY HIGH Flooding across the Somerset Levels and Moors can cut off some communities (e.g. Muchelney). Some impact on railways
Estuary floodplain	308	330	618	1,152	LOW Generally low risk today due to good standard of tidal embankment. However risk of breach remains and could increase in the future	LOW Area generally protected against high estuary levels. Some surface water problems	LOW Several minor roads flood from surface water.

There are locations within the Parrett CFMP where key infrastructure is at risk from flooding during a one per cent AEP flood event; summarised in Table 3.3.3. Disruption of critical infrastructure during a flood event can significantly worsen both the social and economic affects of a flood event. For example, loss of electricity through flooding of an electricity sub station would affect a broader percentage of the population than just those areas that are affected by the flood water.

Table 3.3.3. Risks to property and infrastructure

Risks to property and critical infrastructure				
Division		**Uplands**	**Lowlands (Somerset Levels and Moors)**	**Estuary**
Indicative number of properties and critical infrastructure affected during a one per cent AEP flood	**Residential**	1950	1009	308
	Industry / retail / shops	210	32	1
	Caravan and camping sites	0	2	0
	Sewage treatment works	2	0	0
	Healthcare	8	1	0
	Schools	4	1	0
	Police stations	1	0	0
	Ambulance stations	1	0	0
	Fire stations	0	1	0
	Electricity sub stations	30	25	2

Some sectors of the population are particularly susceptible to flooding and are likely to have greater difficulty in coping with the after effects. We have assessed how vulnerable the population is by considering health and income profiles (see Section 2.9).

Velocity Coefficient C	0.5									
(V+C) * D	Depth									
Velocity	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
0.00	0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25
0.50	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00	2.25	2.50
1.00	0.38	0.75	1.13	1.50	1.88	2.25	2.63	3.00	3.38	3.75
1.50	0.50	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50	5.00
2.00	0.63	1.25	1.88	2.50	3.13	3.75	4.38	5.00	5.63	6.25
2.50	0.75	1.50	2.25	3.00	3.75	4.50	5.25	6.00	6.75	7.50
3.00	0.88	1.75	2.63	3.50	4.38	5.25	6.13	7.00	7.88	8.75
3.50	1.00	2.00	3.00	4.00	5.00	6.00	7.00	8.00	9.00	10.00
4.00	1.13	2.25	3.38	4.50	5.63	6.75	7.88	9.00	10.13	11.25
4.50	1.25	2.50	3.75	5.00	6.25	7.50	8.75	10.00	11.25	12.50
5.00	1.38	2.75	4.13	5.50	6.88	8.25	9.63	11.00	12.38	13.75

	From	To	
Class 1	0.75	1.25	Danger for some
Class 2	1.25	2.50	Danger for most
Class 3	2.50	20.00	Danger for all

Source: Flood Risks to People Methodology (Environment Agency/Defra, 2006)

Figure 3.3.1. Flood hazard rating

It is difficult to quantify the effects of flooding on the community, so for the purposes of the CFMP, we have measured the impact on the people and community in terms of the scale of public disruption:

- low: few properties affected by flooding. Some flooding on minor streets;
- medium: flooding across the area but not a major disruption to community life; and
- high: wide-spread flooding causing major disruption to community life for some time (weeks). This may happen at a local level if entire villages are cut off. In an extreme event, this may result in loss of access to health care, community infrastructure and emergency services.

Transport links within the CFMP area are relevant to flood risk in three ways: they can increase runoff rates, they alter flood flows (through embankments and under capacity culverts/bridges), and they can be damaged or cause public disruption when they themselves are flooded. The following rating has been used to quantify the scale of disruption to transport links in each broad division:

- low: short sections of road and/or railway lines flooded for short periods of time. Transportation infrastructure has a minor impact on flood flows;
- medium: several sections of road and/or railway lines flooded for a medium length of time. Alternative routes required. Transportation infrastructure has a moderate impact on flood flows; and
- high: long sections of major roads and/or railway lines flooded for a medium to long length of time. Alternative routes cause significant disruption to travel times. Transportation infrastructure has a major impact on flood flows.

Upland Flood Risk Summary

The uplands include the important communities of Taunton and Yeovil. The existing flood defences in **Taunton** provide a good standard of flood protection from the River Tone. However tributaries in Taunton are less well protected and would be a source of significant flooding in the one percent AEP flood. Hydraulic modelling has shown that the main river defences in Taunton would be overtopped if the one percent AEP were to be only slightly exceeded. We know that **Yeovil** is at less risk of flooding than Taunton because it is situated near the top of the catchment on relatively high ground. Despite this, sewer flooding remains a problem. Some roads around Yeovil (for example) are flooded, causing relatively short term inconvenience. Other towns and villages are at some flood risk, sometimes caused by a combination of surface water, sewer and fluvial flooding. Some of these areas flood relatively frequently, although the absolute number of properties at risk to frequent flooding is relatively low. Floodplain extents are generally quite narrow (although larger on the River tone catchment), and therefore the corresponding risk to agricultural land is low.

Lowland Flood Risk Summary

Lowland flooding tends to be of long duration, flooding extensive areas of agricultural land. Depending on the location within the **Somerset Levels and Moors** flooding can remain for weeks or months. Some smaller communities can become cut off. Settlement is scattered through the area and some properties are at risk, although the number at risk does not compare with the towns in the Upland areas. The area is reliant on river embankments to protect the low lying areas. There remains a risk that these embankments can breach suddenly with corresponding risk to life. **Bridgwater** is protected from high estuary levels at the moment by an extensive system of banks and walls. Today flooding in Bridgwater is generally associated with surface water and sewer flooding exacerbated by high tides in the River Parrett. However because of our previous investment in flood defences the flood risk is generally low.

Estuary Floodplain Summary

The situation in the Estuary floodplain is similar to that in the lowland area. The tidal embankments are believed to provide a good standard of protection against flooding to the moor areas, but are at risk from breaching, although the risk today is considered low. Higher areas (outside of the areas protected by tidal embankments) are also generally at low risk.

3.3.3 Flood risks to the economy

To assess the economic consequences of flooding, we have estimated flood damages to property and agriculture using our Model Decision Support Framework (MDSF) software package. This package uses information from the broad scale model, along with information about properties, businesses and agricultural production. The result is a value for flood damage within the catchment under baseline conditions, for different probability events. Flood damages are related to the extent and depth of flooding.

MDSF damages are based on a complex flood damage relationship for a range of property types and agricultural land use in the CFMP area.

There are limitations to the accuracy of the broad scale model results and the MDSF software when analysing the economic consequences. The modelling techniques are likely to be less accurate where:

- flooding occurs in urban areas;
- there are flood defences (which are not included in the broad scale model in detail);
- drainage lines are very narrow (less than 60m wide); and
- the duration of flooding is longer than average, such as in the lowlands.
- The model does not include surface water or sewer flooding which is important in some areas.

These factors are not a concern for the CFMP as the damage figures are only indicative and are used as a tool to help us identify where most damages are happening at the moment and where damages are likely to increase the most in the future. The broad scale model only identifies flooding from significant watercourses. It does not consider surface water flooding (from field runoff) or sewer flooding.

We have focussed on identifying the average annual damage for each policy unit. The average annual damage is the average flood damage expected to occur in a year. However the actual damage in any one year is very variable. In most years the damage is much lower than this average (perhaps 10% or less), but occasionally major floods cause very significant flooding well above the average.

Table 3.3.4. Average Annual Damage (AAD) by policy unit

Average Annual Damage By Policy Unit			
Policy Unit	**Property**	**Agricultural**	**Total**
Upper Yeo	£1,129,000	£150,000	£1,279,000
Yeovil	£53,000	£11,000	£64,000
Upper Parrett	£116,000	£75,000	£191,000
Upper Isle	£231,000	£55,000	£286,000
Upper Cary	£61,000	£31,000	£92,000
Upper Tone	£450,000	£114,000	£564,000
Taunton	£1,885,000	£30,000	£1,915,000
Somerset Levels and Moors	£631,000	£241,000	£872,000

Bridgwater	£1,130,000	£23,000	£1,153,000
North West Parrett	£120,000	£30,000	£150,000
TOTAL	**£5,806,000**	**£760,000**	**£6,566,000**

Most of the economic flood risk damage is focussed in the Uplands (particularly Taunton and the towns and villages in the upland area). Within the Somerset levels and Moors area, agricultural impacts are important although our work indicates that some villages are at risk in the Lowland area.

Table 3.3.5 takes the assessment slightly further. We have calculated the 'damage density' which is the average annual damage divided by the policy unit area. The purpose of this calculation is to determine how 'concentrated' geographically the damage is. The more concentrated the damage the more likely it is that future public investment (both capital works and maintenance operations) can be directed to address the flood risk. If the properties are very dispersed through an area it is often not economic to protect them (because you need a lot of work to protect relatively little). The second figure is the 1% AEP damages divided by the average annual damage. A relatively high value signifies that much of the damage in the policy unit derives from infrequent but relatively serious flooding. A high value would be expected in areas where existing flood defences are in place which reduce damages significantly particularly in less severe events. Conversely a relatively low value suggests that damages are caused by relatively frequent events which tend to be less severe.

Table 3.3.5. Economic Damage Analysis

Damage 'Density' (or concentration) and Significance of Major Flood Events		
	Damage Density (measures how concentrated the flood damage is)	**Shows the significance of infrequent major events**
Policy Unit	**Average Annual Damage (£/km^2) / Policy Unit area**	**1% AEP Damage / Average Annual Damage**
Upper Yeo	**3,749 (Medium)**	**18 (Low)**
Yeovil	**2,434 (Medium)**	**12 (Low)**
Upper Parrett	**1,204 (Low)**	**35 (Medium)**
Upper Isle	**1,679 (Low)**	**35 (Medium)**
Upper Cary	**764 (Low)**	**32 (Medium)**
Upper Tone	**1,635 (Low)**	**19 (Low)**

Taunton	**42,566 (High)**	**61 (High)**
Somerset Levels and Moors	**2,917 (Medium)**	**36 (Medium)**
Bridgwater	**30,346 (High)**	**150 (High)**
North West Parrett	**1,059 (Low)**	**82 (High)**

From the above analysis we can draw the following conclusions:-

- Taunton and Bridgwater are similar with high damage density, but the existing defences ensure that frequent flooding is reduced (resulting in infrequent events being highly significant).
- The Somerset Levels and Moors has a medium damage density and a wide range of events are important
- The Upper Yeo has a medium damage density and damages tend to be caused by relatively frequent events
- The analysis for Yeovil is less informative because the average annual damage is very low which tends to distort the assessment. Much of the damage in this unit derives from sewer flooding which is not included in the analysis above.
- The North West Parrett has a low damage density, and damages are caused by infrequent events.
- The Upper Parrett, Upper Isle and Upper Cary have a low damage density (implying that damages are dispersed through these areas) and a wide range of events are significant.
- The Upper Tone has a low damage density (implying that damages are dispersed through these areas) but the damages tend to be caused by relatively frequent events

We have not undertaken a full economic assessment of the impact of flooding on key infrastructure such as roads and railways. Economic impacts due to road closures tend to be modest normally, although when closure occurs for long periods the impact can be more significant. In most cases long duration flooding tends to affect small communities, with limited economic impact. Regionally significant infrastructure such as the railways that cross the lowland areas is very significant. Whilst economic damages associated with flooding have been modest in the past, the infrastructure relies on the river embankments to operate. Therefore the economic benefit to the nation of the flood risk infrastructure remains very significant. A similar point can be made in relation to electricity transmission lines that cross the lowland area, which are equally reliant on the flood risk infrastructure.

3.3.4 Flood risks to the environment

Table 3.3.6 contains a summary of the area of environmentally designated sites that fall within the one per cent AEP flood outline within each broad division. The lowlands division contains the greatest area of environmentally designated sites affected by flooding.

In Section 2.8.1 we described the main environmentally designated sites within the CFMP area and showed that most designated sites are not adversely affected by flooding. In fact many of the lowland environmental habitats and species rely on high water levels. Improvements to rhyne and ditch maintenance, improvements in water quality, and water level management are three factors that would help to improve the condition of these sites. These factors are not directly related to flooding or flood management.

Whilst the flooding itself is unlikely to harm the condition of the sites, flood risk management activities may have a negative or positive impact. For example, a flood embankment may affect water level management in an area. Alternatively, there are opportunities to positively affect the condition of sites by combining flood management with other activities, such as water quality management. For example, a new flood storage wetland may also help to improve water quality.

Table 3.3.6 Risks to the environment during a one per cent AEP flood event

Risks to the environment during a one per cent AEP flood event				
Division		**Uplands**	**Lowlands (Somerset Levels and Moors)**	**Estuary**
SSSI	Area affected (km^2)	1.5	43	0
	Impact of flooding	Positive (Millwater SSSI; Holme Moor and Clean Moor SSSI)	Somerset Levels and Moors: Positive	N/A
	Impact of FRM	No likely impact	Positive and negative if activities affect water quality, ditch management or water level management	N/A
AONB	Area affected (km^2)	1.3	0	0.4
	Impact of flooding	Dorset Heights and Blackdown Hills: no likely impact	N/A	Quantock Hills: no likely impact
	Impact of FRM	Dorset Heights and Blackdown Hills: no likely impact	N/A	Quantock Hills: no likely impact
SAC	Area affected (km^2)	0.03	0	0
	Impact of flooding	No likely impact	N/A	N/A
	Impact of FRM	No likely impact	N/A	N/A
SPA	Area affected (km^2)	0	34	0
	Impact of flooding	N/A	Somerset Levels and Moors: Positive	N/A
	Impact of FRM	N/A	Positive and negative if activities affect water	N/A

			quality, ditch management or water level management	
Ramsar	Area affected (km^2)	0	34	0
	Impact of flooding	N/A	Somerset Levels and Moors: Positive	N/A
	Impact of FRM	N/A	As SPA	N/A
NNR	Area affected (km^2)	0	4	0
	Impact of flooding	N/A	As SPA	N/A
	Impact of FRM	N/A	As SPA	N/A
ESA	Area affected (km^2)	0	74	0
	Impact of flooding	N/A	As SPA	N/A
	Impact of FRM	N/A	As SPA	N/A
SAM	Area affected (km^2)	5 (cemetery, iron age enclosure, moated site, Bowl barrow and duck decoy)	11 (5 bridges, 5 duck decoys, 1 wall)	0
	Impact of flooding	No likely impact	Possible damage to bridge structure due to deep, fast flowing floodwaters	N/A
	Impact of FRM	No likely impact	No likely impact	N/A

3.4 Summary of flood risk

Flood risk is the combination of the likelihood of a flood occurring (probability) and the potential damage which may result (consequence). The broad scale hydraulic model allows us to assess both these elements of risk consistently across the whole of the area covered by the CFMP.

Table 3.4.1 shows the increase in estimated damages associated with various storm events. The annual average damage from fluvial flooding within the catchment as a whole is estimated as £7 million. The damages have been calculated to a level of detail appropriate to the CFMP and do not include for surface water or sewer flooding. The values allow a qualitative comparison of damages to be made between different flood events. These damages must not be used in any context that is inappropriate to the broad scale nature of the CFMP and should not be confused with the findings of more detailed studies.

Table 3.4.1. Economic damages for different probability events

Annual exceedance probability (AEP)	Commercial and residential flood damages
Annual Average Damage	£7m
20%	£0.9m
10%	£4m
4%	£14m
1%	£150m
0.1%	£691m

The majority of properties affected during a one per cent AEP flood event are residential properties (see Table 3.4.2). Relatively few community buildings are affected which shows that it is local residents in the catchment who are mainly affected by flooding.

Table 3.4.2. Summary of estimated flood damages for the CFMP

Damages from a one per cent AEP flood event			Number of properties affected in a one per cent AEP flood event							
					Non-residential properties					
Total	**Prop.**	**Agric.**	**All prop.**	**Res. Prop.**	**Industry / retail / shops**	**Caravan / camp sites**	**STW**	**Health-care**	**Schools**	**Other**
£153m	£150m	£3m	4031	3267	266	3	2	10	5	478

Notes:

Prop = properties

Agric = agricultural production

Res = residential properties

STW = sewage treatment works

Table 3.4.3 presents a summary of current flood risk in the CFMP area using the three broad CFMP divisions. With the exception of the Estuary, flood risk is significant throughout the CFMP area. Flooding affects the most people in the uplands but affects the largest area in the lowlands. Depths of flooding vary. Upland depths of flooding tend to be relatively low, but flooding on the lowland moors can be 4m. The community most at risk is Taunton, although flood risk is significant in many smaller communities, often caused or exacerbated by surface water or sewer flooding. There is little risk to the environment or heritage. Generally the risk to the environment is due to too little rather than too much water.

Table 3.4.3. Summary of current flood risk

Summary of current flood risk			
Division	**Uplands**	**Lowlands (Somerset Levels and Moors)**	**Estuary**
People in a 0.1 per cent AEP flood	14,111	28,825	1,152
All properties in a one per cent AEP flood	2,584	1,128	319
Sewage Treatment Works	2	0	0
SAM	7	14	0
AONB	0.95km^2	-	0.25km^2
Main community at risk	Taunton	Bridgwater	-

3.5 Existing flood risk management

3.5.1 Introduction

Since the Environment Agency was set up in 1996, we have taken a leading role in flood risk management within England and Wales. We also have a supervisory role over our partners who are also responsible for land drainage issues, including internal drainage boards, emergency services, Highways Authority, Councils and the general public.

Over the last few years, we have progressively adopted a more integrated approach to flood risk management, leading to different activities, which have focused more on development control and flood warning. Since the flooding of Easter 1998, our flood monitoring and warning capability have improved considerably.

We do not manage flood risk just by using physical barriers such as embankments and river walls, but also by providing flood warning systems and raising public awareness about flood risk. We also carry out annual maintenance programmes, making sure that main river channels and culverts are kept clear of excessive vegetation and other debris that can cause blockages. We are desilting rivers less than we used to, so that we can prevent further damage to the environment. We now consider this kind of activity more carefully and only do it if it is really necessary. We manage flood risk by preventing inappropriate development within the floodplain. When development cannot be avoided, we will advise on flood resilient designs, which can reduce risk to life and damages when flooding does occur.

We use a National Flood and Coastal Defence Database (NFCDD) to hold all information on assets, known as structures and defences. Structures and defences are built to help reduce the consequence and impact of flooding. The assets are owned, operated and maintained by the local authorities, private companies, residents, or us.

We carry out inspections of the assets and report their condition to the NFCDD database. We use the data from these inspections to let the owner know that it is their job to maintain assets to an appropriate level.

History of flood defence in the Parrett CFMP area

Flood defences have been constructed in the catchment since the Roman period. On the Somerset Levels and Moors in particular, significant defences were built from the Medieval Period, and particularly in the 18th and 19th Centuries. From the late 19th Century pumping stations assisted the evacuation of flooded moors. The drainage system of the Somerset Levels and Moors and the resulting landscape flora and fauna are fundamentally a man-made system. There is an established procedure of managed flooding, which effectively allows some moors to flood before others. Flood defences have been built throughout the catchment. Most of these defences were built to protect urban areas. A list of defences with approximate standards of service is shown in Table 3.5.1 below. It should be noted that flood defence schemes may not have addressed all the risks in each community and the quoted design standards may not be as high as stated because of known changes in the hydrological assessment of peak flows in recent years.

From Table 3.5.1 it can be seen that all major urban areas at risk from flooding have been subject to flood defence schemes in the past and this supports the assessment that about 90% of properties at risk are protected to some extent. Yeovil is an exception because there are a limited number of properties at high risk of fluvial flooding. The table does not show the investment in the surface water sewer infrastructure which, for Yeovil in particular, has been significant in recent years.

Table 3.5.1. Relevant Schemes and Defences and their Return Period Defences

Summary of flood damages and properties affected (without flood defences)			
Flood Management Unit	**Scheme/Defence**	**Nominal standard of protection (AEP %)**	**Status**
Upper Yeo	Yetminster FAS[6]	4	Built Sep 1981
Upper Yeo	Yeovilton FAS	0.83	Built Oct 1983
Upper Parrett	Thorney/Kingsbury Episcopi	-	Built 1997
Upper Yeo	Stoford FAS	0.5	Built Dec 1981
Upper Yeo	Sherborne FAS	1	Built May 1982
Upper Yeo	Mudford FAS	0.83	Built 1980

[6] Flood Alleviation Scheme

Somerset Levels and Moors	Muchelney	1	Built Jan 1992
Upper Isle	Isle Brewers	1	Built 1982
Upper Isle	Ilminster FAS	10	Built Aug 1977
Upper Isle	Ilford	4	Built Oct 1984
Upper Yeo	Ilchester FAS	1	Built May 1980
North West Parrett	Ashford Mill	5	Built Mar 1987
Upper Parrett	South Perrott Detention Dam	1	-
Upper Tone	Hillfarrance FAS	-	Built 2003
Upper Tone	Ham, Creech St Michael and Ruishton	-	
Taunton	Taunton	1	Built Oct 1991
Somerset Levels & Moors	Langport-Cocklemoor Bank	1	Built Jun 1993
Bridgwater & NW Parrett	Bridgwater	0.5	Built Jul 1993
Taunton	Norton Fitzwarren Dam	1	Under construction

The uplands tend to include areas with little active flood risk management with focussed intervention in areas with high asset value (such as Taunton).

The lowlands are highly managed with a variety of water level management infrastructure to keep water levels high in summer, and embankments along the main rivers to limit flooding in the lowlands during winter. A significant proportion of the Somerset Levels and Moors is low lying and drainage of these areas is often supported by pumping stations.

In the Estuary Floodplain, the predominately agricultural land is protected by high (4m typically) tidal embankments drained via tidal outfalls. Because of the high tidal range in the Estuary, pumping stations are unnecessary, as any water on the land can flow out during low tide periods.

The water level management and flood defence systems have in the past, and continue to, directly influence the landscape, agricultural, and environmental interests of the CFMP area. The current flood defence system extends the grazing season by preventing intermittent spring, summer and early autumnal flooding. More flooding occurs from November to January due to larger flows. This approach of providing seasonal relief from flooding is more realistic and economical than earlier attempts at complete

flood control. However, there is still a risk of flooding in the system during summer from intense storms, which can cause significant agricultural and environmental damage.

Flood risk management by organisation

Flood risk management is supported by a number of professional partners. Together these partners invest considerable sums of money as well as time and effort in maintaining and improving flood defences. Table 3.5.2 summarises the main responsibilities of the partners carrying out flood risk management.

Table 3.5.2. Flood risk management by organisation/group

Flood risk management by organisation/group	
Organisation/ group	**Rights, responsibilities and powers**
The Environment Agency	Production of Flood Zone Maps and management of historical flood records and data. General supervision over all aspects of flood defence. Installing and operating flood warning system. Building and maintaining sea, tidal and river defences (permissive powers to do works]. Improving and maintaining 'Main Rivers.' Regulating activities in and alongside river systems and defences on main rivers and other waterways, except those within an internal drainage board district. Influencing land use planning and preventing inappropriate development within the floodplain. Regard for protecting and conserving the natural environment, whilst carrying out flood risk management activities.
Internal drainage boards	General supervision over all aspects of land drainage within their districts. Improving and maintaining the drainage system. Regulating activities in and alongside the drainage system (other than those watercourses under the control of the Environment Agency. Duties to conservation. Raising income to support land drainage works.
Highways Authority	Have powers to clear the highway, drain and keep water off the highway. They have the right to discharge water from their drainage assets but not to pollute the receiving watercourses.
Local authorities	Investigates any problems occurring on or next to a watercourse. Investigates incidents of flooding. Gives guidance and assistance on flooding issues. Issue sandbags under certain circumstances in times of flooding. Powers to serve notice on landowners, to remove any blockage of an ordinary watercourse. Permissive powers to carry out works on an ordinary watercourse to prevent flooding.
Land owners	The responsibility to pass on the flow without obstruction, pollution or diversion affecting the rights of others. The responsibility for maintaining the watercourse, and for clearing any debris, even if it did not originate from their land. The responsibility for keeping the watercourse clear from any matter that could cause an obstruction, either on their land, or being washed away by high flow and causing an obstruction further downstream.

3.5.2 Flood mapping, data management and development control

Since the 1980s preventing further development in the floodplain has been a central part of flood risk management. The Town and Country Planning Act 1990 requires specific flood defence related policies to be included in county Structure Plans and district wide Local Plans. This was supported in July 2001 by the publication of PPG25 (Planning Policy Guidance Note 25: Development and Flood Risk), which made local planning authorities (LPAs) responsible for making objective judgements about flooding when drawing up land allocations for development plans. PPG25 was replaced in December 2006 by Planning Policy Statement 25: Development and Flood Risk (PPS25).

PPS25 is designed to provide stronger, clearer guidance with regard to flood risk and development. This includes further detail on matching development types (based on vulnerability) to degrees of flood risk. The document also strengthens the guidance on the need to include Flood Risk Assessments at all levels of the planning process. PPS25 defines three zones of flood risk (table 3.5.3).

Table 3.5.3. Flood risk zones (PPS25, December 2006)

Flood Zone	*Annual probability of flooding*
Zone 1 Little or no risk	Land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
Zone 2 Low to medium risk	Land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% – 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5% – 0.1%) in any year.
Zone 3a High risk	This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.
Zone 3b Functional floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes).

In addition to PPS25, on 1 October 2006 the Environment Agency was made a statutory consultee for planning applications where flood risk is a key issue. This means that LPAs are required to consult us about all developments located in areas affected by flooding. Together these set out the Environment Agency role as the leading authority providing advice on flood issues to LPAs and other relevant organisations.

Although we will normally object to development on the floodplain, we recognise that there are circumstances when other planning considerations can outweigh flooding implications. In these circumstances, we make every effort to make sure that appropriate measures to reduce flooding and emergency arrangements are included in the design and implementation of the development proposal. In this way we try at a local level to influence, and over time reduce, the risk of flooding across the country. We also try to influence development at a strategic level through the regional assemblies and the regional frameworks.

We are responsible for defining the Flood Zones throughout England and Wales. We are continually improving our knowledge of flooding and modifying our Flood Zone Maps. These activities are part of our current Flood Mapping Strategy (2003-2008). The Flood Zone Maps can be accessed via our website. They show land within the Zone 2 and Zone 3 boundaries and whether the land is at risk of river flooding or tidal flooding or both. The land in these categories falling within the area covered by the CFMP is shown in Figures 3.2.1.

We have direct control of some activities relating to watercourses. Consent is needed for works in, over, or under a watercourse under the Land Drainage Act 1994, the Water Resources Act 1991 and local byelaws. This process can play an important role in flood risk management by making sure that works to watercourses do not cause a temporary or permanent flood risk.

3.5.3 Flood defence asset management

It is our responsibility to manage the implementation of water level management plans, and to maintain and improve sections of main rivers so that floodwater can flow efficiently. Whilst our flood defence assets can also be used for other purposes, such as water level management, in this CFMP we only address the use of these assets to manage flooding. We provide an agreed level of response to flood events, and develop and deliver an effective and efficient programme of work to ensure that our flood defence assets are maintained and operated to an appropriate standard.

A national asset management strategy has been developed which will require us to manage our assets so that they perform as designed, are fit for purpose and provide value for money. We will know what assets we have, where they are and what they are supposed to do. Our operating and investment decisions will optimise whole life costs whilst ensuring the assets continue to work properly until disposed or replaced. As well as asset management, we are responsible for a range of activities including performance specification and enforcement activities. Our programme includes urgent works and also larger capital schemes.

We maintain thousands of assets that help to reduce flood risk to people and property. We store data relating to these assets in our National Flood and Coastal Defence Database (NFCDD). Good quality reliable data is essential so that we can make operational decisions that make best use of the funds available to us when managing flood risk. Important assets located within the CFMP area are shown in Figure 3.5.1. and Table 3.5.1.

Figure 3.5.1. Location of important flood management assets (river flooding only)

A lot of money is spent on repairing and maintaining existing defences, as well as meeting health and safety obligations on our structures. We spend annually about £1.4 million on maintaining assets. Operational work includes inspecting assets, maintaining and clearing sluice gates and pumping stations, dredging of channels as well as various minor and emergency works as needed. More specific maintenance works includes:

- maintenance of defences, control structures and pumping stations as necessary;
- operation of sluice gates and pumping stations to minimise flood risk and control water levels and flows to support achievement of environmental and agricultural objectives
- Cleaning and desilting of channels as required
- Clearing weirs and bridges on the watercourses of debris to help flood waters drain away.
- Maintaining flood embankments in the appropriate condition.
- Asset inspections both on a regular basis and during flood events
- Other studies and investigations to support our maintenance operations (e.g. to investigate the effectiveness of desilting operations)

The management of our maintenance activities is currently being revised. In future, management activities will be grouped into Flood Risk Management Systems. These systems contain flood defence assets, which as a whole; contribute to reducing flood risk within an area. There is a great variation both

in what the system protects and the type of flood defence assets that make up the system. Costs for managing the systems will be identified, which will allow us to prioritise our work in the future. System Asset Management Plans will inform the changes that need to be made.

As existing structures and defences reach the end of their serviceable life we will need to look at replacing them. The CFMP process is the first step in identifying whether defences should be replaced or removed. Generally we will only replace defences if we can secure the necessary funding. All the flood defence work we carry out aims to be sustainable in terms of social, environmental and economic objectives. The work also satisfies European Legislation (such as the Habitats Directives and Water Framework Directive) and involves environmental impact assessments.

3.5.4 Flood incident management and flood warning

The aim of flood warnings is to protect human life and minimise flood damage to properties and businesses.

In the uplands, the quick response of the catchment to rainfall makes flood warning via flow or water level too slow particularly on the upper tributaries. This is a challenge that may be addressed in the future by more sophisticated rainfall forecasting methods. Towns like Taunton are further downstream and receive flood warnings based on river gauging stations located throughout the catchment. Unfortunately no flood warning system can provide reliable warnings for flash flooding.

In contrast the lowland areas of the Somerset Levels and Moors normally suffer flooding due to an extended period of heavy rain and the timing of flooding can be predicted with relative accuracy. However in the lower reaches of the lowland and in the estuary, high tides can potentially overtop or breach embankments. Breaching, in particular, is very difficult to predict. We maintain a programme of bank inspections during flood events, to minimise the risk of dangerous rapid flooding due to breaches.

Dissemination of flood warnings is key to how predictions of flooding can be used to reduce risks and damage. We work with local authorities and emergency services to ensure that information is disseminated effectively. We maintain the ‘Floodline Warnings Direct’ system which is available to provide direct flood warnings to residents in flood warning areas by automated phone messaging. We operate the national floodline service (0845 988 1188) to those that have concerns regarding flood risk in their area, and operate an online service giving real time flood warnings on the internet http://www.environment-agency.gov.uk/subjects/flood/floodwarning/.

4 Future changes

In section 3 we looked at the areas currently at risk from flooding and estimated the cost of damages. In this Section we look to the future and show how flood risk may change over the next 100 years.

4.1 Introduction

Having set a baseline for flood risk we now need to consider how the catchment may respond to any future changes. This will help determine appropriate policies, strategies and actions to meet the needs of flood risk management both now and for the next 100 years.

Based on our current understanding and the flood risk issues identified in Sections 2 and 3, we have identified three factors that are likely to change flood risk in the future:

- urbanisation - an increase in urban area;
- land use change - a change in the way land is managed causing increased compaction of soils; and
- climate change - changes in future climatic conditions due to global warming.

We tested the sensitivity of river flooding to changes in these three factors using the CFMP broad scale model. The factors were tested by altering the hydrology and water levels in the catchment. Section 4.2.1 describes the assumptions we made and the results we found.

We used a combination of the most sensitive factors to make our future scenarios. These were climate change and land use change and are described in Section 4.2.2. We used this future scenario to appraise how well our policies are likely to meet our catchment objectives in the future.

4.2 Future scenarios

4.2.1 Sensitivity testing

The three factors that are most likely to change flood risk in the future are urbanisation, land use change and climate change. We tested the catchment by considering each factor independently, to see how sensitive the catchment is to each one.

The aim of the urbanisation test is to see how sensitive the catchment is to the increased housing numbers allocated in local authority plans and the South West Regional Spatial Strategy (SWRSS). The SWRSS states that up to 25,000 new homes are needed each year between 2006 and 2026 for the South West region, and they are to be located as much as possible on brownfield sites. Within the Parrett CFMP area, proposed future development is focussed in Taunton and Bridgwater, with some further development in other towns such as Yeovil, Wellington and Crewkerne. No significant development is proposed in the Somerset Levels and Moors area.

There is a growing realisation that agricultural land use and management can have a significant impact on flood flows. However the impact depends on the soil types, the season, the crop, farm operations and equipment, the event rainfall and other factors. Some modern farming practices can lead to a reduction in soil water storage and infiltration capacity, particularly within the soft siltstone/fine-grained sandstone landscape which dominates much of the upland area. The impact of land management on flooding has been shown in the Parrett catchment, although only at a local scale.

Rising global temperatures will affect climatic conditions, including changing weather patterns, rising sea levels and increasing the frequency and intensity of extreme weather events. Changes in climatic conditions will mean changes to flooding patterns and flood risk. Flooding in some catchments will be more sensitive to changes in climate conditions than others. We have used the climate change sensitivity test to see how sensitive the Parrett CFMP area is to these changes.

Table 4.2.1 contains a summary of the assumptions and results of the sensitivity testing.

Table 4.2.1. Assumptions and results of sensitivity testing

Factor	Main assumptions and data	Results	Approximate Change in flood risk driver
Urbanisation	Urban area was increased in certain parts of the CFMP area, to reflect forecast housing numbers and likely locations for these, as outlined in local structure plans and the SWRSS. The biggest increases were in urban areas, particularly Taunton. To a lesser extent, the urban area of larger towns in other areas of the CFMP was increased. Increasing urban area leads to an increase in the amount of runoff. We therefore increased the peak flood flows in our model. The assumption when testing this factor is that increasing urban area will have some overall impact on flooding, but by using sustainable urban drainage systems (SUDs), this runoff will not increase as much as it would otherwise. It is assumed that changes to existing transport routes or new transport routes will include placing correctly sized culverts in an appropriate location so that they will not affect flood flows, and SUDs to manage any increase in runoff from new roads.	Increasing urban area showed a minor impact on river flooding on a catchment scale. Flood depths increased locally in urban developments and for a short distance downstream of major towns in the uplands. As the impact of urbanisation was on a local, not catchment scale, we have not investigated urbanisation trends and its effect on flooding further.	+1% increase in peak flow
Land use change	A change in the way that land is used in the CFMP area is likely to cause more soil compaction. Compaction of soils means that less water can soak into the ground and instead increases flows in nearby rivers. The peak flood flows in our broad scale model were increased to reflect this change.	Land use change showed a widespread moderate impact on river flooding across the CFMP area. Flood extents increased in the lowlands and flood depths increased in the impermeable uplands. Minor changes were shown in the coastal strip and permeable uplands.	+5% increase in peak flow
Climate change	Climate change is predicted to result in wetter winters with increased storminess and a rise in mean sea levels due to a combination of southern England land mass falling and sea level rise due to global warming (continental ice caps melting and thermal expansion of the oceans). Following Defra and National CFMP guidance, we tested this change by increasing peak flood flows in our broad scale model by 20 per cent, and increasing mean sea levels.	Climate change showed a widespread large impact across the CFMP area. All areas showed increased flood depths and extents.. Large areas in the lowlands flooded where there was no flooding previously (showing sensitivity of flooding to flood defence embankment heights).	+20% increase in peak flow 500mm to 1000mm increase in tidal levels

4.2.2 Future scenarios

We tested the sensitivity of flooding in the CFMP area to changes in three factors. In reality, however, changes in these factors will not occur by themselves. To assess flood risk under future changes, we developed a 'future scenario' which is a combination of the sensitivity test factors to produce our best assessment of likely conditions in the future. We used this future scenario to develop and test how different CFMP policies perform against this likely future situation.

We found that river flooding in the CFMP area is sensitive to climate change, as flood depths and extents increased over a wide area. Climate change is also highly likely to occur, so this factor has been used as a component of our future scenario.

The CFMP area was moderately sensitive to land use change over a wide area and sensitive to urbanisation changes in certain locations (downstream of larger urban areas). The land use change and urbanisation that were assessed in our sensitivity tests are unlikely to occur at the same time or to the same extent in the future. As the land use change scenario had a greater effect on river flooding at a wider (catchment) scale, it was used as the second component of our future scenario.

We have therefore used climate change combined with land use change as our 'future scenario' to provide a picture of flood risk in the future. The simulated flood extent and depths obtained from the broad scale model for the future scenario were used to calculate the cost of flood damages.

With respect to the increase in flow due to climate change, a 20% increase is likely to be an upper bound at least in the next 100 years. It is possible that this value could be exceeded but this seems unlikely given the information available today.

With respect to sea level rise estimates, national guidance has recently changed and we are adopting the advice published by DEFRA *Supplementary Note to Operating Authorities – Climate Change Impacts October 2006*. Previously the sea level rise was considered as 500mm over a 100 year period, but this allowance has now been increased to just under 1000mm, but with the rate of rise increasing over time. The implications of this change have not been fully assessed. However what even the lower estimate indicates is that damages in the Bridgwater and parts of the North West Parrett units will increase significantly, which will require investment to address. This is discussed further below.

4.3 Assessment of future flood risk

4.3.1 Model results

The impact of future changes on flood risk remains uncertain but we highlight below where the modelling has identified the main changes over a 100 year period.

In the upper tributaries of the upland the impact is relatively modest, because there are relatively few assets outside of the towns. Surface water/sewer flooding in **Yeovil** may be particularly vulnerable if short intense events are more frequent in the future. **Taunton** is particularly vulnerable because the present standard of protection from the River Tone which today is relatively high (approximately 1% AEP), will reduce to 2% AEP or worse. **Bridgwater** is primarily vulnerable to high tide levels. Work we have undertaken in the last two years has shown that the risks of overtopping of the defences in Bridgwater will become unacceptable within about 30 years, depending on the actual rate of sea level rise.

The **Somerset Levels and Moors** is particularly complex. Modelling has shown that whilst the change in water level in the future may be relatively modest (because of very extensive floodplain) the change in flood duration may be particularly high. The broad scale modelling undertaken for the Parrett CFMP underestimates the importance of flood duration, but it will be locally important for some communities on the Somerset Levels and Moors, and particularly for the farming community. The frequency of flooding will also increase significantly.

Table 4.3.1 contains a summary of future scenario river flooding and its characteristics, using the three CFMP broad divisions.

Table 4.3.1. Summary of future flooding and its characteristics

Summary of future flooding and its characteristics			
Descriptor	**Uplands**	**Lowlands (Somerset Levels and Moors)**	**Estuary**
Change in pathway	Capacity of the channel exceeded more often.	Capacity of the channel exceeded more often. Increased overtopping of earth embankments.	Flood levels in estuary increase causing more frequent overtopping and potential for breaching of tidal embankments
Increase in average flood depths during a 1% AEP flood (m)	+0.3m	+0.2m (some moors may increase substantially more than this). Lower areas (e.g. Bridgwater) potentially much higher than +0.2m	Model very sensitive to breach and overtopping assumptions. In some places increase greater than 1m
Increase in average velocities during a 1% AEP flood (m/s)	Little change (high)	Generally little change except in areas at risk from breaching where increase will be very high	High increase in velocity in areas at risk from breaching and overtopping of tidal embankments
Increase in indicative duration of a 1% flood	Little Change	Large increase in duration of flooding	Most areas are not at risk today in the 1% flood. But duration of flooding limited
Increase in indicative frequency of flooding	Increase in frequency of flooding (still relatively infrequent flooding of narrow floodplain)	Significant increase in frequency of flooding	Much higher frequency of flooding, driven by overtopping and breach risks

Notes: indicative values of:
Depth [shallow < 0.5m < deep < 2.0m < very deep]
Duration [short < 12 hours < moderate < 8 hours < long]
Velocity [low < 1m/s < medium < 2m/s < high]

4.3.2 Future flood risk to society

Areas of high population density where flood risks are shown to increase significantly will have the largest impact on society. In particular, the risks to residents in **Taunton** will increase significantly, unless works are undertaken to address the risks. Unfortunately because of the administrative role of Taunton, flooding here will have potential indirect impacts on society, as a considerable number of staff who work in the various administrative centres (e.g. Somerset County Council, Taunton Deane Borough Council etc) may not be able to get to work, or would be directly flooded themselves. In **Bridgwater** within about 30 years tidal flood levels will start to overtop defences in a 0.5% AEP event. Critically the risks to life in the Bridgwater area (particularly some of the lower lying suburbs) would increase due to the risk of overtopping. **Yeovil** is vulnerable to flash flooding, but the risk to society will be relatively modest, as flood depths will tend to be low. Elsewhere in the upland areas towns and villages will be at higher risk, but the absolute risk to life and society will be modest as depths tend to be relatively low.

In the **Somerset Levels and Moors** the population is widely scattered. Modelling indicates that depths of flooding may not increase significantly, but the duration will be much longer. This will cause disruption to communities as access will be impeded as roads become closed for longer periods. The risk to life on the Somerset Levels and Moors may increase more than expected as car drivers may chance access across roads that are flooded. Our research has shown that people are most at risk when travelling, particularly in remote areas.

In the **estuary** breach risks will increase, so significantly increasing the risk to life. The number of properties at risk is relatively modest here, although some of the estuary embankments also protect lower areas of Bridgwater providing potentially an unexpected back door flood route.

We indicate in Table 4.3.2 the changes to risk associated with our scenario.

Table 4.3.2. Social Risks

Increase in Social Risks		
Division	**Increase in Residential Properties at Risk in the 1%AEP Event**	**Increase in People at Risk in the 1% AEP Event**
Uplands	+1050 (3000 total)	+1748 (8700 total)
Lowlands	+2291 (3300 total)	+4669 (14200 total)
Estuary	+7 (315 total)	+132 (750 total)

4.3.3 Future flood risk to the economy

We have undertaken a broad scale assessment of the change in average annual damage for each policy unit. This is not a prediction of the future, as there remains considerable uncertainty. The change in average annual damage has assumed that we maintain our current assets but do not enhance them to respond to the increasing risk. Of course a major increase in damages associated with climate change and land use change would indicate that further investment is likely to be required. Table 4.3.3 summarises the change based on these assumptions.

Table 4.3.3. Future flood risk by policy unit

Change in Average Annual Damage by Policy Unit				
Policy Unit	**Present Day Average Annual Damage £**	**Future Scenario Average Annual Damage £k**	**Percentage Change**	**Comment**
Upper Yeo	£1,279,000	£2,558,000	+100%	Increase due to higher flows
Yeovil	£64,000	£157,000	+145%	Increase due to higher flows
Upper Parrett	£191,000	£385,000	+102%	Increase due to higher flows
Upper Isle	£286,000	£663,000	+132%	Increase due to higher flows
Upper Cary	£92,000	£192,000	+109%	Increase due to higher flows
Upper Tone	£564,000	£1,161,000	+106%	Increase due to higher flows
Taunton	£1,915,000	£5,213,000	+172%	Large increase due to reduction in standard of protection provided by the Taunton flood defences
Somerset Levels and Moors	£872,000	£2,035,000	+133%	Increase due to higher flows
Bridgwater	£1,153,000	£11,357,000	+885%	Very large increase due to overtopping of the Bridgwater tidal defences
North West Parrett	£150,000	£1,285,000	+757%	Very large increase due to overtopping of Parrett estuary flood defences
TOTAL	**£6,566,000**	**£25,006,000**	**Mean 281% Median 133%**	In most areas the average annual damage is more than doubled. In the estuary the impacts are much higher

As with the baseline model results, we recognise the limitations of the broad scale model results and the MDSF software.

In broad terms the analysis shows that in most areas flood damages may more than double in response to climate and land use change. However in the areas at risk from tidal flooding (Bridgwater and parts of the North West Parrett policy unit) the impact on damages associated with sea level rise is very dramatic, with damages increasing by ten times compared with the present day, this reflects the risk of serious flooding due to tidal overtopping of defences. There is a tidal component of flooding to the Somerset Levels and Moors but due to the distance from the sea and the limited channel capacity the impact is not as much as may be expected. Paradoxically modelling has shown that by increasing protection to Bridgwater and the North West Parrett policy units may increase the impact of tidal flooding on the Levels and Moors.

Taunton damages would almost triple in the future, reflecting the increase in fluvial flows, which would reduce the standard of protection provided by the Taunton flood defences that protect much of the town. As discussed previously, these increases would only occur if we did not respond. One of the key outputs of the Parrett Catchment Flood Management Plan is to help us focus on where future investment should be directed to adapt to increasing risk in the future.

The 1% AEP flood damage increases from £150m to about £300m, reflecting the overall indication that damages will broadly double in the future if we do not respond.

4.3.4 Future flood risks to the environment

As discussed in Section 2.8 flooding is not, in itself, a major problem, and many of the habitats rely on high water levels and flooding to thrive. However, excess flooding on the Somerset Levels and Moors particularly in the summer, can cause grass kill and subsequent pollution (reducing dissolved oxygen to critical levels). This can cause at least a short term reduction in a variety of important species.

It is not generally expected that the duration of flooding will change very significantly in the upland areas, and the increase in the area of flooding will not change greatly (because the floodplain is generally well defined). However in response to higher flows the channel shape is likely to change as further erosion is likely associated with higher flood flows. This will impact on the environmental interest, although it is likely that this change will be gradual.

Muddy floods occur during periods of heavy rain particularly on areas which have suffered inappropriate farming practices, making the soil vulnerable to high runoff and associated erosion. Silt generated in this way from the upland areas will have a detrimental impact on water quality. We are actively working with the farming community to address this problem.

In the Somerset Levels and Moors the situation is complex. Longer duration flooding is predicted from the models, which will increase the risk of grass kill in the summer, and potentially lead to habitat changes

more generally. Habitats will be vulnerable to other climate changes (such as temperature and summer droughts). However it is not possible to assess the likely changes as the science is still very uncertain.

In Bridgwater and the North West Parrett units flood risks are primarily caused by high tide levels. Tidal overtopping, which is very unlikely now but much more likely in the future, would have a major impact on habitats and species. This is due to sea water flooding predominately freshwater areas.

4.4 Summary of future flood risk

We have summarised below the key messages from the analysis undertaken.

Table 4.4.1. Summary of future flooding

Key Impacts By Policy Unit of increased Flood Risk Scenario			
Policy Unit	**Social[1]**	**Environmental[2]**	**Economic[3]**
Upper Yeo	Frequency of flooding more than doubles	Low impact expected, some channel widening envisaged	+100% increase in flood damages due to higher flows
Yeovil	Area sensitive to high intensity rainfall, which may overwhelm existing sewer system, putting homes and transport links at risk	Low Impact expected	+145% increase in flood damages due to higher flows. This will underestimate damages associated with sewer flooding
Upper Parrett	Frequency of flooding more than doubles	Low impact expected, some channel widening envisaged	+102% increase in flood damages due to higher flows
Upper Isle	Frequency of flooding more than doubles	Low impact expected, some channel widening expected	+132% increase in flood damages due to higher flows
Upper Cary	Frequency of flooding more than doubles	Low impact expected	+109% increase in flood damages due to higher flows
Upper Tone	Frequency of flooding more than doubles	Low impact expected, some channel widening expected	+106% increase in flood damages due to higher flows
Taunton	Wide scale flooding risk increases by three times. Local government centres at risk	Low impact expected	+172% large increase in flood damages due to higher flows and reduction in standard of protection provided by existing defences
Somerset Levels and Moors	Increasing risk of communities being cut off by flood water, increase risk of embankment breaching putting people at risk	Increase in duration of flooding may promote habitat change and increase the risk of grass kill	+133% increase in flood damages due to higher flows, particularly high impact on agriculture
Bridgwater	Overtopping of tidal defences will increase risk of property flooding and cut off major roads	Saline flooding will increase risk of major changes to freshwater habitats	+885% increase in flood damages due to higher tide levels and overtopping of existing defences
North West Parrett	Increased risk of breaching and possible risks to the public (particularly to those in cars)	Saline flooding will increase risk of major changes to freshwater habitats	+757% increase in flood damages due to higher tide levels and overtopping of existing defences, high impact on agriculture

Notes

1. Social: 'frequency of flooding more than doubles' implies that floods will occur approximately twice as often (e.g. an event which would be expected every 50 years would occur every 25 years)
2. Environmental: Strictly changes to the environment should take into account other changes such as changes to temperature, soil moisture etc which are also associated with climate change. However the science to support such an

analysis is not available. We have restricted our high level review simply to flood risk change. Where channel widening is highlighted this indicates that some geomorphological change is expected in the channel and there would be some environmental impact

3. Figures show increase in average annual damage (including both property and agriculture)

5 Catchment objectives

Having looked at the possible future changes to the catchment in Section 4, in this section we outline the objectives that will bring sustainable flood risk management and wider benefits to the catchment.

5.1 Introduction

5.1.1 Vision

In the previous sections we have identified the areas, properties and habitats that could be affected by flooding in the catchment today and possibly in the future. In this section we consider our vision for the catchment and consider the key questions. For example:-

- What should underpin our approach to flood risk in the future?
- Are flood risks manageable today and how about the future?
- Can we continue to manage the Somerset Levels and Moors in the same way as we do today?
- What are the principal opportunities and constraints in the catchment?

The CFMP is a high level document, and it is aspirational although we aim to understand the main constraints. At a regional level we aim to support the South West's Mission for Sustainability *"People in the South West of England chose to live, work and prosper within environmental limits, pursuing justice and well being and valuing diversity and distinctiveness"* (Partners to this mission include the Government Office for the South West, The South West Regional Assembly, The South West Regional Development Agency and Sustainability South West). The principles that derive from this mission and the relevance to this CFMP are summarised in Table 5.1.1 below:

Table 5.1.1. CFMP key principles

Principle	*Application*
Improve physical and mental well being	Reducing the risk of flooding fully supports this principle
Be resource wise	We need to challenge policies and activities that use resources inefficiently or unnecessarily
Support thriving low carbon economies	By minimising flooding we aim to support local businesses including the local agricultural community. We must ensure that any investment by us is cost effective, as ultimately the costs are met by the local community and the nation as a whole
Enhance local distinctiveness & diversity including biodiversity	We aim to support biodiversity and the wide range of internationally and nationally important habitats and species. We have legally binding international and national obligations in some areas
Take a long term approach	We are building on a long legacy of flood risk and drainage works. We need to ensure that we consider the long term future – even if we cannot know for certain what the long term challenges will be.
Help everybody to join in public decision making	We are very grateful for the involvement from the community in the Parrett catchment over the last 10 years or more, and we aim to foster that good relationship into the future. Ensuring that the local public has a say in centrally funded works remains a challenge
Improve equality in meeting basic needs	We need to ensure that we consider all areas within the Parrett catchment equally, with a particular focus on areas which are struggling socially or economically today
Use local and ethical goods and services	We are now enforcing strict sourcing of materials to ensure (as much as possible) sustainable sources (e.g. timber).
Develop sustainability learning and skills	We aim to work with our staff, and the wider community to improve our understanding of sustainability and ensure that principles are carried out effectively
Reduce high carbon travel	We aim to reduce high carbon travel where possible

5.1.2 Key Questions

In the table above we consider the principles that underpin our approach to flood risk. From our knowledge of the flood risks today and with some indication of the future risks, we are in a position to answer some of the key flood risk questions relevant to this catchment. These questions are high level and are concerned with the strategic direction of our approach to flood risk. There are many other questions, some of which are considered later in the CFMP but others which are only relevant in other plans (refer to section 1.4). We understand that the answers below may not be 'right' in the future – the climate may change more or less rapidly than expected, habitats may change in ways we do not understand, and economic development or social objectives may change how we consider flood risks in the future. There are many other changes that may occur which may change our view. However, in the table below we summarise what we believe are the key questions regarding flood risk in the catchment, and our view today.

Table 5.1.2. Key questions regarding flood risk in the catchment

Key Question	*Our Current View*
Will we be able to minimise the risk of flooding in the key towns in the catchment?	Further investment will be required, but it will be proportional to the assets protected by our works. Some significant practical difficulties may arise in some areas (particularly Bridgwater), which may require a change of approach and a step change in investment
Can we continue to effectively manage the Somerset Levels and Moors in the future?	The Somerset Levels and Moors are vulnerable to increased flooding due to increased storminess in the future, and to a lesser extent increasing tide levels. The current flood risk infrastructure is required to protect property and businesses. We have obligations to protect the habitats that have developed hand in hand with the man-made flood risk infrastructure. As far as we can see today we see no reason why the Somerset Levels and Moors cannot be managed broadly as it is today, although from an agricultural perspective the area may be more difficult to farm. Despite these objectives, the assets are dispersed throughout the area. From an economic point of view a lot of money is required to protect relatively little when considered at a £ per square kilometre point of view. Historically investment decisions have underestimated the value of the infrastructure (such as Railways), which cross this area, and it is essential that this is considered in future decision making. We remain concerned that investment in the Somerset Levels and Moors may compare poorly with other national flood risk priorities providing a challenge in the future. The distribution of floodwater across the Somerset Levels and Moors is, to some extent, based on historical practice which should be challenged in the future. This will have social and financial implications which will have to be considered carefully.
In principle are pumping stations sustainable in the future?	Our modelling has shown that some pumping stations provide an important flood risk management function. The Parrett CFMP cannot address technical means to reduce flooding, but it is likely that there are also some pumping stations that are not economic and are inconsistent with sustainable principles.

Will it be possible to reduce flood risks significantly in the future?	We continue to look for ways to reduce flood risk. Where appropriate we work with others to fund or carry out works or other activities. However, the CFMP generally confirms that there are few new projects which are likely to be economic at least in the short term. The primary focus is likely to be in the maintenance and upgrading of previous works, and related activities such as flood warning. Using what we have better will be a key objective. In the future the situation may well change and incremental upgrading or improvement may not be possible when considering climate change or other drivers.
Will flooding impact adversely on habitats and species in the future	Many of the habitats and species in the catchment are either tolerant of flooding or require high water/wetness to thrive. Future changes in flooding have to be seen within the likely other climatic and farming changes. In particular changes in winter and summer temperatures may have a significant impact on the habitats in the area, although the supporting science is still limited in this area.

After considering these key questions we have looked for opportunities to reduce flood risk and constraints that could limit our actions. We also reviewed legislation and other policies, plans and strategies that affect the CFMP area. This helped us to develop catchment objectives, which have been used to help select the most appropriate policy for areas of the catchment known as 'policy units'.

5.2 Catchment opportunities and constraints

5.2.1 Opportunities

Traditionally, flood management has focused on identifying engineered solutions to flood defence (e.g. walls, embankments, sluices, new channels, pumps, dredging etc). Engineering solutions will continue to have an essential role in reducing flood risk in the catchment, but will come under increasing pressure from future changes such as climate change, increasing urbanisation and changes to the way we manage land. The challenge for future flood management is to reduce the impact of these pressures by identifying sustainable opportunities and approaches which take into account future change. Most of these opportunities span the social, economic and environmental objectives, but for simplicity we have put the opportunity under one heading. We have identified the following opportunities for the CFMP:

Social

From a social perspective opportunities to minimise flood risks are likely to go hand in hand with the regeneration of key urban areas. This opportunity is discussed in the economic section below.

Transport enhancements (e.g. improvements to roads, new footpaths) provide an opportunity to reduce the isolation of some communities during flood events.

Economic

Most development in the CFMP area is expected in Taunton and Bridgwater. This concentration of development provides an opportunity to improve flood management systems in these areas. Controlling runoff is also important, but storing water in all areas may not be the best use of resources, and should probably be focussed in the upland areas. Available resources generated in connection with development may be better directed at enhancing existing defences particularly in the lowlands and in the Estuary.

Working with local planning authorities, Wessex Water and the Parrett Internal Drainage Board to analyse urban drainage systems to develop more effective water management options is an opportunity that should be progressed.

Working with the Highways Authority to make sure that the M5 is not adversely affected by flood risk and does not contribute to flood risk in the future.

We know that we cannot economically address all flood risks with large scale engineered options. However we are investigating ways by which we can help landowners and businesses make their properties more resistant to flooding (by the use of local flood protection measures such as flood boards on properties) and more resilient if flooding occurs (by advising on types of construction etc).

Environmental

Changes to upland land management will provide multiple benefits. Work within the Parrett catchment has been at the forefront of improving land management nationally. Whilst national CFMP guidelines require us to consider a deteriorating situation with respect to land management, there is evidence locally that the situation may be improving. This and other activities will help support our work in relation to the Water Framework Directive.

Creating flood storage areas in the uplands has some benefits from a flood risk perspective, particularly in relation to new development and to smaller upstream tributaries. There are other environmental benefits associated with flood storage areas (particularly if they provide permanent wetland areas) but they are not a panacea to flooding in the lowland catchment.

Emerging national ‘outcome measures’ (the measures by which the Government will monitor the success of flood management activities and guide future flood risk investment) includes the DEFRA PSA target to have 95% of SSSIs in favourable condition by 2010 and the contribution that flood management can have to this target. Our view is that much of the works required to achieve this national target tend to be related to ‘normal’ water level management rather than flooding. However there is an opportunity to ensure that future capital investment achieves both flood risk and environmental objectives.

Improving river corridors, floodplains and wetland areas where possible will improve ecological values and biodiversity in the area and enhance BAP habitats, as well as having some flood risk benefit.

Floodwater will continue to be stored in the lowland area and there are limited practical opportunities to reduce this. However where the water is stored is due in part to the historical development of the Somerset Levels and Moors. Logically water would be stored in areas where there is little at risk and where gravity discharge (as opposed to pumping) can be achieved. A review of the lowland areas has shown that there are opportunities to remove some of the legacy issues and redirect floodwater to lower risk areas.

Flood Management Constraints

Constraints may restrict or prevent certain actions. However, these constraints may also provide opportunities when taken in the wider context. Where there is a constraint on a particular way of managing flooding, it is important to consider what alternative options may be acceptable or even provide benefits to that feature or issue. We have identified the following constraints for the CFMP:

Social

There are many isolated properties and communities at risk of flooding in the CFMP area. Finding an economic approach to flooding is difficult when compared with other national priorities. Targets to provide more housing are set well into the next decade. Land must be allocated to meet these targets.

Economic

Nationally there are limited resources to address flood risk issues. For major projects different schemes effectively compete for the available funding at a national level. This process of judging which schemes are of most value to the nation is under review at the time of writing, but will effectively be based on how well schemes achieve national 'outcome measures'. The Parrett catchment has suffered in the past in terms of investment because it is a relatively large area but the value of assets at risk is relatively low on a £/km^2 basis. It is unlikely that this situation will change greatly in the future.

The lowland and estuary areas rely on highly managed and less sustainable drainage systems (such as pumping) to manage flooding. We have considered if there is any practical way to achieve a more sustainable solution. However at the moment, due to existing assets and environmental constraints, there does not appear to be a practical way to reverse almost 2000 years of drainage operations without massive cost and damage to the local communities in the area.

The local economy in the CFMP area relies on agriculture and tourism and flood risks need to be managed to ensure that these key businesses continue.

Transport links in the region, particularly the M5, are a vital part of the communication network. Flood risk management should reflect the importance of these links.

Environmental

Protected and designated sites are susceptible to changes in water levels. Flood risk management must not adversely impact on water level management.

Much of the CFMP area is under environmental designation, or of recognised landscape or biodiversity value. Flood risk management must not harm these sites.

5.3 Catchment objectives

Table 5.3.1 contains the catchment objectives, targets and indicators that we have identified for this CFMP.

The objectives seek to define an overall direction for the catchment. It will not be possible to meet all catchment objectives in all locations. For example, with current climate change trends, it will not be possible for us to prevent increases in flooding everywhere. However if we allow flooding to increase in some areas and manage, adapt and avoid it in others, we can reduce the overall consequences of flooding across the catchment. In reducing the consequences of flooding, we will reduce risk.

We have used these catchment objectives to appraise policy options for the catchment. We have used our knowledge of the catchment to choose features, called 'indicators,' to show us how well our catchment objectives will be met with each policy option. The targets have been identified during the policy appraisal process. This is described further in Section 6.

Table 5.3.1. CFMP objectives, targets and indicators

	Catchment objectives	Indicators	Targets
	Social		
A	Reduce the risk of serious injury/harm to people caused by flooding.	Number of people exposed to deep and/or fast flowing floodwaters during a 0.1 per cent AEP flood.	Reduction of the number of people exposed to deep and/or fast flowing floodwaters during a 0.1 per cent AEP flood.
	Economic		
B	Reduce the economic damage to properties caused by flooding.	Annual average damage of flooding to property (£).	Reduction in the annual average damage of flooding to property.
		Number of residential properties lying within the one per cent AEP floodplain.	No increase in the number of residential properties lying within the one per cent AEP floodplain.
C	Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding.	Number of non-residential properties that lie within the floodplain of a one per cent AEP flood.	Reduction in the number of non-residential properties that lie within the floodplain of a one per cent AEP flood.
		Length of motorway and A road flooded during a one per cent AEP flood (km).	Reduction in length of motorway or A road flooded during a one per cent AEP flood.
D	Reduce the economic damage to agricultural production caused by flooding.	Average annual damage of agricultural land caused by flooding (£).	Reduction in the average annual damage of agricultural land caused by flooding.
		Length of flooding of agricultural land (days).	No increase in the length of flooding (days) of agricultural land.
E	Reduce the cost of flood risk management in the CFMP area.	Annual average cost of flood risk management (£).	Reduction in the annual average cost of flood risk management.
	Environmental		
F	Maintain / restore natural river processes and linkages with the floodplain where appropriate.	Length of natural soft edged river connected to floodplain (km).	Increase in length of natural soft edged river connected to floodplain.
		Number of active fluvial floodplain features (active meander movement, oxbows, semi-natural channels)	Increase in number of active fluvial floodplain features
		Number of times flood related maintenance to channels is undertaken per year.	Reduction in flood related maintenance to channels.
G	Protect / improve features of cultural heritage that are affected by flooding.	Number of scheduled ancient monuments that lie within the one per cent AEP floodplain.	No increase in the number of scheduled ancient monuments affected in the one per cent AEP flood.
H	Seek to maintain / improve the condition of environmentally designated sites.	Condition of environmentally designated sites.	Maintain or improve the condition of environmentally designated sites.
I	Seek to help protect and improve biodiversity habitats, where appropriate.	Habitat/river corridor survey scores.	Maintain or improve habitat/river corridor survey scores.

6 Policy appraisal

The aim of this section is to assess the impact of flood risk management policies and to assign preferred policies to various parts of the catchment.

6.1 Introduction

Based on what we understand about the catchment, we have divided the CFMP area into 'policy units.' These are areas that face similar types of flooding (source and pathway of flooding) and contain similar assets that are vulnerable to damage during flooding (receptors of flooding). We set one of six standard flood risk management policies (listed below) for each policy unit. We are applying this standard set of policies to areas of catchments across England and Wales.

Table 6.1.1. Standard flood risk management policies

Standard flood risk management policies	
Policy option	**Policy**
1	No active intervention (including flood warning and maintenance). Continue to monitor and advise.
2	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
3	Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
4	Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change).
5	Take further action to reduce flood risk (now and/or in the future).
6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, which may constitute an overall flood risk reduction (e.g. for habitat inundation). Note: This policy option involves a strategic increase in flooding in allocated areas, but is not intended to adversely affect the risk to individual properties.

An important part of the appraisal process is to agree what geographical area each of the policy units should cover. We have done this by finding areas that have similar characteristics. The criteria we used included:

- topography;
- geology;
- hydrological response;
- land use;
- position in the catchment;
- hydraulic characteristics;
- current level of flood risk;
- future level of flood risk;
- receptor; and
- links to other plans.

6.2 Policies for the CFMP

We have divided the Parrett CFMP area into ten separate policy units, shown on the map in Figure 6.2.1. The policy units are numbered 1 to 10, and each unit is colour coded according to which policy we selected.

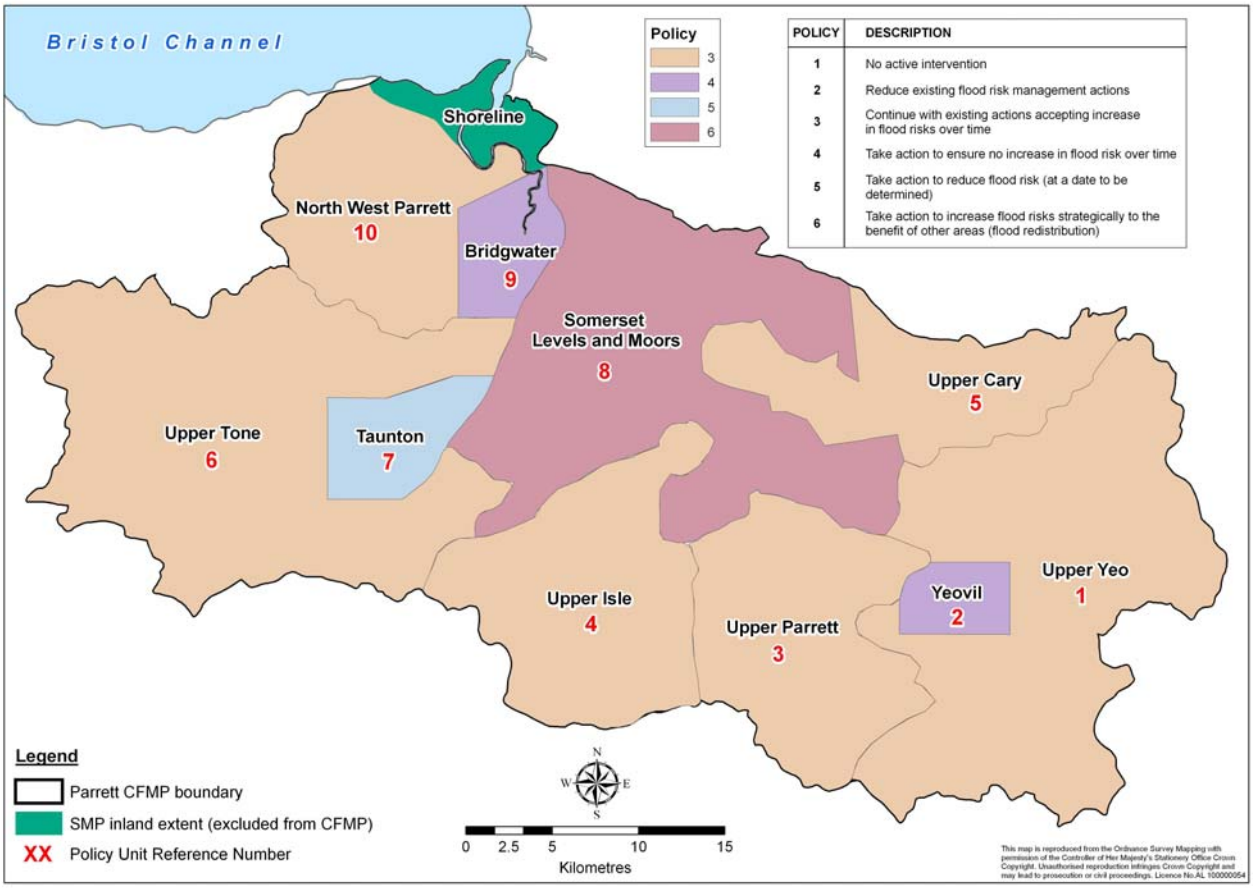


Figure 6.2.1. Parrett CFMP policy units and policies

We chose which policy to assign to each policy unit using a policy appraisal process. This process showed us which policy option best met our catchment objectives (as described in Section 5). We based this assessment on what we knew about the catchment, information about flooding in the past and the results from the baseline and future scenario broad scale modelling. We used all the information and data we collected throughout the study to select the preferred policy for each policy unit. Not all of the catchment objectives are relevant to all of the policy units.

As discussed previously, the Parrett CFMP is aspirational, and cannot confirm in detail what flood risk management activities will be undertaken in the future. We are mindful of the funding constraints which will continue despite recent national budget increases. We have taken into account the economic realities and identified where we consider future investment would be best directed. Therefore policy 5, take further action to reduce flood risk (now and/or in the future) has only been identified in areas where this is likely to be justifiable.

The following tables (6.2.1 to 6.2.10) provide a summary of the information we used in selecting the preferred policy for each of the policy units. We summarise the main features of each policy unit, explain the flood risk in each area, and explore any existing or likely future flood risk management problems. We select the policy by assessing how well it would meet catchment objectives and the effect it could have on the social, economic and environmental cost of flooding.

It is important to recognise that flooding can benefit the condition of environmentally designated sites and sometimes agricultural production. The duration of flooding is also important in this CFMP area, as well as frequency, depth and extent. The environmental report in Appendix B includes the full set of policy appraisal tables which considers the full range of social, economic and environmental objectives.

Table 6.2.1. Policy unit 1

Summary of policy unit 1 – Upper Yeo	
Policy unit 1	Policy Unit 1 includes the River Yeo upstream of Ilchester, excluding Yeovil which is considered separately in policy unit 2. The policy unit includes Sherborne, Ilchester, Yetminster, Chetnole, Milborne Port, and other smaller communities.
Problem / risk	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Fluvial flooding is focussed on particular communities in the policy unit. This reflects the relatively small and steep watercourses which dominate the area. Some communities adjacent to the River Yeo, in particular Ilchester have suffered fluvial flooding. Other villages (such as Queen Camel and West Camel) have suffered from complex fluvial and surface water problems. Sherbourne is considered at risk (particularly in relation to the operation of Sherbourne lake). Sewer flooding has been recorded specifically in Ilchester. There have been other scattered surface water problems elsewhere.
Policy	Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
Reasons why	With current flood defences in place, the annual average damage is estimated as £1129k to property and £150k to agricultural land. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The scattered nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas (for example in Ilchester or Sherbourne). Wessex Water's capital programme identifies minimal sewer work in this catchment, which appears to be consistent with the level of known problems.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. The soils in the Upper Yeo catchment are less sensitive to poor farming practices than some other units (specifically the Upper Parrett, Upper Isle and the Upper Tone) It is our view that it is unlikely that policy 6 (increasing the frequency of flooding to deliver benefits elsewhere) can be applied in this policy unit generally because the economic benefit would be insufficient. However at a more local scale (individual farms) ponds provided for other reasons (water quality or habitat provision) will have a small local flood risk management benefit. High level information indicates that there may be some risk of flooding to the Sutton Bingham water treatment works in extreme events. These risks should be investigated.
Risks, uncertainties & dependencies	Our current low level of investment is appropriate, and the risks associated with this are generally limited.

Table 6.2.2. Policy unit 2

Summary of policy unit 2 – Yeovil	
Policy unit 2	Policy unit includes Yeovil
Problem / risk	Yeovil is situated on a relatively high plateau (~70-100m AOD) well above the floodplain of the adjacent River Yeo (~30m AOD). Flooding occurs on various small streams but the majority of the problems are related to surface water and sewer flooding. Access to Yeovil from the A303 (i.e. the A3088 and A37) which does cross lower ground can be affected by flooding. Historic records show many cases of sewer flooding
Policy	Policy option 4 – Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change)
Reasons why	The annual average damage is estimated as £53k to property. It is likely that this estimate significantly underestimates the overall flood risk which has derived from surface water and sewer flooding in recent years. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. Given the high density of properties in the town, we envisage that it will be possible to direct further investment to respond to increasing risks due to climate change. However unlike some policy units, Yeovil is generally at lower risk of major flooding particularly when compared to Taunton and Bridgwater. In the future the main problems in Yeovil may be related to higher intensity summer storms which overwhelm the local sewers and smaller streams. Wessex Water's capital programme identifies considerable investment in this policy unit (8 separate schemes, some of which we know have been completed already), reflecting the cluster of sewer problems identified historically.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. Wessex Water have works proposed to address sewer flooding in many areas in the town. We are aware that there are some industrial areas at higher risk of flooding than most of the rest of the town. Our investment priorities are focused on residential areas (particularly when only one or two businesses would gain from our investment). However there is the opportunity to investigate improvements in conjunction with the relevant businesses. It is essential that flooding is not exacerbated by future development in the town. Sustainable drainage approaches should be adopted to minimise future changes in flood risk.
Risks, uncertainties & dependencies	Our current low level of investment is appropriate, and the risks associated with this are limited. Further investment may be required in the future in response to climate change. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding on small streams and it is essential we work together with Wessex Water and the Local Authority to ensure that effective projects are developed.

Table 6.2.3. Policy unit 3

Summary of policy unit 3 – Upper Parrett	
Policy unit 3	Policy Unit 3 includes the upper River Parrett upstream of Martock. The policy unit includes Crewkerne, Merriott, Chiselborough and South Petherton
Problem / risk	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Some communities (Crewkerne, Martock, South Petherton) do have localised problems, exacerbated (particularly in Crewkerne) by small culverted watercourses which are prone to blockage or undersized. South Petherton flooding has also been exacerbated by farming practices, contributing to localised flooding well outside of the fluvial floodplain area. Sewer flooding has been recorded specifically in Crewkerne.
Policy	Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
Reasons why	With current flood defences in place, the annual average damage is estimated as £116k to property and £75k to agricultural land. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The scattered nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas. Many of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. Wessex Water have works proposed to address local flooding problems in Crewkerne. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. It is our view that it is unlikely that policy 6 (increasing the frequency of flooding to deliver benefits elsewhere) can be applied in this policy unit generally because the economic benefit would be insufficient. However at a more local scale (individual farms) ponds provided for other reasons (water quality or habitat provision) will have a small local flood risk management benefit.
Risks, uncertainties & dependencies	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Table 6.2.4. Policy unit 4

Summary of policy unit 4 – Upper Isle	
Policy unit 4	Policy Unit 6 includes the River Isle upstream of the Somerset Levels and Moors. The policy unit includes Ilminster, northern parts of Chard, and other smaller communities.
Problem / risk	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. There are a number of isolated flooding problems specifically in Donyatt, Sea, Ilton and Ilminster. Sewer flooding has been recorded specifically in Ilminster and Chard. Some isolated problems exist elsewhere.
Policy	Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
Reasons why	With current flood defences in place, the annual average damage is estimated as £231k to property and £55k to agricultural land. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The scattered nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas. Some of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme which specifically focuses on Chard and Ilminster.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. Wessex Water have works proposed or completed in Ilminster. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. It is our view that it is unlikely that policy 6 (increasing the frequency of flooding to deliver benefits elsewhere) can be applied in this policy unit generally because the economic benefit would be insufficient. However at a more local scale (individual farms) ponds provided for other reasons (water quality or habitat provision) will have a small local flood risk management benefit.
Risks, uncertainties & dependencies	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Table 6.2.5. Policy unit 5

Summary of policy unit 5 – Upper Cary	
Policy unit 5	Policy Unit 5 includes the River Cary upstream of Henley. The policy unit is typified by scattered communities (such as Somerton, Charlton Adam, Charlton Mackrell, Keinton Mandeville, and parts of Castle Cary).
Problem / risk	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Fluvial flooding to property is relatively limited in this policy unit. This reflects the relatively small watercourses which dominate the area. Flooding problems are generally isolated, although the exact mechanism of flooding is often poorly understood, and is probably a combination of surface water, fluvial and sewer problems. Sewer flooding has been recorded specifically in Somerton.
Policy	Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
Reasons why	With current flood defences in place, the annual average damage is estimated as £61k to property and £31k to agricultural land. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The scattered nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas. Many of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. Wessex Water have works proposed to address local flooding problems in Somerton. Work continues in the catchment to promote catchment sensitive farming. This provides water quality improvements and also helps to reduce runoff. However the soils and the topography in this area are less sensitive than in other policy units (specifically, the Upper Parrett, Upper Isle and the Upper Tone). It is our view that it is unlikely that policy 6 (increasing the frequency of flooding to deliver benefits elsewhere) can be applied in this policy unit generally because the economic benefit would be insufficient. However at a more local scale (individual farms) ponds provided for other reasons (water quality or habitat provision) will have a small local flood risk management benefit.
Risks, uncertainties & dependencies	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Table 6.2.6. Policy unit 6

Summary of policy unit 6 – Upper Tone	
Policy unit 6	Policy Unit 6 includes the River Tone catchment outside of Taunton. The policy unit includes the Town of Wellington, and is typified by scattered villages and communities (such as Wiveliscombe, Milverton, Bishops Lydeard and Kingston St Mary)
Problem / risk	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Some villages (such as Hillfarrance) situated on the lower part of the catchment have suffered fluvial flooding in the past, although work has been undertaken to address this particular risk. Sewer flooding has been recorded specifically in Wellington and Wiveliscombe. Some isolated problems exist elsewhere.
Policy	Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
Reasons why	With current flood defences in place, the annual average damage is estimated as £450k to property and £114k to agricultural land. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The scattered nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas. Many of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. Wessex Water have works proposed to address local flooding problems in Bradford on Tone, Wiveliscombe, Bishops Lydeard and Wellington. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. Over the last few years flood detention options have been developed in connection with new development within the policy unit. It is our view that it is unlikely that policy 6 (increasing the frequency of flooding to deliver benefits elsewhere) can be applied in this policy unit more generally because the economic benefit would be insufficient. However at a more local scale (individual farms) ponds provided for other reasons (water quality or habitat provision) will have a small local flood risk management benefit.
Risks, uncertainties & dependencies	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Table 6.2.7. Policy unit 7

Summary of policy unit 7 – Taunton	
Policy unit 7	Policy unit 7 includes Taunton and the immediate surrounding urban area, west of the M5 motorway. The area is densely populated. The River Tone flows through Taunton where it is joined by a number of smaller tributaries including the Hales Water, Back Stream, Galmington Stream, Sherford Stream and other smaller watercourses.
Problem / risk	Historically flooding in Taunton has been dominated by the River Tone. In the 20th century the 1960 flood event was the most severe, reported to have flooded approaching 500 properties in the town. In response to this flooding the Taunton Flood Defence scheme was constructed in the 1960s and the scheme was further upgraded in the 1990s. Detailed studies have shown that the flood defences in Taunton generally provide about a 1% AEP standard of protection, although there are some slightly low spots in the defences. Since the scheme was constructed in the 1960s there have been no major flood events in Taunton although the defences were tested in October 2000. Most of the remaining risks in Taunton are related to tributary flooding. Areas such as Norton Fitzwarren, Bathpool and areas around Tangier are at risk. The level of flood risk to areas affected by tributary flooding is uncertain although significant. Wessex Water have confirmed that the surface water sewer system in Taunton is relatively efficient and been subject to considerable investment in the past. Little further sewerage capital investment is envisaged in Taunton.
Policy	Policy Option 5: Take further action to reduce flood risk
Reasons why	Significant risks to existing properties adjacent to the tributaries in Taunton remain. The scale of the risk is uncertain at the CFMP level, but is significant. The current average annual damage to property in the policy unit with flood defences on the River Tone is £1185k. Work is presently ongoing to address one of the main tributaries (the Halse Water) which flows through Norton Fitwarren (north west of Taunton Town centre). There are relative weaknesses in the River Tone defences as identified in recent studies. These should be addressed (refer to opportunities below).
Catchment-wide opportunities & constraints	Taunton is subject to major regeneration. Opportunities should (and are) being taken to address the deficiencies in the River Tone defences in connection with the redevelopment of the Town. We value the partnership with Taunton Deane Borough Council where we are working together to maximise this potential. Tributary flooding is significantly more difficult to address and the risk is spread throughout the policy unit in many areas. Flood detention is being used to address flooding in Norton Fitzwarren (by constructing a flood detention dam within policy unit 6 in connection with development in Norton Fitzwarren). It is essential that flooding is not exacerbated by future development in the town. Sustainable drainage approaches should be adopted to minimise future changes in flood risk.
Risks, uncertainties & dependencies	Economically it may be difficult to justify future schemes to address risks on the tributaries because of the scattered nature of flooding and the technical challenges. However there is sufficient information to justify more investigation. Recent work has shown that the River Tone defences do not provide the standard of service to which they were originally designed. However we believe the standard is still appropriate although this should be kept under review at regular intervals as further data becomes available.

Table 6.2.8. Policy unit 8

Summary of policy unit 8 – Somerset Levels and Moors	
Policy unit 8	Policy unit is the lowland Somerset Levels and Moors area within the Parrett Catchment The area includes the lower reaches of the River Parrett, River Tone, River Yeo, River Isle, King's Sedgemoor Drain and the Sowy River.
Problem / risk	The flood risks in this area are complex and derive from the low lying topography and the very limited hydraulic gradient. Because of the low gradient, flood velocities are low, resulting in low flow capacities and extensive flooding over the lowland area. Properties are generally scattered throughout the catchment, with villages and small communities often situated on land slightly above moor level or on the embankments which separate the rivers and the moors. These embanked watercourses act as 'high level carriers' taking water from the upper catchment through the low lying moor area. Drainage from the moors is often pumped up back up into the watercourses. Agricultural land is frequently flooded in the winter, with roads flooded, disrupting communication across the area. Property flooding occurs because of high flood levels in the moors. However those properties along the top of the high level carriers are also at risk from high levels in the rivers caused by high tides in the Bristol Channel which propagate upstream and can be damaging particularly during periods of high flow combining with high tides. The extensive network of embankments is necessary to retain the current agricultural system and the associated environmental habitats. Modelling has shown that channels are often full (i.e. with water levels near to embankment crest levels) and there remains a risk of breaching of the embankments, although works continue to minimise the risk. Infrastructure across the moors (such as railways and pylons) is reliant on the continued management of the system. Because of problems with safe access and high water levels it is unlikely that railways would be sustainable across the moors without this protection. Our broad scale modelling does not reflect this value, but it is very significant. The distribution of floodwater between moors can be determined to some extent by the use of sluices and other structures on the rivers. The distribution of floodwater has developed to some extent by historical 'accident' rather than design. When considering the distribution of assets across the policy unit it makes sense to direct water to areas which have limited assets at risk. This does not necessarily happen today. Climate change will have impacts both in terms of higher river levels (due to higher tide levels in the River Parrett and higher flows) and also more frequent and longer flooding of the moors. Sewer problems are limited in this policy unit, although Wessex Water continues to address risks where appropriate (they have worked planned for Langport, and Huish Episcopi for example).
Policy	Policy option 6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, which may constitute an overall flood risk reduction. Within this context work must be undertaken to maintain the safety of the embankments and infrastructure
Reasons why	The current average annual damage is estimated as £631k to properties and £241k to agricultural land. By redistributing flood water (primarily from upstream of Langport to the King's Sedgemoor Drain) the overall damage and disruption from flooding would be reduced. Other redistribution options may also be possible, although modelling has shown that technically not all options are feasible. By redistributing water some areas will be subject to increased flooding while others will benefit from reduced flooding. The aim is to achieve a net overall benefit. Once it is accepted that the embanked system must be retained then embankments must be stable and fit for purpose, if breach risks are to be minimised and investment is required to minimise risks today and into the future taking into account the consequences of climate change.

Summary of policy unit 8 – Somerset Levels and Moors	
Catchment-wide opportunities & constraints	Providing a robust economic case for maintenance works on the Somerset Levels and Moors remains a challenge. We believe it is appropriate to look again at the benefits derived from our work, particularly focussing more on the infrastructure and the environmental benefits, which previous studies have probably underestimated. We have international obligations to maintain and enhance the habitats and species in the Somerset Levels and Moors, and it is within this context that all decisions have to be made. We are doubtful that all the pumping stations on the Somerset Levels and Moors are required for flood risk management purposes. Many pumping stations are relatively old and in some cases difficult to maintain. It is necessary to decide which ones are necessary particularly in the context of redistributing water. Redistributing floodwater, while logical in some areas, may be difficult to promote because individual farms will be affected in different ways. From an agricultural perspective some may gain financially but some may also lose. We will need to work with our partners, particularly the Parrett Internal Drainage Board, to discuss the way forward.
Risks, uncertainties & dependencies	The Somerset Levels and Moors system is particularly complex. Technical options have to be considered very carefully to ensure that the system responds as expected. We are aware that challenging centuries of drainage operations may be difficult, and it requires good communication and cooperation between various authorities to take this further. Effective maintenance and upgrading of the Somerset Levels and Moors requires a robust economic, social and environmental case. Whilst our present investment strategy is focused on minimizing risk and is 'plan led', we feel that a more robust strategic plan is required in the future to ensure that the national priority of the area is reflected in national funding priorities.

Table 6.2.9. Policy unit 9

Summary of policy unit 9 – Bridgwater	
Policy unit 9	This policy unit includes Bridgwater and the immediate urban area
Problem / risk	Flood risks in Bridgwater are dominated by high tides in the Bristol Channel propagating up the Parrett Estuary. The town is relatively low lying and protected from tidal flooding by flood embankments and walls through Bridgwater. Modelling has shown that existing risks due to high tide levels are low, and the current flood defences in Bridgwater are generally in good condition. However, due to sea level rise and expected deterioration in the standard of the defences, further works will be required within 20-30 years if risks are to be maintained at a low level. Records have shown some sewer flooding problems and some limited fluvial problems which probably occur during high tides and high intensity rainfall. Some limited works have been identified by Wessex Water to relieve surface water flooding problems.
Policy	Policy option 4. Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change and climate change)
Reasons why	Flood risks are low today but will increase significantly in the future. The current average annual damage to property in this policy unit with the tidal defences in place is £1130k. Economically taking action in the future should be viable due to high risks in the future.
Catchment-wide opportunities & constraints	Opportunities have and continue to be taken in relation to improving flood walls and banks as part of the regeneration of parts of Bridgwater. However we are aware that it will become increasingly difficult to raise defences in Bridgwater in the future, because of the existing infrastructure levels (e.g. bridges) and the potential damage to the urban landscape by constructing high walls along the river frontage. A step change may be required in the future by excluding high tides from the Town, with the use of a tidal sluice. This poses a dilemma in terms of our (and our partners) investment strategy. The step change is not required from a flood risk management perspective now, and flood risk management investment would not be forthcoming. We are aware that our partners have an emerging vision which sees a tidal sluice as a component, but there is significant uncertainty regarding funding and the environmental and social implications. We do see the potential for significant improvements associated with a sluice, although the environmental risks are significant. It is essential that flooding is not exacerbated by future development in the town. Sustainable drainage approaches should be adopted to minimise future changes in flood risk.
Risks, uncertainties & dependencies	However it is clear that due to sea level rise the risks will become unacceptable in the future. Significant investment will be required if the flood risks to Bridgwater are to be maintained at a low level.

Table 6.2.10. Policy unit 10

Summary of policy unit 10 – North West Parrett	
Policy unit 10	This policy unit includes two distinct areas. The majority of the area includes scattered communities on the high ground just north east of the Quantock hills including Nether Stowey, Spaxton and Goathurst. A very small part of the policy unit includes lowland areas protected by tidal embankments along the Parrett estuary. Generally occupation in this lower area is limited to occasional farms but Cannington is just on the edge of this lowland area
Problem / risk	Flooding in the higher areas in this policy unit have been limited to local surface water problems Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Limited sewer flooding has been recorded In the lower area there are very limited assets at risk. However the tidal embankments do protect some low suburbs of Bridgwater from flooding as well as the occasional farm.
Policy	Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
Reasons why	With current flood defences in place, the annual average damage is estimated as £120k to property and £30k to agricultural land. Our current level of investment in this area is generally low, and is focused in areas where we have undertaken works, specifically the tidal embankments which protect parts of Bridgwater. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further on the higher ground areas. The scattered nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas. In particular investment will be required to the tidal embankments.
Catchment-wide opportunities & constraints	Opportunities are likely to be found primarily in partnership with others. However it does not appear that Wessex Water have any immediate plans in this area. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff.
Risks, uncertainties & dependencies	Our current low level of investment across the higher areas is appropriate, and the risks associated with this are limited. The risks to the tidal embankments will increase over time (although this is a very small proportion of the policy unit). Our assessment probably underestimates the importance of managing the tidal embankments to protect properties on the periphery of Bridgwater.

7 Implementing the CFMP

The aim of this section is to outline what we need to do next. We have prepared an action plan, which sets out what our actions will be in response to the selected policy in each policy unit. We have also said what we believe the future consequences of these policies will be, so that we can tell if we are achieving the goals we have set.

7.1 Action plan

To make sure that policies are implemented, we have agreed a set of actions. In some cases, we are not the responsible body for implementing the actions. However we will take the lead and be responsible for overseeing implementation.

We and our partners will need to take some of these actions in the short term, and others throughout the lifetime of the Plan. Some actions depend on others being completed and so will not happen straight away. Some actions have greater priority than others. Table 7.1.1 summarises the actions we identified during the appraisal of policies.

Table 7.1.1. Policy unit specific action and monitoring plan

Action	*Relevant objectives*	*Relevant monitoring indicators*	*Success criteria*	*Partners*	*Timescale*	*Priority*	*Funding*
Policy unit 1 Upper Yeo Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline)							
1.1 Investigate ways to support flood resistance and resilience methods to individual properties where other options are not practical. Communities may include Queen Camel and West Camel	Reduce the economic damage to properties caused by flooding.	Number of properties with resistance/ resilience methods	Number of properties protected increasing annually	EA, SSDC, WDDC	2018	Medium	Three
Policy Unit 2 – Yeovil Policy option 4 – take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change							
2.1 Investigate the current and future capacity of the existing surface water drainage systems in policy unit 2, focusing on the effects of climate change. Develop integrated urban drainage strategy with consideration of receiving watercourses and climate change	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Preparation of integrated urban drainage strategy	Strategy complete	EA, WW, SSDC, SCCHD.	2013	Medium	Three
2.2 Investigate existing transport links into Yeovil and vulnerability to flooding. Implement improvements where practical	Reduce the risk of serious injury/harm to people caused by flooding	Investigations and works undertaken	Practical works complete	EA, SCCHD, SSDC	2018	Medium	Two

Policy Unit 3 – Upper Parrett Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline)							
3.1 Work with the farming community to encourage best practice farming and soil management. Pay particular attention to water/runoff management on a farm scale and water quality	Reduce the economic damage to agricultural production caused by flooding Reduce the cost of flood risk management in the CFMP area Seek to maintain/improve the condition of environmentally designated sites	Level of farming community involvement	Area of land under improved management	NE, NFU, EA, Defra, FWAG	Ongoing	High	One (but further increases may be required)
3.2 Investigate ways to support flood resistance and resilience methods to individual properties where other options are not practical. Communities may include Martock and Merriott	Reduce the economic damage to properties caused by flooding	Number of properties with resistance/ resilience methods	Number of properties protected increasing annually	EA, SSDC,	2018	Medium	Three

Policy Unit 4 – Upper Isle Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline)							
4.1 Work with the farming community to encourage best practice farming and soil management. Pay particular attention to water/runoff management on a farm scale and water quality	Reduce the economic damage to agricultural production caused by flooding Reduce the cost of flood risk management in the CFMP area Seek to maintain/ improve the condition of environmentally designated sites	Level of farming community involvement	Area of land under improved management	NE, NFU, EA, Defra, FWAG	Ongoing	High	One (but further increases may be required)
4.2 Investigate ways to support flood resistance and resilience methods to individual properties where other options are not practical. Communities may include Ilminster, Ilton and surrounding villages	Reduce the economic damage to properties caused by flooding	Number of properties with resistance/ resilience methods	Number of properties protected increasing annually	EA, SSDC,	2018	Medium	Three

Policy Unit 5– Upper Cary Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline)							
5.1 Investigate ways to support flood resistance and resilience methods to individual properties where other options are not practical. Communities may include Somerton and Babcary	Reduce the economic damage to properties caused by flooding	Number of properties with resistance/ resilience methods	Number of properties protected increasing annually	EA, SSDC,	2018	Medium	Three
Policy Unit 6– Upper Tone Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline)							
6.1 Investigate the current and future capacity of the existing surface water drainage systems in policy unit 6 including Wellington and Wiveliscombe, focusing on the effects of climate change. Develop integrated urban drainage strategy with consideration of receiving watercourses and climate change	Reduce the economic damage to properties caused by flooding	Preparation of integrated urban drainage strategy	Strategy complete	EA, WW, TDBC, WSDC, SCCHD	2013	Medium	Three
	Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding						

6.2 Work with the farming community to encourage best practice farming and soil management. Pay particular attention to water/runoff management on a farm scale and water quality	Reduce the economic damage to agricultural production caused by flooding Reduce the cost of flood risk management in the CFMP area Seek to maintain/ improve the condition of environmentally designated sites	Level of farming community involvement	Area of land under improved management	NE, NFU, EA, Defra, FWAG	Ongoing	High	One (but further increases may be required)
6.3 Investigate ways to support flood resistance and resilience methods to individual properties where other options are not practical. Communities may include Wellington, Tonedale and Waterrow	Reduce the economic damage to properties caused by flooding	Number of properties with resistance/ resilience methods	Number of properties protected increasing annually	EA, TDBC, WSDC	2018	Medium	Three

Policy Unit 7– Taunton Policy option 5 – Take further action to reduce flood risk							
7.1 Prepare development guidance for proposed developments in Taunton identifying methods to reduce run off rates and include SUDs in all new developments	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Preparation of development guidance	Guidance complete	EA, WW, TDBC	2010	Medium	Two
7.2 Investigate the current and future capacity of the existing surface water drainage systems in policy unit 7, focusing on the effects of climate change. Develop integrated urban drainage strategy with consideration of receiving watercourses and climate change	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Preparation of integrated urban drainage strategy	Strategy complete	EA, WW, TDBC, SCCHD.	2013	Medium	Three
7.3 Investigate existing transport links into Taunton and vulnerability to flooding. Implement improvements where practical	Reduce the risk of serious injury/harm to people caused by flooding	Investigation and works undertaken	Practical works complete	EA, SCCHD, SSDC	2018	Medium	Two

7.4 Investigate identified marginal deficiencies in River Tone flood defences and implement improvements in connection with urban regeneration	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Investigation and works undertaken	Practical works complete	EA, TDBC	2013	High	Two
7.5 Investigate potential to reduce flood risks from tributary flooding and implement improvements where practical	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Investigation and works undertaken	Practical works complete	EA, TDBC	2018	Medium	Two

Policy Unit 8- Somerset Levels and Moors Policy option 6 – Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, which may constitute an overall flood risk reduction. Note: This policy option involves a strategic increase in flooding in allocated areas, but is not intended to affect the risk to individual properties.							
8.1 Investigate existing transport links within the Somerset Levels and Moors and vulnerability to flooding. Implement improvements where practical	Reduce the risk of serious injury/harm to people caused by flooding	Investigation and works undertaken	Practical works complete	EA, SCCHD, SSDC, SDC, TDBC	2018	Medium	Two
8.2 Identify a robust and nationally agreed economic case for investment into the long term sustainability of the Somerset Levels and Moors flood risk infrastructure	Reduce the economic damage to properties caused by flooding	Preparation of nationally agreed strategy	Strategy complete	EA, IDB, SSDC, SDC, TDBC	2010	High	Two
	Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding						
	Reduce the economic damage to agricultural production caused by flooding						
	Reduce the risk of serious injury/harm to people caused by flooding						
	Seek to maintain/improve the condition of environmentally designated sites						
	Seek to protect and improve biodiversity habitats, where appropriate						

8.3 Investigate, consult upon, and trial redistribution of flood water within the Somerset Levels and Moors	Reduce the economic damage to properties caused by flooding	Undertake trials	Trials complete and action plan prepared	EA, IDB, SSDC, SDC, TDBC	2013	High	Two
	Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding						
	Reduce the economic damage to agricultural production caused by flooding						
	Seek to maintain/improve the condition of environmentally designated sites						
	Seek to protect and improve biodiversity habitats, where appropriate						
8.4 Undertake a comprehensive study of the geomorphology of the River Parrett and River Tone to inform future operations (e.g dredging) and construction (e.g tidal sluice discussed in policy unit 9)	Reduce the economic damage to properties caused by flooding	Preparation of geomorphology study	Study complete. Conclusions integrated into maintenance and capital programmes	EA, IDB, SSDC, SDC, TDBC	2010	High	Two/ Three
	Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding						
	Reduce the economic damage to agricultural production caused by flooding						

Policy Unit 9 - Bridgwater Policy option 4 – Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change)							
9.1 Investigate the current and future capacity of the existing surface water drainage systems in policy unit 9, focusing on the effects of climate change. Develop integrated urban drainage strategy with consideration of receiving watercourses and climate change	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Preparation of integrated urban drainage strategy	Strategy complete	EA, WW, SDC, SCCHD.	2013	Medium	Three
9.2 Undertake a comprehensive study of the geomorphology of the River Parrett to inform potential future construction (e.g tidal sluice)	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Preparation of geomorphology study	Study complete	EA, SDC	2010	High	Two/ Three
9.3 Undertake studies to address key risks associated with long term flood management in Bridgwater (e.g. in connection with further defence raising or tidal sluice). Implement recommendations in appropriate phases	Reduce the economic damage to properties caused by flooding Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding	Undertake study	Study complete	EA, SDC	2010	Medium	Two/ Three

Policy Unit 10 – North West Parrett Policy option 3 – Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline)							
10.1 Work with the farming community to encourage best practice farming and soil management. Pay particular attention to water/runoff management on a farm scale and water quality	Reduce the economic damage to agricultural production caused by flooding	Level of farming community involvement	Area of land under improved management	NE, NFU, EA, Defra, FWAG	Ongoing	High	One (but further increases may be required)
	Reduce the cost of flood risk management in the CFMP area						
	Seek to maintain/improve the condition of environmentally designated sites						
10.2 Investigate ways to support flood resistance and resilience methods to individual properties where other options are not practical. Cannington and surrounding villages may benefit from this approach	Reduce the economic damage to properties caused by flooding	Number of properties with resistance/ resilience methods	Number of properties protected increasing annually	EA, SDC,	2018	Medium	Three

Note: Actions relevant to the very small area of tidal floodplain within the policy unit are logically addressed within the Shoreline Management Plan (which considers the majority of the estuary) and are not repeated here.

Key

Funding

One: Funding currently identified and approved
Two: Funding to be identified and approved
Three: Funding to be sought outside of EA

Organisations

EA Environment Agency
WW Wessex Water
IDB Internal Drainage Boards
HA Relevant highways authority (local/national)
SDC Sedgemoor District Council
TDBC Taunton Deane Borough Council
SSDC South Somerset District Council
WDDC West Dorset District Council
LPA Local planning authority
LA Local authority
NFU National Farmers Union
NE Natural England
RSPB Royal Society for the Protection of Birds
SWRDA South West Regional Development Agency

7.2 Consequences of our policies

We selected the policies for each policy unit based on a broad understanding of the catchment and how it responds to flooding. Using this knowledge and the hydraulic models we developed for this study, we have been able to determine what the future might look like.

We have made assumptions about possible 'standard responses' to represent how each preferred policy might be implemented. Examples of these measures include new storage reservoirs, best practice farming techniques, pumping, creating wetlands, localised flood defences and flood warning. With these responses in mind, we can gain an insight into what each policy unit might look like in the future, and thus estimate the consequences of implementing that policy. Table 7.2.1 contains a summary of the consequences of the policy we selected in each policy unit.

Table 7.2.1. Consequences of selected policies

Policy unit	Policy	Consequences of our policies
Policy unit 1 Upper Yeo	3	Flood risks in the communities will increase due to climate change, although the scale of the change is very dependant on climate change and associated changing rainfall patterns. Better surface water drainage and flood resistance/resilience measures will mitigate this change
Policy unit 2 Yeovil	4	Option 4 in this unit will allow us, with our partners, to address increasing flood risks particularly in relation to possible high intensity storms. The use of SUDS and better advice in terms of the future development of the town will help mitigate future increases.
Policy unit 3 Upper Parrett	3	Flood risks in the communities will increase due to climate change, although the scale of the change is very dependant on climate change and associated changing rainfall patterns. Better surface water drainage and flood resistance/resilience measures will mitigate this change. The soils within this unit are vulnerable to poor farming practices, which can cause flooding and poor water quality. Catchment sensitive farming will help mitigate these risks.
Policy unit 4 Upper Isle	3	Flood risks in the communities will increase due to climate change, although the scale of the change is very dependant on climate change and associated changing rainfall patterns. Better surface water drainage and flood resistance/resilience measures will mitigate this change. The soils within this unit are vulnerable to poor farming practices, which can cause flooding and poor water quality. Catchment sensitive farming will help mitigate these risks.
Policy unit 5 Upper Cary	3	Flood risks in the communities will increase due to climate change, although the scale of the change is very dependent on climate change and associated changing rainfall patterns. Better surface water drainage and flood resistance/resilience measures will mitigate this change
Policy unit 6 Upper Tone	3	Flood risks in the communities will increase due to climate change, although the scale of the change is very dependant on climate change and associated changing rainfall patterns. Better surface water drainage and flood resistance/resilience measures will mitigate this change. The soils within this unit are vulnerable to poor farming practices, which can cause flooding and poor water quality. Catchment sensitive farming will help mitigate these risks.
Policy unit 7 Taunton	5	Taunton is particularly vulnerable to future changes, but the current flood defences through the town reduce risk significantly, although there are some deficiencies which we believe can be addressed in tandem with the regeneration of the town. Our proposed policy allows us to keep this issue under review and aim to identify methods of reducing risks from the tributaries which are probably the main risk today. The use of SUDS and better advice in terms of the future development of the town will help mitigate future increases.

Policy unit	Policy	Consequences of our policies
Policy unit 8 Somerset Levels and Moors	6	The Somerset Levels and Moors is very complex hydraulically. We believe that there is merit in redistributing flood water within the unit to reduce flood risks overall. Within this context it is essential that future investment in the Somerset Levels and Moors is put on a sound footing, to ensure that the infrastructure (which supports both farming and internationally designated environmental areas) is maintained and enhanced effectively. Increased rainfall may challenge flood risk management in the future (particularly the frequency and duration of flooding).
Policy unit 9 Bridgwater	4	Bridgwater is protected to a good standard from high tides by flood defences. Whilst we consider the defences satisfactory today, within 20-30 years (depending on sea level rise) this will not be the case. Therefore option 4 is the appropriate response. We consider that studies should be undertaken in the near future to help the decision making process and to support regeneration of the town. Option 4 in this unit will allow us, with our partners, to address increasing flood risks particularly in relation to possible high intensity storms. The use of SUDS and better advice in terms of the future development of the town will help mitigate future increases.
Policy unit 10 North West Parrett	3	Flood risks in the communities will increase due to climate change, although the scale of the change is very dependant on climate change and associated changing rainfall patterns. Better surface water drainage and flood resistance/resilience measures will mitigate this change. The soils within this unit are vulnerable to poor farming practices, which can cause flooding and poor water quality. Catchment sensitive farming will help mitigate these risks.

7.3 Monitoring, review and evaluation

The responsibilities for flood risk management and associated activities are summarised in Appendix A.

We will be jointly responsible with others from the Steering Group and Consultation Group for implementing this CFMP. The members of the Steering Group and Consultation Group are summarised in Appendix A. We need to continue to review and monitor it to help us:

- manage the implementation of the CFMP;
- check that the CFMP is being implemented as it should; and
- check that the policies and actions of the CFMP are being implemented.

The Area Flood Risk Manager (AFRM) is acting as CFMP sponsor and has agreed timescales for implementing CFMP actions. The AFRM will manage the implementation of the plan and involve people both within and outside the Environment Agency. The steering group will help to guide, review and act on the monitoring process and its results.

We need to record progress and performance. We will evaluate how CFMP policies are applied. We will update and expand CFMP data to make sure we have the most up to date information available. We will look at new planning and modeling tools, the effects of recent significant flood events, catchment development and improved understanding of climate change or changes in national policy guidance.

The CFMP will be a ‘living document’ that develops as we understand more about flood risk.

We will use clear measures to monitor how the CFMP is performing and we will produce regular progress reports. Targets and indicators are set for each of the catchment objectives used for the policy appraisal, and are listed in 5.3.1. These will be the main measures of the success in achieving efficient and effective flood risk management within the CFMP area.

There will be a formal review after five years or when there are significant changes in flood risk. This review will inform or influence other plans, such as the Water Framework Directive ‘River Basin Management Plans’.

Glossary of terms

Appraisal
Defining objectives, examining options and evaluating costs, benefits, risks, opportunities and uncertainties before a decision is made.

Annual exceedance probability (AEP)
The percentage chance that an event of a certain size will occur in any given year.

Area of Outstanding Natural Beauty (AONB)
Areas of Outstanding Natural Beauty (AONBs) were formally designated under the National Parks and Access to the Countryside Act of 1949 to protect areas of the countryside of high scenic quality that cannot be selected for National Park status due to their lack of opportunities for outdoor recreation (an essential objective of National Parks). The Countryside Agency is responsible for designating AONBs and advising Government and others on how they should be protected and managed.
Further information on AONBs can be found at http://www.aonb.org.uk/

Capital plan
The Environment Agency's short, medium and long-term programme for capital engineering schemes over the next 3 – 10 years.

Catchment
A surface water catchment is the total area that drains into a river. A groundwater catchment is the total area that contributes to the groundwater part of the river flow.

Catchment Flood Management Plan (CFMP)
Catchment Flood Management Plans (CFMPs) are a large-scale strategic planning framework for managing flood risk to people and the developed and natural environment in a sustainable way.

Communication plan
A plan that sets out the CFMP consultation programme, and specific arrangements for internal (Environment Agency) and external consultation.

Consultation group
A group of people representing interested groups whom we should consult on the CFMP as agreed with the project board. The consultation group should be identified within the communication plan.

Defra
Department for Environment, Food and Rural Affairs. The department of central Government responsible for flood management policy in England.

Defra High level targets
High-level targets prepared by Defra to help meet its flood and coastal defence aims and objectives. The targets have been in places since 2005:

Target 1 - Policy Delivery Statements
Target 2 - Information on the National Flood and Coastal Defence Database (NFCDD)
Target 3 - Shoreline Management Plans (SMPs)
Target 4 - Biodiversity
Target 5 - Development in areas at risk of flooding and coastal erosion
Target 6 - IDB organisation and administration

Further information can be found on Defra's website:
http://www.defra.gov.uk/environ/fcd/hltarget/default.htm

Defra FCDPAG documents
Defra's FCDPAG (flood and coastal defence project appraisal guidance) documents set out the criteria which determine whether or not a scheme is eligible for grant aid. There are five documents that correspond to the following areas:

- Overview
- Strategic planning and appraisal
- Economic appraisal
- Approaches to risk
- Environmental Appraisal

DG5 register
Register held by water companies which shows where properties at risk of sewage flooding problems are located.

Environment Agency
Non-departmental public body responsible for implementing government policy relating to the environment and flood risk management in England and Wales.

Environment Agency vision
The Environment Agency's vision is of a rich, healthy and diverse environment for present and future generations. We want people to have peace of mind, knowing that they live in a clean and safe environment, rich in wildlife and natural diversity - one they can enjoy to the full, but feel motivated to care for. we have identified nine main themes:
1. A better quality of life
2. An improved environment for wildlife
3. Cleaner air for everyone
4. Improved and protected inland and coastal waters
5. Restored protected land with healthier soils
6. A 'greener' business world
7. Wiser sustainable use of natural resources
8. Limiting and adapting to climate change
9. Reducing flood risk

For further information refer to our website:
http://www.environment-agency.gov.uk/aboutus/286233/289892/?version=1&lang=_e

Environmentally Sensitive Areas (ESA)
ESA schemes were introduced by the Ministry of Agriculture, Fisheries and Food (MAFF; predecessor to Defra) in 1987 and are designated under the provisions of sections 18 and 19 of the 1986 Agriculture Act and Environmentally Sensitive Area (Stage II) Designation (Amendment)(No2) Order 2001. They are governed by Defra and offer incentives (on a 10 year agreement with a 5 year break clause) to encourage farmers to adopt agricultural practices, which would protect and improve parts of the country of particularly high landscape, wildlife or historic value.
Further detail can be found on Defra's website:
http://www.defra.gov.uk/erdp/schemes/landbased/esas/esasindex.htm

Flood defence
A structure (or system of structures) for reducing flooding from rivers or the sea.

Floodplain
Any area of land over which water flows or would flow if there were no flood defences. It can also be any area where water is stored during a flood event.

Flood risk
The level of flood risk is made up of the frequency or likelihood of the flood events together with their consequences (such as loss, damage, harm, distress and disruption).

Flood risk assessment
An assessment carried out by planning authorities, developers and applicants of flood risk and runoff and implications of land use applications or proposals, appropriate in scale and nature to the development proposal.

Flood risk management
Modifying the frequency or consequences of flooding to an appropriate level (in line with land use), and monitoring to make sure that flood risks remain at the proposed level. This should take account of other water level management requirements, and opportunities and constraints.

Flood warning levels of service (FWLoS)
The flood warning levels of service study provides an indication of the levels of service provided at locations within the catchment and possibilities and reasons for improving them.

Flood zones
More accurate and consistent data on flood risk than the indicative floodplain map (IFM) introduced in July 2004.
PPS25 defines flood zones as:

- Zone 1 – low probability with an annual probability of flooding from rivers and the sea of less than 0.1 per cent
- Zone 2 – medium probability with an annual probability of flooding of 0.1-1.0 per cent from rivers and 0.1-0.5 per cent from the sea
- Zone 3 – high probability with an annual probability of flooding of 1.0 per cent or greater from rivers and 0.5 per cent or greater from the sea.

River
Relating to a watercourse (river or stream).

Geomorphology
Processes of erosion, deposition and sediment transport that influence the physical form of a river and its floodplain.

Groundwater
Water occurring below ground in natural formations (typically rocks, gravels and sands).

Hydrological model
Estimates the flow in a river from a given amount of rainfall falling into the catchment. These models tend to account for factors such as catchment area, topography, soils, geology and land use.

Hydraulic model
A simplified representation of flow within a river system. Used within the CFMP to test the influence of flood risk management measures on flooding.

Internal drainage boards (IDB)
Independent bodies that manage land drainage in areas that need special drainage. There are some 200 boards in England, concentrated in the lowland areas of East Anglia, Somerset, Yorkshire and Lincolnshire. Each board operates within a defined area where they have power under the Land Drainage Act 1991 to undertake flood defence works, other than on watercourses that have been designated as 'main rivers'. Members of the internal drainage board include elected members that represent people occupying the land in the district and members nominated by local authorities to represent other interests.

IDB watercourses
Named watercourses managed by the internal drainage board that may be within or form the boundary of the internal drainage district.

Inception report
Provides a detailed description of the work carried out during the CFMP inception phase. This includes a summary of catchment data and early understanding of the main issues to be considered for effective flood risk management during subsequent phases of the CFMP process. Indicative flood maps (IFMs) show our best estimate of the extent of the floodplain. These cover all main rivers and some ordinary watercourses. The floodplain is defined as the area that has a one per cent per annum risk of river, or a 0.5 per cent per annum risk of tidal, flooding, Defended areas are also shown. These maps are sometimes referred to as Section 105 maps, or flood risk maps.

Indicative standard of protection
The range of level of protection to be considered for flood defences, based upon the use of the land being protected. They do not represent any entitlement to protection or minimum level to be achieved. The standard of defence is measured by the return period of the flood from which property is defended.

Land management
Land management can include urban uses (for example the introduction of impermeable surfaces in connection with development) or agricultural applications (such as pasture, arable crops, forestry etc). How an area is managed often impacts significantly on the hydrological response of the land. Good farming practices can help reduce flood risks and improve water quality.

Landscape character area (LCA)
The Countryside Character Initiative is a programme of information and advice on the character of the English countryside. It includes descriptions of the features and characteristics that make the landscape, and guidance documents on how to carry out landscape character assessment.
Further information about landscape character areas can be found on the Countryside Agency's website: http://www.countryside.gov.uk/cci/

Local authority development plans
These statutory land development plans generally cover a 10-year period from the date they are adopted. However, the local authorities currently review these plans every five years. A district council and a unitary authority will produce a local plan and a county council will produce a structure plan. A structure plan guides the local plans of several district councils.

Local Biodiversity Action Plan (LBAP)
A local agenda (produced by the local authority) with plans and targets to protect and improve biodiversity and achieve sustainable development. We are committed to Biodiversity Action Plans and work with central Government (Rio Earth Summit, 1992) to meet LBAP objectives.

Local Environment Agency Plan (LEAP)
Now superseded, these were a non-statutory plan based on the river basin (or sub-catchments or groups of smaller catchments) providing environmental baseline information and actions/objectives for that river basin (largely replaced by the National Rivers Authority's Catchment Management Plans (CMPs)).

Main river
Watercourses defined on a 'main river map' designated by Defra. We have powers to carry out flood defence works, maintenance and operational activities for main rivers only. Responsibility for maintenance However, the landowner is responsible for maintaining them.

Modelling and decision support framework (MDSF)
The modelling and decision support framework - a GIS based decision support tool developed specifically to help the CFMP process by automating parts of the analysis.

Planning Policy Guidance 25: Development and Flood Risk (PPG25)
Superseded by Planning Policy Statement 25 (PPS25) in December 2006. See PPS25 for more details.

Planning Policy Statement 25: Development and Flood Risk (PPS25)
One of a series of Planning Policy Statements (PPS) issued by Communities and Local Government to advise local planning authorities and developers. While the PPS is not statutory, planning authorities are obliged to consider them in preparing plans and determining planning applications. PPS25, issued in December 2006, raises the profile of flood risk, which should be considered at all stages of the planning and development process and on a catchment-wide basis. It emphasises the need to act carefully and to take account of climate change. It provides advice on future urban development in areas subject to flood risk, subjecting proposals to a sequential response (depends on the amount of risk) and promotes the concept of Sustainable Drainage Systems (SuDS) in new developments or re-developments. PPS25 replaced PPG25. For further information please refer to the Department for Community and Local Government planning website: http://www.communities.gov.uk/index.asp?id=1504953

Probability of occurrence

The probability of a flood event being met or exceeded in any one year. For example a probability of one in 100 corresponds to a one per cent or 100:1 chance of an event occurring in any one year.

Receptor
The thing that is affected by (receives) flooding. Receptors can be environmental (for example SSSI), social (for example people or public transport) or economic (for example property or agricultural land).

Regional flood defence committee capital investment programme
Details of proposed flood defence schemes and planned improvements within the catchment.

Regional planning guidance (RPG)
Planning guidance issued for the South West by the Government Office for the South West.

Rhynes
Network of shallow usually man-made ditches used for drainage and irrigation purposes.

Scenario
A possible future situation, which can influence either catchment flood processes or flood responses, and the success of flood risk management policies/measures. Scenarios will usually be made up of the following: urban development (both in the catchment and river corridor); change in land use and land management practice (including future environmental designations); or climate change.

Scheduled monuments, Scheduled ancient monuments (SAM)
To protect archaeological sites for future generations, the most valuable may be 'scheduled'. Scheduling means giving nationally important sites and monuments legal protection by placing them on a list, or 'schedule'. English Heritage identifies sites in England, which should be placed on the schedule by the Secretary of State for Culture, Media and Sport. The current legislation, the Ancient Monuments and Archaeological Areas Act 1979, supports a formal system of Scheduled Monument Consent for any work affecting a designated monument.
Further information can be found on English Heritage's website: http://www.english-heritage.org.uk

Shoreline Management Plan (SMP)
Non-statutory plans to provide sustainable coastal defence policies (to prevent erosion by the sea and flooding of low-lying coastal land), and to set objectives for managing the shoreline in the future. They are prepared by us or maritime local authorities, acting individually or as part of coastal defence groups.

Site of Special Scientific Interest (SSSI)
Sites of Special Scientific Interest (SSSI) are notified under the Wildlife and Countryside Act 1981 (as amended) and the Countryside and Rights of Way (CRoW) Act 2000 for their flora, fauna, geological or physiographical features. Notification of a SSSI includes a list of operations that may be harmful to the special interest of the site. The Wildlife and Countryside Act 1981 (provisions relating to SSSI) has been replaced by a new Section 28 in Schedule 9 of the CROW Act. The new Section 28 provides significantly improved protection for SSSI. All cSACs, SPAs and Ramsar sites are designated as SSSI.
For further information refer to Natural England's website:
http://www.english-nature.com/special/sssi/default.htm

Special Area for Conservation (SAC), candidate Special Area for Conservation (cSAC)
An internationally important site for habitats and/or species, designated as required under the EC Habitats Directive. A cSAC is a candidate site, but has the same status as a confirmed site.
SACs are protected for their internationally important habitat and non-bird species. They also receive SSSI designation under The Countryside and Rights of Way (CRoW) Act 2000; and The Wildlife and Countryside Act 1981 (as amended).
For further details refer to the following The Joint Nature Conservation Committee website:
http://www.jncc.gov.uk/ProtectedSites/SACselection/UK_SAC_map.htm

Strategy plan
A long-term (usually 50 years or more) plan for managing rivers or coasts, including all necessary work to meet defined flood and coastal defence objectives for the target area. A strategy plan is more detailed and usually covers a smaller area than a CFMP or SMP.

Strategic Environmental Assessment (SEA)
Applying EIA to earlier, more strategic, decision-making policies, plans and programmes. Practically applying SEA is still in its infancy in the UK, but will become a statutory requirement when implemented through an EC Directive (anticipated in 2004).
For further details, please consult Defra's website: http://www.defra.gov.uk/environment/rtgea/6.htm

Structure plan
A statutory plan made up of part of the development plan, prepared by county councils or a combination of unitary authorities, containing strategic policies that cover main planning issues over a broad area and provide a framework for local planning, including unitary development plans (UDPs).

Sub-catchment
The catchment, for which each CFMP is to be produced, is split into sub-catchments to make the analysis of flooding in the catchment easier.

Sustainability
Sustainability is a concept, which deals with man's impact, through development, on the environment. Sustainable development is 'development which the meets the needs of the present without compromising the ability of future generations to meet their own needs' (Brundtland, 1987). It is the degree to which flood risk management options avoid tying future generations into inflexible or expensive options for flood defence. This usually includes considering other defences and likely developments as well as processes within a catchment. It should also take account, for example, of the long-term demands for non-renewable materials.

Sustainable drainage systems (SuDs)
Management practices and control structures designed to drain surface water in a more sustainable way than some traditional techniques (may also be referred to as sustainable drainage techniques).

Water Framework Directive (WFD)
European Community Directive (2000/60/EC) on integrated river basin management. The WFD sets out environmental objectives for water status based on: ecological and chemical guidelines; common monitoring and assessment strategies; arrangements for river basin administration and planning; and a programme of measures to meet the objectives.
For further details, consult the European Commission website:
http://europa.eu.int/eurlex/pri/en/oj/dat/2000/l_327/l_32720001222en00010072.pdf

Water Level Management Plan (WLMP)
A document setting out water level management requirements in a defined floodplain area (usually a SSSI), which is designed to meet different drainage needs.

List of abbreviations

— A —

AAD – Annual Average Damage

AFRM – Area Flood Risk Manager

AOD – Above Ordnance Datum

AONB – Area of Outstanding Natural Beauty

AEP - Annual Exceedance Probability

— B —

BAP – Biodiversity Action Plan

BANES – Bath and North East Somerset

— C —

CAMS – Catchment Abstraction Management Strategy

CEH - Centre for Ecology and Hydrology

CFMP – Catchment Flood Management Plan

— D —

Defra – Department for Environment, Food and Rural Affairs

— E —

EEC – European Economic Community

EH – English Heritage

NE –Natural England

ESA - Environmentally Sensitive Area

EU – European Union

— F —

FEH – Flood Estimation Handbook

FFD – Freshwater Fisheries Directive

FRM – Flood Risk Management

— G —

GQA – General Quality Assessment

— H —

HA – Highways Authority

HBAP – Habitats Biodiversity Plan

— L —

LBAPs – Local Biodiversity Action Plans

LCA – Landscape character Area

LEAP – Local Environment Agency Plans

LPA – Local Planning Authority

LTP – Local Transport Plans

— M —

MDSF – Modelling & Decision Support Framework

— N —

NFCDD – National Flood & Coastal Defence database

NFU – National Farmers Union

— P —

PPG – Planning Policy Guidance notes

PUAs – Principle Urban Area

PSA – Public Service Agreement

— R —

RPG – Regional Planning Guidance

— S —

SAC – Special Area of Conservation

SEA – Strategic Environmental Assessment

SFRA – Strategic Flood Risk Assessment

SMP – Shoreline Management Plan

SPA – Special Protection Area

SPARQ – Spatial Pressures Analysis of River Quality

SSSI – Site of Special Scientific Interest

SuDS – Sustainable Drainage Systems

— U —

UK BAP – United Kingdom Biodiversity Action Plan

— W —

WFD – Water Framework Directive

WLMP – Water Level Management Plan

WW – Wessex Water

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Appendix A

Responsibilities for Flood Risk Management

The Department for Environment, Food and Rural Affairs (Defra) has overall responsibility for flood risk management in England. Their aim is to reduce flood risk by:

- Discouraging inappropriate development in areas at risk from flooding:
- Encouraging the provision of adequate and cost effective flood warning systems: and
- Encouraging the provision of adequate technically, environmentally and economically sound and sustainable flood defence measures.

The Governments Foresight Programme has recently produced a report called *Future Flooding* which warns that the risk of flooding will increase between 2 and 20 fold over the next 75 years. The report, produced by the Office of Science and Technology, provides a long-term vision for the future (2030 – 2100), helping to ensure effective strategies are developed now. Sir David King, the Chief Scientific Advisor to the Government concluded:

> *"continuing with existing policies is not an option – in virtually every scenario considered (for climate change), the risks grow to unacceptable levels. Secondly, the risk needs to be tackled across a broad front. However, this is unlikely to be sufficient in itself. Hard choices need to be taken – we must either invest in more sustainable approaches to flood and coastal management or learn to live with increasing flooding".*

In response to this, Defra is leading the development of a new strategy for flood and coastal erosion for the next 20 years. This programme, called 'Making Space for Water' will help define and set the agenda for Governments future strategic approach to flood risk. Within this strategy there will be a holistic approach to the assessment of options through a strong and continuing commitment to CFMPs and SMPs within a broader planning matrix which will include River Basin Management Plans prepared under the Water Framework Directive and Integrated Coastal Zone Management.

The Environment Agency provides the lead role in preparing Catchment Flood Management Plans (CFMPs). We recognise that all key organisations and decision makers must work together to plan ad take action to reduce flood risk. Consultation with other authorities, organisations and groups has been carried out in order that the plan can be adopted as a way forward for flood risk management in the catchment.

The development of the CFMP has been supported by a Steering Group with representatives from the following organisations:

- District Councils/Unitary Authorities
- Internal Drainage Board
- Natural England
- Somerset Wildlife Trust
- RSPB
- Wessex Regional Flood Defence Committee
- Country Land and Business Association
- Defra

Consultation has all taken place with a number of other organisations including:

- Wessex Water
- Highways Agency
- English Heritage
- National Farmer Union

The Environment Agency's role in flood risk management

Since its formation in 1996, the Environment Agency has taken a lead role in flood risk management within England and Wales. Within this CFMP area, the Environment Agency has overall responsibility for land drainage issues on all main river watercourses, while the Internal Drainage Board (IDB) has responsibility for land drainage issues within the Somerset Levels and Moors.

We provide information on flood likelihood on the internet Flood Maps. The maps show areas that would be affected by flooding from rivers or the sea without defences. The flood extent shown on the Flood Map refers to Flood Zone 2 and Flood Zone 3 as defined in PPS25. A Flood Risk Assessment is required by Local Planning Authorities when a planning application is made with Flood Zones 2 and 3.

We are the statutory consultee on development plans and other aspects of development control within the land use planning system. Communities and Local Government (CLG) has issued guidance in relation to flood risk and planning (PPS25, PPS1), which stipulates a "risk based sequential search" for assessing development within the catchment. This guides the approach of planning authorities to land use allocation, and has significant impact on development at both local and regional scale. It is therefore essential that the CFMP is compatible as well as supportive of this process. It should be noted that the CFMP does not replace a strategic flood risk assessment (SFRA), which is a more detailed assessment of flood risk in relation to development and planning.

We are also responsible for flood warning. We provide an online Flood Warning Service for designated Flood Warning Areas in England and Wales that is automatically updated every 15 minutes. Flood warning makes an important contribution to reducing the impact of flooding and can be particularly effective where confidence in the prediction of rising river levels is high, allowing sufficient time for an effective response both by the public and emergency services.

Our flood defence work aims to protect people and property and improve the environment. The Environment Act 1995 and the Water Resources Act 1991 give the Environment Agency certain powers to carry out works on 'main' river watercourses for flood defence purposes. These powers are permissive

and allow us to determine how and where work is carried out according to priority and available resources.

Appendix B - **Environmental Report**

Documenting the Strategic Environmental Assessment and including the Policy Appraisal Tables

Contents

Non-Technical Summary

We are developing the Parrett Catchment Flood Management Plan (CFMP) in order to establish long-term (50 - 100 years) policies for sustainable flood risk management. These policies will not set specific measures to reduce flood risk or establish how to manage flooding issues in a catchment. Our policies are at the highest level in our hierarchy of spatial flood risk management plans and are about setting the right strategic direction so that in the future we take the best and most sustainable approach to managing flood risk to people, the environment and the economy.

Although not a legal requirement, we are undertaking strategic environmental assessment (SEA) as part of our planning process in order to demonstrate how our plan takes account of the environment and, in particular, the likely significant environmental effects of the CFMP.

The CFMP involves:

- working with key partners and decision makers to establish long-term policies for sustainable flood risk management;
- carrying out a strategic assessment of current and future flood risk from all sources (such as rivers, sewers, groundwater and tidal influence) within the catchment, understanding both the likelihood and consequence of flooding and the effect of current ways of reducing risk. We measure the scale of risk in social, environmental and economic terms;
- considering how the catchment works, and looking at other policies, plans and programmes to identify opportunities and constraints to achieving sustainable flood risk management;
- finding ways to work with nature, and manage flood risk to maintain, restore or improve natural and historic assets.

In undertaking the SEA we considered the baseline environment, and how this would evolve without the influence of our plan.

Outside the estuary of the Parrett, a significant flood risk exists, affecting the most people in the uplands, but the largest area in the lowlands. Taunton is the urban centre at greatest risk of flooding, although the flood risk in smaller communities is caused or exacerbated by surface water and/or sewer flooding. Environmental risks in the catchment are primarily from too little water, rather than too much.

Future flood risk modelling suggests that there will be an increase in the frequency and depth of flooding in all regions. The area affected in the uplands and the estuary is expected to increase by around 20%. Depth is expected to increase most in the estuary and the narrow upland floodplains. This leads to a greater risk of flooding in larger urban centres (Taunton, Bridgwater and Yeovil), where the majority of people will be affected.

Our understanding of the future was based on scenarios where estimated changes to the climate, development and land management could result in changes to flood risk. We used these scenarios to

understand what six generic policy options could mean for flood risk to people, the environment and the economy. The options we considered were:

Policy option	Policy
1	No active intervention (including flood warning and maintenance). Continue to monitor and advise.
2	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
3	Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
4	Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change).
5	Take further action to reduce flood risk (now and/or in the future).
6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, which may constitute an overall flood risk reduction (e.g. for habitat inundation).

With our Steering Group we established a series of social, environmental and economic objectives for the catchment that drew from other policies, plans and programmes. These are:

Social:

A. Reduce the economic damage to properties caused by flooding.
B. Minimise loss of life and health impacts associated with flooding.

Economic:

C. Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding.
D. Reduce the economic damage to agricultural production caused by flooding.
E. Reduce the cost of flood risk management in the CFMP area.

Environmental:

F. Maintain / restore natural river processes and linkages with the floodplain where appropriate.
G. Protect / improve features of cultural or landscape heritage that are affected by flooding.
H. Seek to maintain / improve the condition of environmentally designated sites.
I. Seek to protect and improve biodiversity, where appropriate.
J. The CFMP will respond to the likely impacts of climate change and will not make any significant contribution to it.

These objectives establish the key aims of the CFMP. We also consulted with the public on our draft objectives in the pilot phase and it was against these that we appraised the alternative policy options, drawing from opportunities and constraints provided from other policies, plans and programme.

The most important opportunities are:

- Protection of property and lives through better flood management.
- Improvements in water quality.

- Enhancement of nature conservation interest.

The most significant constraints are:

- The highly modified watercourses of the levels and moors.
- The influence of wider land management in the catchment upon flooding and water quality.
- The impacts of tidal flooding on Bridgwater.
- The location and extent of urban areas and significant infrastructure.

Our preferred policies are as follows:

Policy Unit	Policy
1. Upper Yeo	3
2. Yeovil	4
3. Upper Parrett	3
4. Upper Isle	3
5. Upper Cary	3
6. Upper Tone	3
7. Taunton	5
8. Somerset levels and Moors	6
9. Bridgwater	4
10. North West Parrett	3

Significant positive and negative impacts likely to result from the CFMP are as follows:

- Some damage to property from flooding will inevitably occur, along with disruption to daily life.
- Some cultural heritage sites and their settings may be damaged, though the extent and significance of this is not possible to judge at this scale.
- There is a possible risk of significant impact on certain Natura 2000 sites, depending on the actions taken to implement CFMP policies at subsequent stages in the flood management hierarchy.

As a result of possible effects on Natura 2000 sites, we have undertaken an appropriate assessment of the plan. This identified potentially significant effects on the Somerset Levels and Moors (all designations) associated with possible future initiatives to redistribute floodwater and potentially significant adverse effects on the Severn Estuary (all designations) associated with possible future plans to manage tidal flooding. As a result, actions required to avoid adverse effects on the integrity of these sites have been identified. These include some of the monitoring and ecological studies which would be

required to support future assessments under the Habitats Regulations of flood management strategies and other plans arising out of the CFMP.

We selected these policies because alternative options would have resulted in unacceptable increases in flood risk to urban areas in particular to Taunton and Bridgwater. Directed flooding on the Somerset Levels and Moors has the potential to enhance already significant nature conservation interest, (depending on how it is designed and implemented), as well as reducing the speed of floodwater and intensity of flooding elsewhere in the catchment.

Our mitigation and enhancement measures are included within the appraisal of alternatives and in the action plan. These will be cascaded down through our subsequent and more detailed plans as we decide the flood risk management measures we need to implement the policies. The monitoring of the significant effects of the plan will include:

- The annual average damage of flooding to residential and non-residential property, as well as to agricultural land
- The number of properties with resistance/ resilience methods
- The number of people exposed to deep and/or fast flowing floodwaters during a 0.1 per cent AEP flood
- The annual average cost of flood risk management
- Water quality
- The condition of environmentally designated sites
- Habitat/river corridor scores

Specific measures required as a result of recommendations in the Appropriate Assessment will be confirmed in the final version of the Parrett Catchment Flood Management Plan, taking into account views from consultation and evolving best practice.

Section B1 Introduction and Background

B1.1 The purpose of SEA

This appendix documents the strategic environmental assessment (SEA) process undertaken for the Parrett Catchment Flood Management Plan (CFMP).

SEA is a systematic process for anticipating and evaluating the environmental consequences of plans and programmes prior to decisions being made. The purpose of SEA is to provide for a high level of protection of the environment and to contribute to the integration of environmental considerations into the preparation and adoption of plans and programmes with a view to promoting sustainable development. There is no legal requirement for us to undertake SEA for CFMPs because they are not required by legislation, regulation or administrative provision. However they clearly help set the framework for future planning decision, and have the potential to result in significant environmental effects. As a result, Defra guidance (Defra, September 20041) and our own internal policy have identified a need to undertake SEA.

In developing our CFMP, we consider the environment alongside social and economic issues. This appendix demonstrates how we have gone about undertaking the SEA for our CFMP. The contents of this Environmental Report have been broadened to include the social and economic effects also considered in our plan making process.

B1.2 The Catchment Flood Management Plan

Figure B1 shows the location of the Parrett CFMP within the South West. Figure B2 shows the policy units and proposed policies.

[1] http://www.defra.gov.uk/environ/fcd/policy/sea.htm

Figure B1 Location of the Parrett Catchment Flood Management Plan

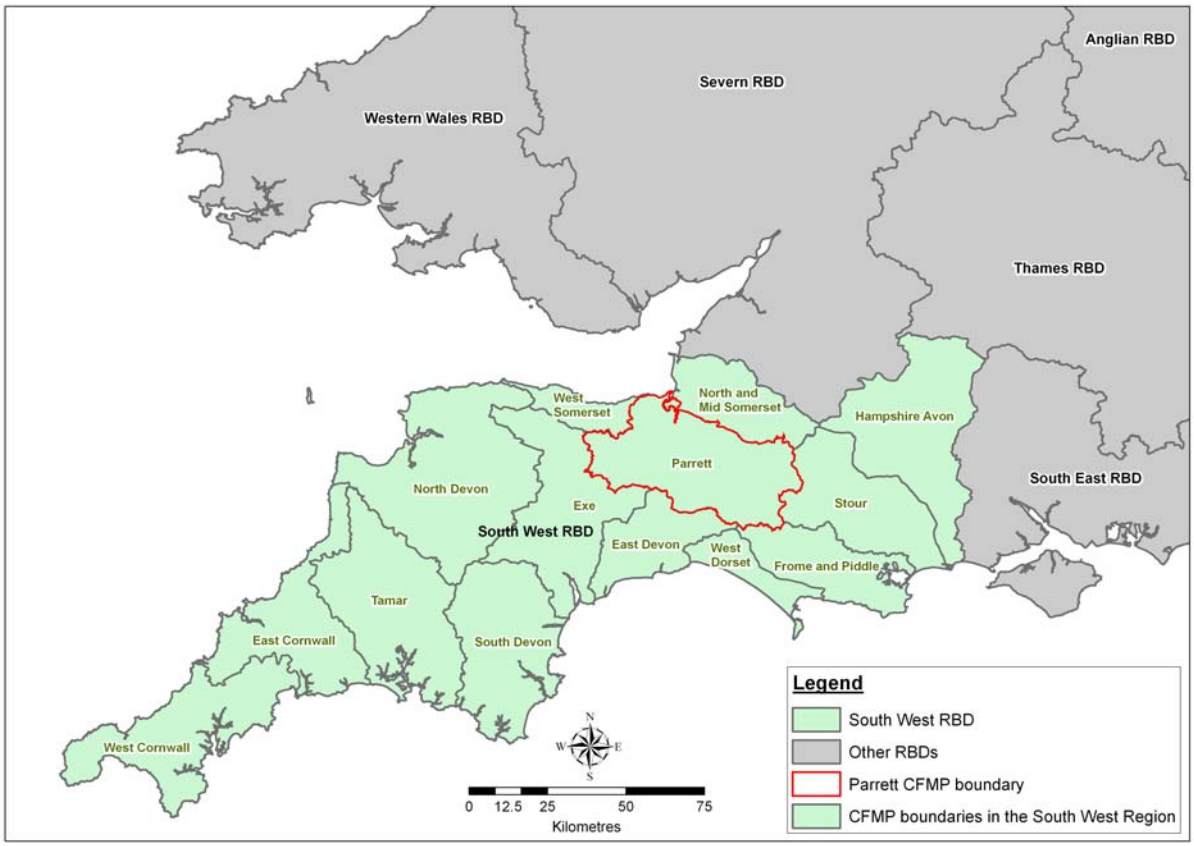
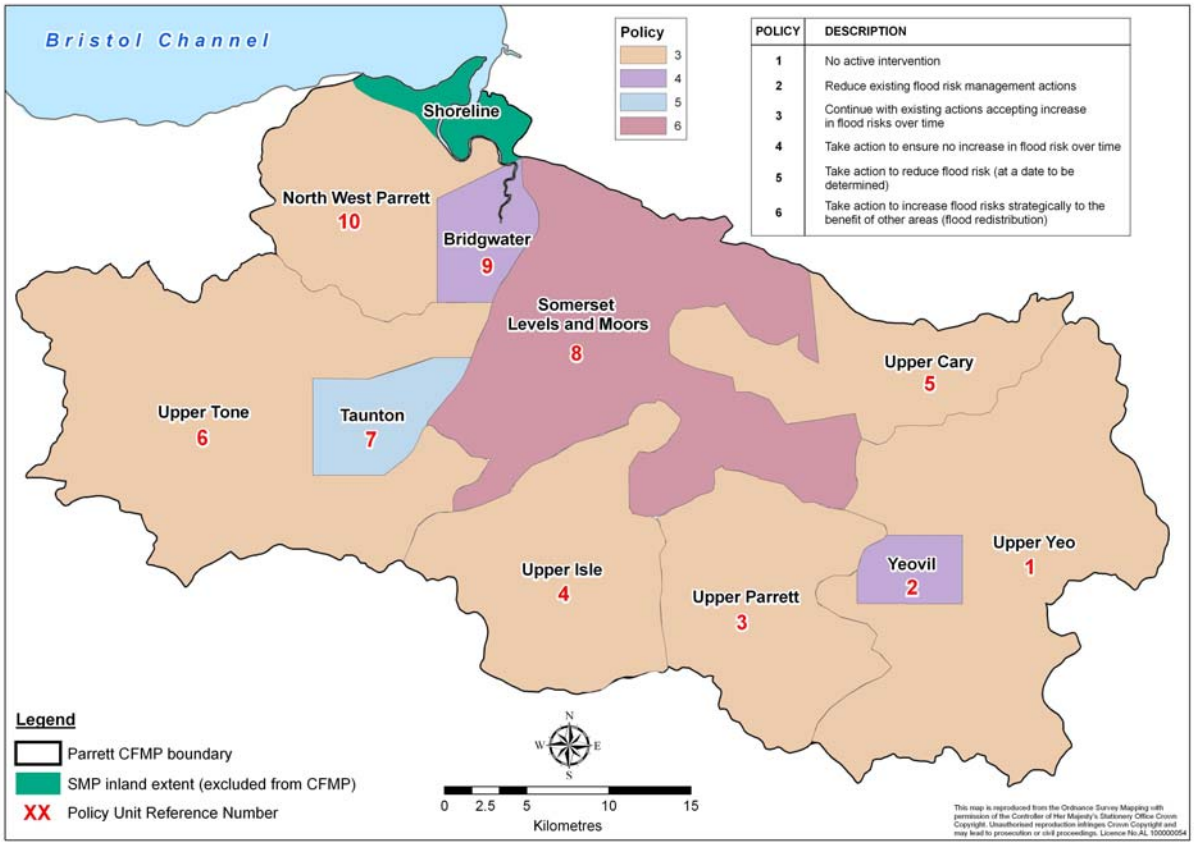


Figure B2 Parrett CFMP policy units and policies



Catchment Flood Management Plans are planning documents that we are preparing for all surface water river catchments across England and Wales. In developing the CFMPs, we are working with other key decision-makers to help us to establish policies to manage flood risk for the next 50-100 years. We know we cannot reduce flood risk everywhere, so we need to target efforts to where they are needed most: this is the purpose of our CFMP. They will not set specific measures to reduce flood risk or establish how to manage flooding issues in a catchment. Our policies are at the highest level in our hierarchy of spatial flood risk management plans and are about setting the right strategic direction so that we take the best and most sustainable approach in the future. To do this, we need to understand the extent, nature and scale of current and future flood risk to people, the environment and the economy across the whole catchment before choosing certain policies. We need to decide at this stage where to take further action to reduce or sustain flood risk, where we need to change the way we currently manage flood risk, or where we need to take little or no action.

The main body of the CFMP report provides a more detailed introduction to the CFMP, including the contents, aims and objectives of the plan: see Section 1.1 (Background) and Section 1.2 (Aims and Scope).

The CFMP involves:

- carrying out a strategic assessment of current and future flood risk from all sources (such as rivers, sewers and groundwater within the catchment, understanding both the likelihood and consequence of flooding and the effectiveness of current ways of reducing risk. We measure the scale of risk in social, environmental and economic terms;
- identifying opportunities and constraints within the catchment to reduce flood risk through changes in land use, land management practices and/or the flood defence infrastructure;
- finding ways to work with nature, and manage flood risk to maintain, restore or improve natural and historic assets;
- working out priorities for studies or projects to manage flood risk within the catchment, and identifying responsibilities for the Environment Agency, other operating authorities, local authorities, water companies or other key interested groups.

B1.3 Structure of the report appendix

This appendix documents the SEA process we have undertaken throughout our CFMP planning process and covers:

- Section B2 – Consultation: setting out information on how we have engaged interested parties, including the SEA consultation bodies, through CFMP development and the SEA process.
- Section B3 – Environmental Context: The relationship between the CFMP and relevant plans and programmes; a summary of the relevant environmental baseline in the catchment. It also sets out the environmental issues scoped into the SEA process and the environmental objectives used to carry out the assessment in Section B4.

- Section B4 – Assessment and Evaluation of Environmental Effects: Setting out the environmental effects of the different options available to the CFMP, cumulative effects of the CFMP as a whole and with other relevant plans in the catchment. It also sets out how mitigation and enhancement are considered at this strategic scale and the future monitoring requirements.

Section B2 Consultation

Section 1.5 'Involving Others' in the main CFMP report provides information about the consultation undertaken to date. This information is repeated below.

We cannot reduce flood risk across England and Wales on our own. All main organisations and decision-makers in a catchment must work together to plan and take action to reduce flood risk.

Whilst we have taken responsibility for producing the CFMP, it has been developed with input from a steering group made up of representatives from:

- District Councils/Unitary Authorities (South Somerset, Sedgemoor District, Taunton Deane)
- Internal Drainage Board
- Natural England
- Somerset Wildlife Trust
- RSPB
- Wessex Regional Flood Defence Committee
- Country Land and Business Association
- Defra

The steering group has provided technical guidance on wider issues, and guided important decisions when developing the CFMP.

The Parrett CFMP was originally one of six pilot CFMPs undertaken in 2003 prior to rolling out nationally across the UK. The Pilot Parrett CFMP was delivered in September 2003, following an extensive consultation and review process. In the following years since the issue of the pilot CFMPs the format of the document has changed and progressed; as such we considered it necessary to revise and update the findings of the earlier Pilot Parrett CFMP document. The Parrett CFMP builds upon the foundation of the earlier study, but some further public consultation is being undertaken to update people on the revised plan and to allow for comment and suggestions.

Considerable consultation has been undertaken during the preparation of the Parrett CFMP. We prepared the pilot CFMP in 2003 (members of the 2003 steering group are shown in Table B1), which built upon the considerable knowledge of local people and organisations brought together under the Parrett Catchment Project (which has now evolved into the Somerset Water Management Partnership). This information combined with the views of the statutory and non-statutory organisations has provided

the main source of information. We have aimed to avoid unnecessary or repetitive consultation where possible, as we know that many people and organisations have passed their views on to us in the past through the various forums available. This draft of the Parrett CFMP has been prepared for general public consultation, the results of which will be used to refine the plan as appropriate.

Table B1 Pilot Parrett CFMP Steering Group

Pilot Parrett CFMP Steering Group 2002/3
Chairman and members of the Flood Defence Committee
DEFRA representative
Parrett Consortium of Drainage Board (now Parrett IDB)
Environment Agency Officers
English Nature (now Natural England)
Somerset County Council
Sedgemoor District Council
Somerset Wildlife Trust
The Royal Society for the Protection of Birds
Somerset Levels and Moors Partnership
Country Landowners Association
Association of Drainage Authorities
RDS

Section B3 Environmental context

B3.1 Policy, plan and programme review

The SEA considers the relationship between the CFMP and other relevant plans and programmes. A review was undertaken at the scoping stage and updated during the main stage assessment, in order to:

- help collate additional environmental baseline information for developing the CFMP;
- identify environmental issues relevant to the SEA (e.g. existing environmental problems / protection objectives);
- identify influences of the CFMP on existing plans and programmes and vice versa;
- understand these relationships to help evaluate the significance of environmental effects;
- help identify any further assessment required.

A diagram setting out our view of the relationship between CFMPs and other key policies, plans and programmes is illustrated in Figure B3. Section 1.4 (Links with other plans hyperlink) discusses the

relationship with other plans. Those plans that we have drawn into the development of the CFMP are listed in Table B2.

Figure B3 How the CFMP fits with the wider planning framework

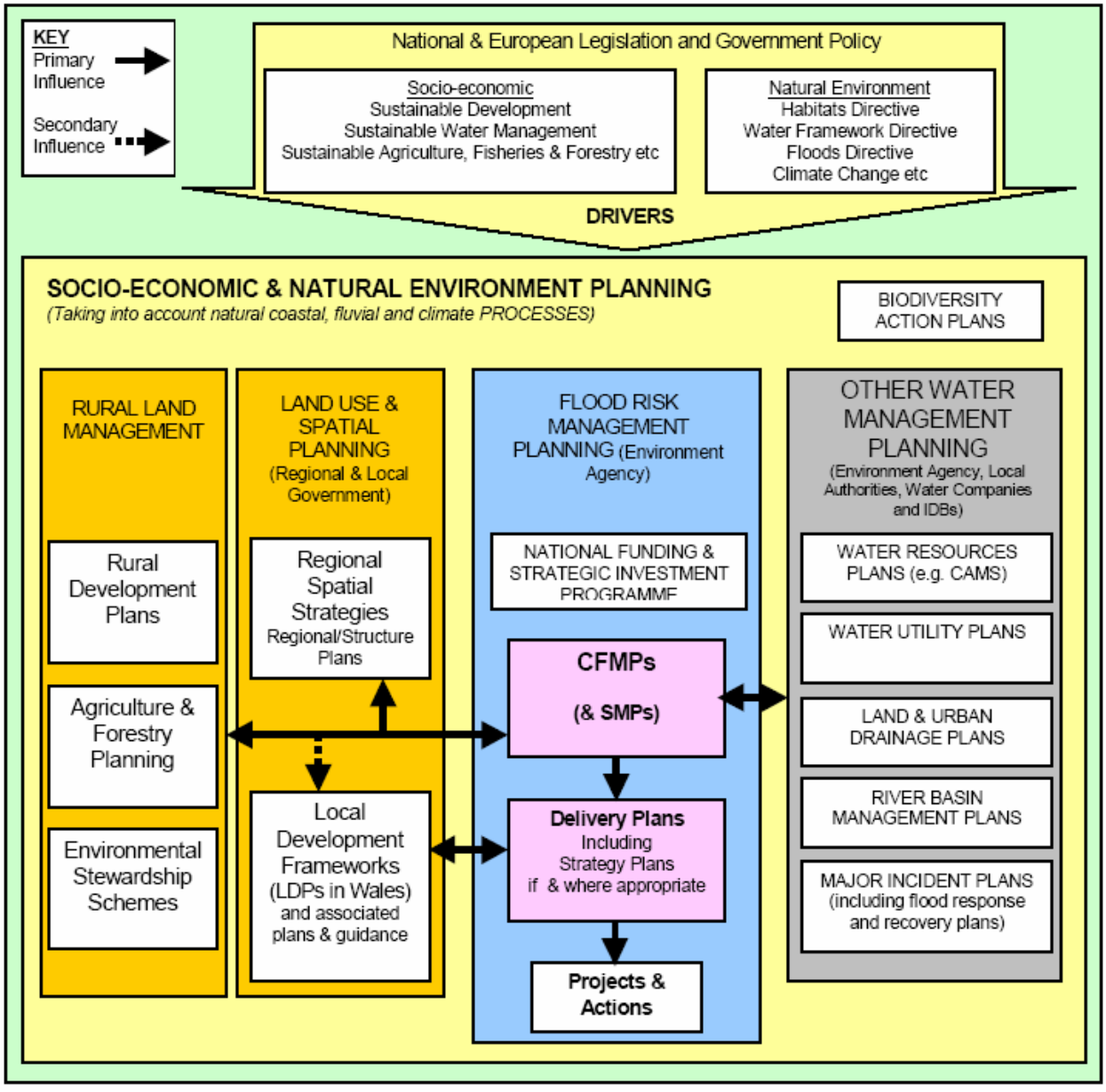


Table B2 Review of policies, plans, and programmes and relevance to the CFMP

Relevant plan, policy or programme	Potential influence	Relevant objectives or constraints we need the CFMP to consider
Regional Spatial Strategy for the South West	Major proposals for strategic infrastructure exposed to flooding (now/future)	Reducing risk to critical infrastructure
Local Development Documents	Future housing allocations within areas exposed to flooding (now/future)	Accommodating future development to meet housing targets
Catchment Abstraction Management Plans (CAMS)	Changes to the quantities and timing of abstractions in the catchment	Changes to capacity of flood storage

Relevant plan, policy or programme	Potential influence	Relevant objectives or constraints we need the CFMP to consider
Shoreline Management Plan	Proposals for the management of the shoreline and tidal influence	Conflicts may arise between the proposed actions for SMP units and adjoining/overlapping areas of the catchment

B3.2 Baseline review

Section 2 (Catchment overview) provides an overview to the characteristics of the catchment, including the environmental aspects relevant to the CFMP. Environmental issues within the catchment relevant to this CFMP are summarised below. Section B4 (Assessment and evaluation of environmental effects) provides more detail about the environmental characteristics of the individual areas most likely to be affected by the plan, their current state of the environment and the likely evolution thereof without implementation of the plan.

Table B3 summarises flood risk through the catchment. Flooding is significant throughout the catchment, with the exception of the estuary, affecting the greater area in the lowlands, yet the greater number of people in the uplands, where the main urban centres are located. Taunton is the key town at risk, although numerous smaller communities are also at risk, often caused or contributed to by surface water and/or sewer flooding.

Table B3 Summary of current flood risk

Summary of current flood risk			
Division	**Uplands**	**Lowlands (Somerset Levels and Moors)**	**Estuary**
People in a 0.1 per cent AEP flood	14,111	28,825	1,152
All properties in a one per cent AEP flood	2,584	1,128	319
Sewage Treatment Works	2	0	0
SAM	7	14	0
AONB	0.95km^2	-	0.25km^2
Main community at risk	Taunton	Bridgwater	-

Table B4 summarises future flood risk to the catchment on the basis of the Policy Units within the Catchment, which are shown on Figure B2 and are explained in more detail in Chapter 6 of the CFMP. Modest increases in flood risk are predicted for upper tributaries in the uplands, primarily because fewer assets occur outside towns. Yeovil may be at greater risk of surface water/sewer flooding if short-period, intense events occur more frequently. Taunton's vulnerability will increase, as flood defences reduce in relation to increased flooding levels. Bridgwater is at greatest risk of flooding caused by or exacerbated by high tides. The levels and moors show a complex pattern: the change in water level may not be great due to the size of the floodplain, but change in flood duration could be more significant.

Table B4 Summary of future flooding

Key Impacts By Policy Unit of increased Flood Risk Scenario			
Policy Unit	**Social**[2]	**Environmental**[3]	**Economic**[4]
Upper Yeo	Frequency of flooding more than doubles	Low impact expected, some channel widening envisaged	+100% increase in damages due to higher flows
Yeovil	Area sensitive to high intensity rainfall, which may overwhelm existing sewer system, putting homes and transport links at risk	Low impact expected	+145% increase in damages due to higher flows. This will underestimate damages associated with sewer flooding
Upper Parrett	Frequency of flooding more than doubles	Low impact expected, some channel widening envisaged	+102% increase in damages due to higher flows
Upper Isle	Frequency of flooding more than doubles	Low impact expected, some channel widening expected	+132% increase in damages due to higher flows
Upper Cary	Frequency of flooding more than doubles	Low impact expected	+109% increase in damages due to higher flows
Upper Tone	Frequency of flooding more than doubles	Low impact expected	+106% increase in damages due to higher flows
Taunton	Wide scale flooding risk increases by three times. Local government centres at risk	Low risk of significant environmental impact due to scale of urbanisation.	+172% large increase in damages due to higher flows and reduction in standard of protection provided by existing defences
Somerset Levels and Moors	Increasing risk of communities being cut off by flood water, increase risk of embankment breaching putting people at risk	Increase in duration of flooding may cause change in characteristic vegetation and invertebrate communities with increased risk of grass kill for very long duration events. However there are also potential benefits for some bird species from longer duration flooding.	+133% increase in damages due to higher flows, particularly high impact on agriculture
Bridgwater	Overtopping of tidal defences will increase risk of property flooding and cut off major roads	Increased risk of saline flooding represents a risk to aquatic and freshwater-dominated habitats such as floodplain grazing marsh.	+885% increase in damages due to higher tide levels and overtopping of existing defences
North West Parrett	Increased risk of breaching and possible risks to the public (particularly to those in cars)	Increased risk of saline flooding represents a risk to aquatic and freshwater-dominated habitats such as floodplain grazing marsh.	+757% increase in damages due to higher tide levels and overtopping of existing defences, high impact on agriculture

[2] Social: 'frequency of flooding more than doubles' implies that floods will occur approximately twice as often (e.g. an event which would be expected every 50 years would occur every 25 years

[3] Environmental: Strictly changes to the environment should take into account other changes such as changes to temperature, soil moisture etc which are also associated with climate change. However the science to support such an analysis is not available. We have restricted our high level review simply to flood risk change. Where channel widening is highlighted this indicates that some geomorphological change is expected in the channel and there would be some environmental impact

[4] Figures show increase in average annual damage (including both property and agriculture)

B3.3 Scope of the SEA and environmental objectives

An important early stage in the SEA process is to identify which environmental issues are relevant to this CFMP. Our Scoping exercise identified some issues that are not relevant to this type and level of plan which were able to exclude from further assessment: allowing us to focus our assessment on what is most important in this context.

The scope of this SEA was determined by:

- developing an understanding of the flood risk management context for the catchment, including current flood risk to people and the environment (we also considered the economy), and the potential constraints and opportunities to the management of flood risk;
- undertaking a review of the environmental context of the catchment, including identifying relevant trends;
- a review of relevant plans and policies, including an assessment of their relationship with catchment flood management planning;
- identifying relevant environmental protection objectives from these plans and policies and consideration of how the CFMP might conflict with these, or influence their achievement; and
- consultation with key stakeholders (see previous Section B2), including the SEA statutory consultation bodies: Natural England and English Heritage.

The environmental and social issues scoped into the SEA were then reviewed alongside economic issues to develop a suite of policy appraisal objectives, indicators and, where possible, targets. Throughout this process we drew on the knowledge and vision of our CFMP Steering Group, see Section 1.5 (Involving others) to help understand what matters in the catchment and shape what this plan was trying to achieve. Following our formal Scoping exercise, we considered what the future might look like, including what the effects of climate change could be, and the impact of future development pressures and changes in land management. While we cannot predict the future with complete certainty, we used this perspective on the future to help us understand the scale of changes we could face in the future and so consider them explicitly within the development of the plan.

Table B5 summarises the issues we scoped into the development of the plan, and the resulting broad objectives we developed against which to test our alternative options. Not all of these issues are equally relevant everywhere in our plan area, and we also drew on other relevant policies, plans and programmes to identify opportunities and constraints for individual areas (Policy Units) within the plan area.

Table B5 Scope of the SEA in relation to the CFMP

Environmental Topic	Scope and Justification		Relevant environmental objective(s)	Relevance to the CFMP
	Scoped in	Scoped out		
Population and Human Health	*People exposed to flooding and the risk of being drowned due to flooding.*	*Disease, stress and trauma as a result of flooding. A robust assessment not established for this level of plan.*	*B: Minimise loss of life and health impacts associated with flooding*	*CFMP must ensure no increased risk through flooding, as far as is reasonable*
Material Assets	*The social and economic impact of flooding on communities and the infrastructure and services they rely on (material assets)*		*A: Reduce the economic damage to properties caused by flooding.* *E: Reduce the cost of flood risk management in the CFMP area.*	*The CFMP should help to minimise risks to property, infrastructure and material assets.*
Livelihood	*The role of flooding and flood risk management in promoting opportunities for employment and livelihood, particularly in the agriculture and tourism sectors.*		*C: Reduce the economic damage to local industry (urban and rural, including tourism) caused by flooding.* *D: Reduce the economic damage to agricultural production caused by flooding.*	
Landscape	*The role of flooding in maintaining characteristic and historic landscape*		*F: Maintain / restore natural river processes and linkages with the floodplain where appropriate.* *G: Protect / improve features of cultural or landscape heritage that are affected by flooding.*	*Detailed landscape assessment not possible without more spatially explicit proposals, but CFMP should not drive significant changes in landscape character.*
Historic Environment, including cultural, architectural and archaeological heritage	*Sites designated or recognised as of regional, national or international importance. Listed buildings will be considered generically but not identified individually.*	*The risk of impacting upon unknown archaeology will be considered for more spatially explicit plans and projects*	G: *Protect / improve features of cultural or landscape heritage that are affected by flooding.*	*The Parrett catchment has a rich cultural heritage and many significant heritage sites. Actions taken to implement the CFMP policies must ensure no significant increase in flood risk to these sites*
Air quality	*No air quality issues have been*	*The CFMP will not have significant*	- *No objectives set*	*The CFMP will not have a significant*

Environmental Topic	Scope and Justification		Relevant environmental objective(s)	Relevance to the CFMP
	Scoped in	Scoped out		
	identified which would be adversely affected by the CFMP	*effects on air quality as it does not include any policies which require increased emissions or generation of particulate matter. Air quality issues are therefore not considered to be significant and have been scoped out of the assessment.*		*effect on air quality.*
Climatic factors	*The plan explicitly considers the implications of climate change on flood risk. The policies in this CFMP are designed to help society to adapt to climate change.*	*The CFMP Policies will not make any significant contribution to climate change.*	*J. The CFMP will respond to the likely impacts of climate change but will not make any significant contribution to it.*	*The CFMP Policies will not make any significant contribution to climate change.*
Biodiversity, fauna and flora	*Sites designated as Special Protection Areas (SPAs), Special Areas of Conservation (SACs), Ramsar sites, National Nature Reserves, Sites of Special Scientific Interest (SSSIs) and Biodiversity Action Plan (BAP) Habitats and Species where these have some dependence on the water environment and flooding.* *We also consider the need to undertake an Appropriate Assessment for Natura 2000 sites.*	*SPAs, SACs, SSSIs, NNRs and BAP habitats and species which do not have a dependence on the water environment or on flood management within the CFMP boundary, whether located within or outside the CFMP boundary.*	*H Seek to maintain / improve the condition of environmentally designated sites.* *I Seek to protect and improve biodiversity, where appropriate* *NB: Where we cannot demonstrate that a significant detrimental effect on a designated European Site is unlikely, we will undertake an Appropriate Assessment in accordance with the requirements of the Habitats Directive.*	*Protected and designated sites in the CFMP area are susceptible to changes in water levels and flood management regimes. Flood risk management must not impact on water level management requirements or on flooding regimes which sustain important or designated sites, habitats and/or species.* *One key SPA/Ramsar site in the catchment has critical links with winter flooding.* *At least two other protected sites could be affected by different approaches to flood management and*

Environmental Topic	Scope and Justification		Relevant environmental objective(s)	Relevance to the CFMP
	Scoped in	Scoped out		
				are designated for wetland features.
Soils	*The effects of flooding and flood risk management on the erosion and transport of sediment and gravel within the river system.* *The effects of surface water run-off on erosion of soils from the land.*			*Protected and designated species are susceptible to changes in sediment supply, sediment dynamics and nutrients.*
Water	*The potential for the CFMP to affect the achievement of good ecological potential of water bodies.* *The potential for flooding to affect the quality of water* *The potential for an increase in poor quality water (and secondary impact on designated sites).*		*H Seek to maintain / improve the condition of environmentally designated sites.* *I Seek to protect and improve biodiversity, where appropriate*	*Compliance with the Water Framework Directive will be affected by flood conditions and water quality of flooding, both of which may be affected by the CFMP.*

Section B4 Assessment and Evaluation of Environmental Effects

B4.1 Strategic options and appraisal process

We have considered six generic options in our policy plan, which are listed in Table B6.

Table B6 Definition of policy options

Policy option	Risk management strategic approach
1. No active intervention (including flood warning and maintenance). Continue to monitor and advise	**Accept the risk** – both current and future increases in risk
2. Reduce existing flood risk management actions (accepting that flood risk will increase over time)	**Accept the risk** – both current and future increases in risk
3. Continue with existing or alternative actions to manage flood risk at the current level (accepting that	**Accept the risk** – our current scale of actions is sufficient to manage the current

Policy option	Risk management strategic approach
flood risk will increase over time from this baseline)	risk, and future increases will be acceptable
4. Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and Climate Change).	**Accept the risk** – but in the longer term take action to ensure the risk does not increase from current level
5. Take further action to reduce flood risk (now and/or in the future)	**Reduce the risk** – lower the probability of exposure to flooding and/or the magnitude of the consequences of a flood, and hence the risk
6. Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, for example for habitat inundation).	**Reduce the risk** by transferring the risk to other locations where the risks (typically the consequences) are positive

These options relate to the outcome of flood risk management in terms of the scale of risk and management activity compared to today. Deciding on the specific measures needed to achieve these outcomes is not the purpose of the CFMP. However, we do need to appreciate whether or not the change in risk under a particular policy is generally feasible and desirable in terms of where the water goes in the catchment and its environmental, social and economic implications. To appreciate this we need to understand how the catchment works in times of flood so that our policies make sense. The water needs to go somewhere when it floods and we need to understand that if we prevent water from flooding homes in one location what the knock-on effects would be in another location.

In order to understand how the catchment works we develop models that can draw on information about the amount of rainfall and show to some extent how this drains off the land and into the river systems. We can then consider at a broad scale how the flow of water within the catchment could change over time with or without management intervention.

Of particular importance in driving future changes in flood risk are:

- the potential impact of climate change on flooding due to increased rainfall and sea level rise;
- the potential impact of new development due to extra run-off from impermeable surfaces as well as new properties being developed in areas exposed to flooding; and
- the potential impact of changes in land management because this can change the permeability of the catchment and how the rate at which water drains into the river system.

To consider what the future might be like, and thus what the flood risk could be like with no management intervention, we have considered a number of scenarios. These scenarios aim to establish what changes there could be in the three important drivers of change listed above (climate change, development and land management). To develop reasonable predictions of change we have looked at past changes and had discussions with our Steering Group [or Project Board] to arrive at reasonable projections of what the future could be like. To consider the impact of climate change on flooding we have used the government guidance issued in the Foresight Report, 2007. A more detailed explanation of the scenarios used is given in Section 4.2 (Scenarios).

Our appraisal of the alternative policies is undertaken by considering how the flow within the catchment could change in the future. This understanding is done at a high level using our models, complemented with expert judgement on how water flows through the catchment during times of flood. For example, we might say that if land management practices changed in the headlands of a catchment, the land would be more permeable and this would reduce the rate at which rainfall enters the river system downstream. Such a change in how water flows through the catchment could then reduce the volume of floodwater downstream (and reduce the frequency of flooding to homes in this downstream location).

Our consideration of how the catchment works, and what the current and future risks are has allowed us to divide the catchment up into smaller geographical areas that we have called Policy Units. In each Policy Unit we have considered how the risks arise (using a source-pathway-receptor model) and what our specific objectives are. We have considered other policies, plans and programmes to see where there may be objectives and constraints that our plan could contribute to or that we need to take account of. For example, a biodiversity action plan (BAP) may identify targets for enhancement requiring an increase in the area of lowland floodplain grassland or wet woodland. Our investigations could start to show that if the area adjacent to the river corridor was to flood more frequently, then this could potentially help contribute to such targets. The process of SEA encourages us to make these links with other plans so that we can help deliver broader benefits and reduce conflict between our flood risk management policies and other aspirations. We have done this during the review of other plans and considered others' objectives as opportunities or constraints to our policy development, as an integral part of our appraisal.

B4.2 Assessment and evaluation of impacts

The alternative options have been assessed against objectives that are specific for each policy unit. The tables set out below detail this appraisal. These tables identify the losses and gains under each of the six generic policy options and identify the preferred option for each Policy Unit along with monitoring requirements. As such they set out the findings of the SEA in relation to the assessment of options.

Information on mitigation and enhancement measures related to the preferred policy option identified for each policy unit is set out in section B4.4.

At this level of plan, the mitigation and enhancement measures are integral to the policy appraisal. Where we have the potential to enhance the environment we have included this potential within the appraisal objectives. Mitigation measures at this level are generally included as part of the policy options, so that a less detrimental impact will tend to be an alternative policy option. We therefore cannot identify any further specific mitigation measures at the policy level. At a lower level in our planning hierarchy, when we are investigating the details of how we will implement flood risk management measures, we will be undertaking an appropriate level of environmental assessment which will, in turn, identify more relevant mitigation measures to the impacts arising.

Table B7 Summary of Appropriate Assessment requirements for Natura 2000 sites

Policy Unit and sites at risk	Findings of the Appropriate Assessment undertaken	Justification for pursuit of option and commitment to mitigation and compensation
Policy Unit 1: *Bracket's Coppice*	*Unlikely to result in damage to features for which the site is designated. No significant effect on site integrity identified.*	*No justification required*
Policy Unit 6: *Hestercombe House SAC Holme Moor & Clean Moor SAC Quants SAC*	*Unlikely to result in damage to features for which the sites are designated. No significant effects on site integrity identified.*	*No justification required*
Policy Unit 8: *Somerset Levels & Moors SPA Somerset Levels & Moors Ramsar*	*Unlikely to result in damage to features for which the site is designated, although this is dependent on scale and duration of flooding and on actions taken to implement policy.*	*The policy has the potential to enhance the condition of Natura 2000 sites, but there is also a risk of adverse effects on integrity. Further information and understanding is required to support the Habitats Regulation Assessments which will be required for lower tier proposals and which will specify actions to be taken to implement the policy. The actions required to provide this information and understanding are included in the Action Plan.*
Policy Unit 10 and outside the CFMP (downstream effects): *Severn Estuary cSAC Severn Estuary SPA Severn Estuary Ramsar*	*Possible effects identified if future plans or projects result in introduction of barriers to fish passage. Also possible impacts on sediment supply and dynamics.*	*Option should not conflict with SMP objectives for the Parrett estuary. Option should seek to enhance conservation interest in the Severn estuary cSAC, SPA and Ramsar.Habitats Regulations Assessments will be required for plans and projects arising out of this CFMP and these should address this issue to ensure that adverse effects on site integrity are avoided.*

B4.3 Cumulative environmental effects

SEA requires assessment of cumulative and synergistic effects. This section sets out the significant environmental effects of the plan as a whole, which have been considered in relation to each of the environmental objectives. It goes on to consider the environmental effects of potential interactions between the CFMP and relevant plans and programmes within the catchment. These findings are summarised in Table B8.

Table B8 Summary of cumulative issues

Objective	Cumulative effects across the whole plan area (sum of Policy Unit impacts)	Interaction of CFMP with relevant Plans and Programmes
No harm to life	Risks to life are likely to increase in certain areas, particularly where we do not expect future investment to be economically viable. The cumulative effect is uncertain and depends on the level of	As alone

Objective	Cumulative effects across the whole plan area (sum of Policy Unit impacts)	Interaction of CFMP with relevant Plans and Programmes
	future investment and the severity of future climate change.	
Maintain critical infrastructure	The CFMP policies support the maintenance of critical infrastructure, e.g. the M5 motorway and railways	As alone
Minimise community disruption	Some disruption will occur as flood risk increases through time; however, investment will be directed to minimise any changes	As alone
Minimise disruption to daily life		
Minimise disruption to public access, amenity & recreation		
Protect and enhance nationally and regionally important cultural heritage sites and their settings.	No significant damage to cultural heritage sites and their settings are anticipated, although this may depend on the effects of locally increased flooding on the Levels and Moors	As alone
Protect and improve habitats and species	Expected to be achieved; attenuation of flooding across most of catchment can enhance biodiversity in many places	Changes in land management through uptake of stewardship schemes in the upper catchment, for instance, will benefit biodiversity and the CFMP policies
No significant adverse impact on European sites	Minor adverse impacts *may* occur, but significance is low and will depend on approach of policy implementation	SMP policies do not conflict significantly with CFMP policies
Water bodies achieve good ecological status (or potential)	The CFMP policies should, in combination, help to maintain or improve ecological status of water bodies. The CFMP is helping drive improved land management in the upper catchment, contributing to this	Changes in land management through schemes such as Environmental Stewardship Schemes should complement the CFMP policies for upper catchments, creating net benefits to ecological status

B4.4 Mitigation and Enhancement

At this level of policy making, where we are setting the direction for future actions, the mitigation and enhancement measures are integral to the policy appraisal with an emphasis on avoiding adverse effects at source. Where we have the potential to enhance the environment we have included this potential within the appraisal as opportunities. Mitigation measures at this level are generally included as part of the policy options, so that a less detrimental impact will tend to be implicit within an alternative policy option. At a lower level in our planning hierarchy, when we are investigating the details of how we will implement flood risk management measures, we will be undertaking an appropriate level of environmental assessment and consultation which will, in turn, identify more relevant mitigation measures to the impacts arising. We will use the assessment of impacts undertaken at this level to help focus our

lower levels of decision making, ensuring that relevant mitigation and enhancement measures are explored fully.

Where Table B8 identifies potential benefits / impacts between the CFMP and other plans / programmes operating within the catchment we will take this into account when developing further proposals, as set out above.

B4.5 Monitoring

SEA requires significant environmental effects related to the implementation of the plan to be monitored. Information on the monitoring requirements related to the implementation of the CFMP is included in the appraisal tables presented in Section B4.2.

Annex A

CFMP title:	Parrett CFMP
Policy author:	Black & Veatch
Date on which policy appraisal was started:	September 2007
Iteration no:	Consultation Draft

The following forms are based on our integrated policy appraisal process, modified for use on CFMPs. The forms pull together all the key data and information gathered throughout the CFMP development process.

The first three and last are generic to the CFMP area and these are listed below. A further seven forms are specific to each policy unit, and are presented in order of policy unit.

Index of Policy Appraisal Forms:	
Generic forms:	
Form B.12.1	CFMP objectives (including BAP targets, environmental targets, housing targets)
Form B.12.2	Legal requirements
Form B.12.3	Summary of flood risk
Form B.12.10	Signature of CFMP Project Manager
Forms specific to each policy unit:	
Form B.12.4	CFMP policy options
Form B.12.5-1 to B.12.5-10	Policy unit description and summary of current and possible future flood risk management generic responses.
Form B.12.6-1 to B.12.6-10	Appraisal of policy options against policy unit objectives, opportunities and constraints.
Form B.12.7-1 to B.12.7-10	Summary of losses and gains.
Form B.12.8-1 to B.12.8-10	Requirements for further development and appraisal.
Form B.12.9-1 to B.12.9-10	Indicators for monitoring, review and evaluation

Form B.12.1	**Purpose of the CFMP**

This form contains the key catchment specific objectives, opportunities and constraints that need ti be taken into account when developing the CFMP.

These factors have been reviewed and amended through consultation undertaken in the Scoping Stage, Draft CFMP and finalisation Stage.

Catchment objectives:

The following nine catchment objectives have been identified and agreed by the Project Team and Steering Group:

(1) Reduce the risk of serious injury/harm to people caused by flooding.

(2) Reduce the economic damage to properties caused by flooding.

(3) Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.

(4) Reduce the economic damage to agricultural production caused by flooding.

(5) Reduce the cost of flood risk management in the CFMP area.
(6) Maintain / restore natural river processes and linkages with the floodplain where appropriate.
(7) Protect / improve features of cultural heritage that are affected by flooding.
(8) Seek to maintain / improve the condition of environmentally designated sites.
(9) Seek to help protect and improve biodiversity habitats, where appropriate.

For policy appraisal, the above agreed catchment objectives have been used in table B.6 for each policy unit.

Catchment opportunities and constraints:

The catchment opportunities and constraints are listed in Section 5.2 of the main CFMP report.
For policy appraisal, the relevant opportunities and constraints have been listed in table B.6 for each policy unit.

Form B.12.2	Meeting legal requirements (and Environment Agency corporate objectives)

This form lists the legal requirements, and government targets that CFMP policy must comply with or support.

Our corporate objectives:

For flood risk management:

(1) Sustainable objections to development in Flood Zones.

(2) People taking appropriate action in response to flooding based on our advice.

(3) Increase the proportion of properties (homes and businesses) within the indicative floodplain that have been offered an appropriate flood warning service.

(4) Increase the number of houses that benefit from reduced flood risk.

(5) All flood systems to be in the condition required by the performance specifications.

(6) Delivery of OPUS.

(7) Produce Catchment Flood Management Plans (CFMPs) for all principal catchments.

(8) All data stored in NFCDD will have data quality indicators.

(9) All new data entered to NFCDD in the year will be spatially accurate and be fully attributed.

(10) Agency Flood Maps comply with policy guidance.

(11) Deliver Water Level Management Plans on 33 priority SSSI to achieve favourable / unfavourable recovering condition by 2010.

(12) Create at least 200 hectares of new Biodiversity Action Plan (BAP) habitats as a result of flood management activities, of which at least 100 ha should be salt marsh and mudflat.

Other government targets:

Biodiversity: UK Action Plan (1994) – objectives for conserving biodiversity:

(1) To conserve and where practicable to enhance:

   a. The overall populations and natural ranges of native species and the quality and range of wildlife habitats and ecosystems:

   b. Internationally important and threatened species, habitats and ecosystems:

   c. Species, habitats and natural and managed ecosystems that are characteristic of local areas:

   d. The biodiversity of natural and semi-natural habitats where this has been diminished over recent past decades.

(2) To increase public awareness of, and involvement in, conserving biodiversity.

(3) To contribute to the conservation of biodiversity on a European and global scale.

Will the appraisal include/meet other specialist appraisal needs?	Yes
If so, state which:	The appraisal process has been prepared within the spirit of the SEA Directive. Thus in addition to appraising policies against catchment objectives and legal requirements, policies will also be appraised against catchment opportunities and constraints.

Form B.12.3	Summary of flood risks, and associated source, pathway and receptor components

This form contains a summary of the location, extent, and degree of flooding (current and future) and related distribution of flood risks that need to be addressed by the CFMP.

A Source – Pathway – Receptor (S-P-R) diagram has been provided for the catchment to indicate the dominant S-P-R characteristics of the different flood producing systems, considering also the drivers of flooding and the policy appraisal objectives as well as possible responses to flood risk.

The two primary sources of flooding that are addressed in the Parrett CFMP are river flooding (including tidally influenced river flooding) and surface water flooding.

Coastal/tidal flooding has been considered but is not addressed by the CFMP. Please see the relevant Shoreline Management Plan (SMP) for more information on coastal flood management.

To understand the frequency, depth, and extent of river flooding within the CFMP area,, we need to look at a range of different size flood events. Although our Flood Zone maps provide outlines for river flooding with a one per-cent and o.1 per-cent AEP, they do not provide information for smaller events. When we were developing this CFMP, we built a broad-scale hydraulic model to simulate flooding within the catchment. This model represents current conditions within the catchment and provides flood outlines, flood depths and flood velocities for the main rivers for a number of different probability events.

From the analysis we have estimated flood extents, depths and velocities at main places of risk across the catchment. The results from the hydraulic modelling have been used with our Flood Zone maps and other historic flooding information to develop our understanding of flood risk in the CFMP area. In this way, we have used all of the best information available to make the most appropriate flood risk management policies.

A Source-Pathway-Receptor (S-P-R) diagram is presented in Table B.3.1

Table B.12.3-1 Typical Source-Pathway-Receptor (SPR) diagram extended to include Drivers, Objectives and Possible Responses

Drivers	SOURCE		RECEPTOR	Aspect	Indicator	Objectives	Responses	Examples	Policy
	Primary Pathway	Secondary Pathway							
Climate Change	Sea Level	Catchment run-off		Population	No. of residents (Population) + type of effect (duration, extent and depth of inundation)	Reduce the risk of serious injury/harm to people caused by flooding		Online storage (existing/ new)	No active intervention (including flood warning and maintenance). Continue to monitor and advise.
Urban Development	Tides	Localised run-off		Population – vulnerability	No. of people affected (according to Social Vulnerability) + type of effect (duration, extent and, depth of inundation)	Improve the character of the landscape and the recreation of amenity value of the floodplain		Online storage (existing/ new)	Reduce existing flood risk management actions (accepting that flood risk will increase over time).
Land Use Change	Waves	Infiltration		Human Health	Hospital capacity affected by flooding (thousand patients p.a.) + specific services	Reduce the economic damage to properties caused by flooding		Floodplain storage / wetland creation (existing / new)	Continue with existing or alternative actions to manage flood risk at the current level of flooding (accepting that flood risk will increase over time from this baseline).
	Storm surges	River system		Transport	Length of transport type affected (main rail, road, etc.)	Reduce the economic damage to local industry (including tourism) caused by flooding	Attenuation / retention	SUDS – new / retrospective	Take further action to sustain current scale of flood risk into the future (responding to the potential increases in flood risk from urban development, land use change, and climate change).
	Rainfall	Rhyne and pumping network	People	Social Infrastructure	Transport links, utilities and services	Reduce the economic damage to agricultural production caused by flooding		Infrastructure storage: above ground (e.g. canal / STW)	Take further action to reduce flood risk (now and/or in the future).
	Localised storms	Ground-water		Social Infrastructure	Leisure & amenity (shops, restraints etc) – size (city, town, village)	Reduce the cost of flood risk management in the CFMP area		Infrastructure storage: below ground	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, (which may constitute an overall flood risk reduction, e.g. for habitat inundation). Note: This policy option involves a strategic increase in flooding in allocated areas, but is not intended to adversely affect the risk to individual properties.
	Ground-water	Urban water drainage systems		Employment	No. employed affected by flooding (full time/part time)	Maintain / restore natural river processes and linkages with the floodplain where appropriate	Rural land use change	Best farming practices	
	Water discharge	Overland flow		Education	Education capacity affected by flooding (primary, secondary, higher, further)	Protect / improve features of cultural heritage that are affected by flooding		Reduced upland grazing	
	Surface water	Surface water drainage system	Property	Property (residential)	Area of resource or no. of residential properties affected	Seek to maintain / improve the condition of environmentally designated sites		Agricultural drainage	
	Reservoir			Property (commercial)	Area of resource or no. of commercial properties affected	Help protect and improve biodiversity habitats, where appropriate.	Water management infrastructure	Pumping (including surface water)	
				Property (development)	Area of resource or no. of proposed developments affected			Distribution networks (e.g. increase network capacity)	
				Property (amenity/sports)	Area of resource or capacity of assets/properties affected		Increased conveyance	River maintenance	
				Agriculture (land resource)	Area of land affected (according to Agri. Land Class)			Dredging/desilting	
				Agriculture (economic productivity)	Crop losses (annual0			Removal of floodplain obstructions	
			Environment	Biodiversity – designated resource	Area (Ha) of SPA, SAC, SSSI, RAMSAR site (favourable/unfavourable status)			Removal of channel obstructions	
				Biodiversity - species	National Biodiversity Action Plans			River re-engineering (e.g. restoration)	
				Biodiversity - habitats	National Habitat Action Plans			Wetland creation	
				Countryside character	Area of countryside affected by flooding			Diversion channel	
				Landscape	Area of AONB, National Parks			Defences (to restrict floodplain)	
				Water pollution	Volume of contaminated runoff (length of receiving waters)		Localised protection measures	Localised defences (e.g. around properties), including against groundwater	
				Land quality/GW?	Location/are of site potentially causing pollution			Individual protection to properties	
				Water quantity	Length of low flow rivers		Influencing and informing	Flood awareness	
				Sediment transport	Volume of sediment input (sources) and sinks (storage) and general system dynamics			Flood warning and evacuation	
				Channel morphology	Sensitivity to adjustment			Planning policy (future and use development)	
				Soil (erosion)	Volume of soil loss			Building regulations (resilience)	
								Data and information	
							Monitoring / survey studies	Analysis and understanding	

Form B.12.4	CFMP Policy Options
The following generic policy options have been recommended in the CFMP guidelines for consideration. They are intended to cover the whole spectrum of potential policy choices in response to flood risk.	
Option 1:	No active intervention (including flood warning and maintenance); continue to monitor and advise.
Option 2:	Reduce existing flood risk management actions (accepting that flood risk will increase over time)
Option 3:	Continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline)
Option 4:	Take further action to sustain the current level of flood risk into the future (responding to the potential increases in risk from urban development, land use change and climate change)
Option 5:	Take further action to reduce flood risk
Option 6:	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere (which may constitute an overall flood risk reduction, e.g. for habitat inundation)

Form B.12.10	Signature of CFMP Project Manager:	
Date (of completion):		

Form B.12.5-1	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 1	**Upper Yeo**
Current responses to flood risk within the policy unit?	Policy Unit 1 includes the River Yeo upstream of Ilchester, excluding Yeovil which is considered separately in policy unit 2. The policy unit includes Sherbourne, Ilchester, Westminster, Chetnole, Milborne Port, and other smaller communities. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Some communities adjacent to the River Yeo, in particular Ilchester have suffered fluvial flooding. Other villages (such as Queen Camel and West Camel) have suffered from complex fluvial and surface water problems. Wessex Water's capital programme identifies minimal sewer work in this catchment, which appears to be consistent with the level of known problems. Our current level of investment in flood risk in this area is low, and is focussed in areas where we have undertaken works. General routine maintenance in undertaken as required and households that are currently at risk from flooding are included on our flood warning system.
Standards of service that apply to flood defences within the policy unit?	The small number of flood defences in this policy unit provides protection for an event greater than a 1 per cent AEP river flood.
What is currently exposed to flooding?	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Sewer flooding has been recorded specifically in Ilchester. There have been other scattered surface water problems elsewhere. Sherbourne is considered at risk (particularly in relation to the operation of Sherbourne Lake).
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 1 are people and property in small communities adjacent to the River Yeo, especially in Sherbourne. Key infrastructure at risk include 3 schools, a police station and a water treatment works..
What are the key factors that could drive future flood risk?	Climate change (increasing flows and rainfall runoff) and land use change.
What are the possible future levels of flood risk under the main scenarios?	With current flood defences in place, the annual average damage is estimated as £1,128,500 to property and £150,000 to agricultural land. The existing maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The disperse nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular area (for example Ilchester or Sherbourne).

What potential responses (or groups of responses) are being considered to manage flood risk?	Possible generic responses for this policy unit include: (a) Localised defences – around watercourses and /or individual properties. (b) Land use management - work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. The soils in the Upper Yeo catchment are less sensitive to poor farming practices than some other units (specifically the Upper Parrett, Upper Isle and the Upper Tone). (c) Attenuation/retention – use of existing online storage, such as at a local scale (individual farms), where ponds, provided for other reasons (water quality or habitat provision) will have a small local flood risk management benefit. (d) Partnership – significant opportunities are likely to found primarily in partnership with others, such as with the Water Utilities.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment is appropriate, and the risks associated with this are limited.

Form B.12.6-1	**Screening of Policy Options against Appraisal Objectives**

This form:

(1) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(2) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(3) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(4) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(5) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 1	**Upper Yeo**								
			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance when required. (b) Automated warning systems to alert when water levels are too high. (c) use of the development control process. Flood risk assumptions: (a) Fluvial flood risk is relatively limited in this policy unit and is mostly limited to small communities adjacent to the River Yeo, including Ilchester, Queen Camel and West Camel. (c) Due to the steep nature of the catchment, surface water flooding is a significant problem in some locations, such as Halstock, Milborne Port and Sutton Montis. Over fifteen incidents of this type have been recorded. These have been caused by excessive rainfall causing field runoff, and / or blockage of inadequate road drainage.	KEY assumptions and limitations Possible future responses: (a) No channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels (which become blocked with weed and silt). (b) Poor landuse and soil management will lead to increased runoff and surface water flooding.	KEY assumptions and limitations Possible future responses: (a) Reduced channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: Same as Option 1.	**KEY assumptions and limitations** Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) Individual flood defences constructed around properties to maintain standard of protection. (b) Channel modification to increase conveyance. (c) Improvements to road and sewer drainage system in problematic areas. Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with more investment to ensure that current risk of flooding is reduced in the land use change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. Impact on other Policy Units: A reduction in flood flows from Policy Unit 1 is unlikely to have a significant impact on flooding in downstream Policy Units (8 and 9).
Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 2000 people are currently at risk from flooding. Due to the steep nature of the surrounding topography, flood flows are considered hazardous when they occur.	More than 2000 people	More than 2000 people	No change from baseline	No change from baseline	0	Application in PU1: Less than 2000 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£1,100k	At least 5 times baseline	Greater than £2,200k	£2,200k	£1,100k	£0	Application in PU1: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** O Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** O No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. There is an opportunity to work with Highways Authorities to ensure that major roads are not affected for a significant duration by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 125 non-residential properties are currently at risk from flooding. The A30 and A359 extend through PU1 and are at a low risk of flooding. 15 recorded incidents of surface water flooding.	More than 125 non-residential properties. Essential infrastructure would be at risk.	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	Application in PU1: Less than 125 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** O Annual average damage of agricultural land caused by flooding. O Length of flooding of agricultural land. **Targets** O No increase in the annual average damage of agricultural land caused by flooding. O Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£150k	At least 5 times baseline	Greater than £300k	£300k	£150k	£0	Application in PU1: Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** O Annual average cost of flood risk management activities (£). **Targets** O No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management.	Reduced expenditure against baseline.	No change.	Initial investment required to upgrade flood management system. Future annual average costs unlikely to change.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	Application in PU1: Significant initial costs.
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 1 is largely rural and watercourses typically have good connectivity with the floodplain. 1 to 2 times per year maintenance is undertaken.	No maintenance will be undertaken.	Reduced maintenance.	No change from baseline.	2 times per year maintenance is undertaken.	Reduced connectivity through keeping floodwater in larger channels. 2 times per year maintenance is undertaken.	Application in PU1: Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	3 scheduled ancient monuments lie within the 1 per cent AEP floodplain.	No change.	No change.	No change.	No change.	No change.	Application in PU1: Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	The southern end of PU1 includes part of the Dorset AONB. There are 12 SSSI sites located in the policy unit and 1 SAC site. The majority of the SSSI sites are in favourable condition. Melbury Park and Halfway House Quarry are unfavourable declining. Melbury Park is located within the 1 per cent AEP floodplain.	No change	No change	No change	No change	No change	Application in PU1: Not applicable.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU1 contains important habitat such as floodplain grazing marsh which is a UK BAP priority habitat. These sites are generally not suffering from flood related factors.	Negative change: A non-strategic reduction in maintenance of the river corridor may impact on BAP habitats.	Same as policy option 1.	No change.	Negative change: Some changes to the river corridor (including removal of important bank vegetation) will affect existing habitats.	Negative change: Major changes to river corridor (including removal of important bank vegetation) will affect existing habitats.	Application in PU1: Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-1	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlighted below in blue.

Policy unit: 1	Upper Yeo					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in large increases in annual average damage to residential and commercial property. Negative impact on agricultural production.	Rapid and non-strategic change in management / may impact on existing ecological system.	No management may result in a slight improvement in landscape character and amenity value.	Savings on maintenance costs. However average annual damages from flooding are likely to be greater than this saving.	No management may result in a slight improvement on existing ecological system.
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	Reduced management may result in a slight improvement on existing ecological system.
Policy Option 3	Some increase in social risks.	Increased economic damages from low baseline.	None identified	No change to existing situation.	No change to existing situation.	No change to existing situation.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management system. Unlikely to be economic when compared to average damages.	Increased flood risk management likely to impact on existing environmental designations in the area.	No change from baseline.	No change to average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Large investment required to upgrade flood management system.. Significant ongoing costs to ensure no flood risk in a 1 per cent AEP flood event. Protection of large areas is unlikely to be economically viable.	Increased flood risk management likely to impact on existing environmental designations in the area.	Negligible risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	Unlikely to provide any significant benefit to people and property in communities downstream.	Unlikely to be economically viable when compared to average damages.	None identified.	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property.	None identified.	None identified.

Form B.12.8-1	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	No
If yes, take forward to Strategy study.	

Form B.12.9-1	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of properties with resistance/ resilience methods	
Economic • Average Annual Damages of flooding to property (£) • Annual average damage of flooding to non-residential properties (£)	
Environmental • Water quality testing.	

Form B.12.5-2	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 2	**Yeovil**
Current responses to flood risk within the policy unit?	Policy unit 2 includes the stretch of the River Yeo that extends through Yeovil. Fluvial flooding is relatively limited in this policy unit due to the fact that the majority of Yeovil is situated on a high plateau well above the floodplain. The majority of the flood problems are related to surface water and sewer flooding. Wessex Water's capital programme identifies considerable investment in this policy unit (8 separate schemes, some of which we know have been completed already), reflecting the cluster of sewer problems identified historically. Wessex Water have works proposed to address sewer flooding in many areas in the town. Our current level of investment in fluvial flood risk is low and the risks associated with fluvial flooding are limited.
Standards of service that apply to flood defences within the policy unit?	Not applicable.
What is currently exposed to flooding?	The majority of the flood risk problems are related to surface water and sewer flooding. Historic records show that there have been many cases of sewer flooding in Yeovil. Some industrial areas within Yeovil are at a higher risk of fluvial flooding than the rest of the town.
Who and what are currently most vulnerable to flood damage and losses?	People and property in Yeovil are the main receptors to flood risk, though these are most vulnerable to surface water and sewer flooding. There are no emergency services or medical facilities at risk in the policy unit; however, a water treatment works is located in the River Yeo floodplain and is at risk.
What are the key factors that could drive future flood risk?	Climate change, land-use change and inadequate investment in sewage/ highways drainage maintenance.
What are the possible future levels of flood risk under the main scenarios?	The annual average damage is estimated as £53k to property. It is likely that this estimate significantly underestimates the overall flood risk which has derived from surface water and sewer flooding in recent years. Given the high density of properties in the town, we envisage that it will be possible to direct further investment to respond to increasing risks due to climate change. However unlike some policy units, Yeovil is generally at lower risk of major flooding particularly when compared to Taunton and Bridgwater. In the future the main problems in Yeovil may be related to higher intensity summer storms which overwhelm the local sewers and smaller streams.
What potential responses (or groups of responses) are being considered to manage flood risk?	Possible generic responses for this policy unit include: (a) Maintenance and flood warning - must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. (b) Partnership – we are aware that in some locations sewer flooding is exacerbated by fluvial flooding on small streams and it is essential we work together with Wessex Water and the Local Authority to ensure that effective projects are developed.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment is appropriate, and the risks associated with this are limited. It is essential that flooding is not exacerbated by future development in the town. Sustainable drainage approaches should be adopted to minimise future changes in flood risk.

Form B12.6-2	**Screening of Policy Options against Appraisal Objectives**

This form:

(6) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(7) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(8) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(9) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(10) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 2	**Yeovil**

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance when required. (b) Automated warning systems to alert when water levels are too high. (c) use of the development control process. Flood risk assumptions: (a) Fluvial flood risk is relatively limited in this policy unit and occurs on various small streams. The majority of the problems are related to surface water and sewer flooding. (b) In some locations sewer flooding is exacerbated by fluvial flooding on small streams. (c) Over ninety-two surface water incidents have been recorded in Yeovil. The majority of which were caused by inadequate capacity or blockage.	KEY assumptions and limitations Possible future responses: (a) No in-channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: (a) Increase in frequency, depth and extent of surface water flooding, due to under capacity of existing channels (which become blocked with silt and debris).	KEY assumptions and limitations Possible future responses: (a) Reduced channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: Same as Option 1.	KEY assumptions and limitations Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) The number of surface water incidents will likely increase due to under capacity of urban drainage systems.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) Individual flood defences constructed around properties to maintain standard of protection. (b) Improvements to road and sewer drainage system in problematic areas. Resultant assumed 2055 to 2100 future flood risk: The above measure will be sufficient to maintain the current standard of protection in a 50 to 100 year time frame. From 2055 timeframe, impact likely to be same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with more investment to ensure that current risk of flooding is reduced in the land use change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. No significant benefit on surface water flooding. Impact for other Policy Units: A reduction in flood flows from Policy Unit 2 is unlikely to have a significant impact on flooding in downstream Policy Units (8 and 9).

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 550 people are currently at risk from flooding. Due to the steep nature of the surrounding topography, flood flows are considered hazardous when they occur.	More than 550 people	More than 550 people	No change from baseline	No change from baseline	0	Application in PU2: Slightly less than 550 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems.	£53k	At least 5 times baseline	Greater than £53k	£130k	£53k	£0	Application in PU2: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** O Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. Rural business is important both socially and economically in the region and should be enhanced where possible.	1 non-residential property is currently at risk from fluvial flooding. 92 recorded incidents of surface water flooding.	More than 1 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	Application in PU2: No change from baseline
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** O Annual average damage of agricultural land caused by flooding. O Length of flooding of agricultural land. **Targets** O No increase in the annual average damage of agricultural land caused by flooding. O Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£11k	At least 5 times baseline	Greater than £25k	£25k	£11k	£0	Application in PU2: Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** O Annual average cost of flood risk management activities (£). **Targets** O No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management.	Reduced expenditure against baseline.	No change.	Initial investment required to upgrade flood management system. Future annual average costs unlikely to change.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	Application in PU2: Significant initial costs.
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 2 is largely urban and watercourses typically have reasonable connectivity with the floodplain. Limited channel maintenance is undertaken.	No maintenance will be undertaken.	Same as policy option 1 in a 2100 future time horizon.	No change from baseline.	No change from baseline. Slight increase in maintenance.	Reduced connectivity through keeping floodwater in larger channels. Significant increase in channel maintenance.	Application in PU2: Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Application in PU2: Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	There is 1 SSSI site (Babylon Hill) located in the policy unit but this is located outside of the 1 per cent AEP floodplain. This site is in favourable condition and is vulnerable to flood related factors.	No change	No change	No change	No change	No change	Application in PU2: Not applicable.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU2 contains important habitat such as lowland dry acid grassland and upland mixed ash woods. These sites are located outside of the 0.1 per cent AEP floodplain and are generally not vulnerable to changes in flood related factors.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Application in PU2: Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-2	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 2	Yeovil					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Some increased risk of injury and/or loss of life due to increased exposure to fast flowing floodwaters.	Significant economic damage to properties.	None identified.	None identified.	Would save some money on channel maintenance.	Limited potential to increase connectivity of the floodplain.
Policy Option 2	As Option 1.	As Option 1.	None identified.	None identified.	As Option 1.	Limited potential to increase connectivity of the floodplain.
Policy Option 3	Some increase in social risks.	Increased economic damages from baseline.	None identified.	No change from existing situation.	No change from existing situation.	None identified.
Policy Option 4	No change from existing situation.	No change from baseline.	None identified.	No increase in risk or serious injury and/or loss of life during future flood events.	Upgrade and on-going maintenance of flood management structures unlikely to exceed annual average damages of flooding in Policy Unit 2.	**Some** potential to increase connectivity of the floodplain. Improvement in ecological interests through use of SUDs in new developments.
Policy Option 5	None identified.	Upgrade and on-going maintenance to reduce current flood risk, may not be feasible when compared with annual average damages. Limited potential to reduce damages resulting from surface water flooding.	None identified.	Slight reduction in serious injury and/or loss of life during future flood events.	A reduction in annual average damages from the baseline.	Same as Option 4.
Policy Option 6	None identified.	None identified.	None identified.	Slight reduction in serious injury and/or loss of life during future flood events.	A slight reduction in annual average damages from the baseline.	Not applicable.

Form B.12.8-2	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	Yes (main focus sewer flood risks)
If yes, take forward to Strategy study.	

Form B.12.9-2	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of people exposed to deep and/or fast flowing floodwaters during a 0.1 per cent AEP flood	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties	
Environmental • Water quality testing.	

Form B.12.5-3	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 3	**Upper Parrett**
Current responses to flood risk within the policy unit?	Policy unit 3 includes the River Parrett upstream of Martock. The policy unit includes Crewkerne, Merriott, Chiselborough and South Petherton. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Some communities (Crewkerne, Martock, South Petherton) do have localised problems, exacerbated (particularly in Crewkerne) by small culverted watercourses which are prone to blockage or undersized. South Petherton flooding has also been exacerbated by farming practices, contributing to localised flooding well outside of the fluvial floodplain area. Sewer flooding has been recorded specifically in Crewkerne. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. General routine maintenance in undertaken as required and households that are currently at risk from flooding are included on our flood warning system.
Standards of service that apply to flood defences within the policy unit?	The South Perrott Detention Dam is designed to provide protection for a 1 per cent AEP river flood.
What is currently exposed to flooding?	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally.
Who and what are currently most vulnerable to flood damage and losses?	People and property are the main receptors to flood risk in policy unit 3. No key infrastructure is at risk from fluvial flooding in this policy unit.
What are the key factors that could drive future flood risk?	Climate change, land-use change and inadequate investment in sewage/ highways drainage maintenance. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.
What are the possible future levels of flood risk under the main scenarios?	With current flood defences in place, the annual average damage is estimated as £116k to property and £75k to agricultural land. This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. Many of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme.
What potential responses (or groups of responses) are being considered to manage flood risk?	Wessex Water have works proposed to address local flooding problems in Crewkerne. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The disperse nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment is appropriate, and the risks associated with this are limited.

Form B.12.6-3	**Screening of Policy Options against Appraisal Objectives**

This form:

(11) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(12) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(13) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(14) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(15) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 3	**Upper Parrett**

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance (b) Automated warning systems to alert when water levels are too high. (c) use of the development control process. Flood risk assumptions: (a) Fluvial flood risk is relatively limited in this policy unit and is mostly limited to small communities adjacent to the River Parrett, including Crewkerne, Merriott, Chiselborough and South Petherton. (b) Some communities (particularly Crewkerne) have localised flooding problems caused by the blockage of small culverted watercourses. (c) Flooding has also been exacerbated by farming practices, particularly around South Petherton and has contributed to localised flooding outside of the fluvial floodplain.	KEY assumptions and limitations Possible future responses: (a) No in channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels (which become blocked with weed and silt). (b) Poor landuse and soil management will lead to increased runoff and surface water flooding.	KEY assumptions and limitations Possible future responses: (a) Reduced in channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: Similar to Option 1 though slightly reduced impact.	**KEY assumptions and limitations** Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) Slight increase in the frequency of flooding caused by the blockage of small culverted watercourses. (c) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) Individual flood defences constructed around properties to maintain standard of protection. (b) Channel modification to increase conveyance. (c) Improvements to road and sewer drainage system in problematic areas. (d) Improvements to farming soil management to reduce the rate of runoff from agricultural land. Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with more investment to ensure that current risk of flooding is reduced in the land use change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. It is unlikely that flood storage can be applied in this policy unit more generally because the economic benefit would be insufficient. Impact for other Policy Units: A reduction in flood flows from Policy Unit 3 is unlikely to have a significant impact on flooding in downstream Policy Units (8 and 9).

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	There are no people at risk from flooding during a 0.1 per cent AEP flood event.	Increase from baseline.	Slight increase from baseline.	No change from baseline	No change from baseline	No change from baseline	Application in PU3: No change from baseline
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£116k	At least 5 times baseline	Greater than £235k	£235k	£116k	£0	Application in PU3: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** o Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. The A303 extends through the policy unit. There is an opportunity to work with Highways Authority to ensure that the road is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 13 non-residential properties are currently at risk from flooding. The A303 extends through PU3 and is at a low risk of flooding. 62 recorded incidents of surface water flooding.	More than 13 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	<u>Application in PU3:</u> Less than 13 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** o Annual average damage of agricultural land caused by flooding. o Length of flooding of agricultural land. **Targets** o No increase in the annual average damage of agricultural land caused by flooding. o Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£75k	At least 5 times baseline	Greater than £150k	£150k	£75k	£0	<u>Application in PU3:</u> Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** o Annual average cost of flood risk management activities (£). **Targets** o No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management.	Reduced expenditure on flood risk management.	No change.	Initial investment required to upgrade flood management system. Future annual average costs unlikely to change.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	<u>Application in PU3:</u> Significant initial costs.
<u>Environmental objectives</u>	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 3 is largely rural and watercourses typically have good connectivity with the floodplain. Limited channel maintenance is undertaken.	No maintenance will be undertaken.	Reduced maintenance	No change from baseline.	Slight increase in maintenance.	Reduced connectivity through keeping floodwater in larger channels. Significant increase in channel maintenance.	Application in PU3: Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Application in PU3: Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	The southern end of PU3 includes part of the Dorset AONB. There are 7 SSSI sites located in the policy unit. There is 1 SSSI site (Grove Farm) located within the 1 per cent AEP floodplain. This site is in favourable condition and is not vulnerable to flood related factors.	No change	No change	No change	No change	No change	Application in PU3: Not applicable.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU1 contains important habitat such as floodplain grazing marsh which is a UK BAP priority habitat. These habitats are vulnerable to changes in flood regime.	Negative change: A non-strategic reduction in maintenance of the river corridor may impact on BAP habitats.	Same as policy option 1.	No change.	Negative change: Some changes to the river corridor (including removal of important bank vegetation) will affect existing habitats.	Negative change: Major changes to river corridor (including removal of important bank vegetation) will affect existing habitats.	Application in PU1: Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-3	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 3	Upper Parrett					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in large increases in annual average damage to residential and commercial property. Negative impact on agricultural production.	Rapid and non-strategic change in management / may impact on existing ecological system.	No management may result in a slight improvement in landscape character and amenity value.	Savings on maintenance costs. However average annual damages from flooding are likely to be greater than this saving.	No management may result in a slight improvement on existing ecological system.
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	Reduced management may result in a slight improvement on existing ecological system.
Policy Option 3	Some increase in social risks.	Increase in economic damages from low baseline	None identified	No change from baseline.	No change from baseline.	No change from baseline.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management system. Unlikely to be economic when compared to average annual damages.	Increased flood risk management likely to impact on existing environmental designations in the area.	No change from baseline.	No change to average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure no flood risk in a 1 per cent AEP flood event. Protection of large areas is unlikely to be economically viable.	Increased flood risk management likely to impact on existing environmental designations in the area.	Negligible risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	Unlikely to provide any significant benefit to people and property in communities downstream.	Unlikely to be economically viable when compared to average damages.	None identified.	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property.	None identified.	None identified.

Form B.12.8-3	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	No
If yes, take forward to Strategy study.	

Form B.12.9-3	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of properties with resistance/ resilience methods	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties. • Average annual damage of agricultural land caused by flooding (£) • Annual average cost of flood risk management (£)	
Environmental • Water quality testing	

Form B.12.5-4	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 4	**Upper Isle**
Current responses to flood risk within the policy unit?	Policy unit 4 includes the River Isle upstream of the Somerset Levels and Moors. The policy unit includes Ilminster, northern parts of Chard, and other smaller communities. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. There are a number of isolated flooding problems specifically in Donyatt, Sea, Ilton and Ilminster. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. General routine maintenance in undertaken as required and households that are currently at risk from flooding are included on our flood warning system.
Standards of service that apply to flood defences within the policy unit?	The flood defences in this policy unit provide protection for an event greater than 1 per cent AEP flood. The Isle Brewers embankments were built in 1982 and are designed to provide protection for an 1 per cent AEP flood event.
What is currently exposed to flooding?	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Sewer flooding has been recorded specifically in Ilminster and Chard. Some isolated problems exist elsewhere.
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 4 are people and property, particularly those within Donyatt, Sea, Ilton and Ilminster. No key infrastructure is at risk from fluvial flooding in this policy unit.
What are the key factors that could drive future flood risk?	Climate change, land-use change and inadequate investment in sewage/ highways drainage maintenance.
What are the possible future levels of flood risk under the main scenarios?	With current flood defences in place, the annual average damage is estimated as £231k to property and £55k to agricultural land.
What potential responses (or groups of responses) are being considered to manage flood risk?	This maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. Some of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme which specifically focuses on Chard and Ilminster.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Form B.12.6-4	**Screening of Policy Options against Appraisal Objectives**

This form:

(16) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(17) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(18) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(19) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(20) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 4	**Upper Isle**

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance (b) Automated warning systems to alert when water levels are too high. (c) Use of the development control process. Flood risk assumptions: (a) Fluvial flood risk is relatively limited in this policy unit and is mostly limited to small communities adjacent to the River Isle, including Ilminster and Chard. (b) Surface water flooding is also a problem and there have been a number of isolated incidences in Donyatt, Sea, Ilton and Ilminster. (c) Sewer flooding has also been recorded specifically in Ilminster and Chard.	KEY assumptions and limitations Possible future responses: (a) No in channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels (which become blocked with weed and silt). (b) Poor landuse and soil management will lead to increased runoff and surface water flooding.	KEY assumptions and limitations Possible future responses: (a) Reduce in channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: Similar to Option 1 though slightly reduced impact.	**KEY assumptions and limitations** Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) Slight increase in the frequency of flooding caused by the blockage of small culverted watercourses. (c) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) Individual flood defences constructed around properties to maintain standard of protection. (b) Channel modification to increase conveyance. (c) Improvements to road and sewer drainage system in problematic areas. (d) Improvements to farming soil management to reduce the rate of runoff from agricultural land. Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with more investment to ensure that current risk of flooding is reduced in the land use change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. It is unlikely that flood storage can be applied in this policy unit more generally because the economic benefit would be insufficient. Impact for other Policy Units: A reduction in flood flows from Policy Unit 4 is unlikely to have a significant impact on flooding in downstream Policy Units (8 and 9).

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 600 people are currently at risk from flooding. Due to the steep nature of the surrounding topography, flood flows are considered hazardous when they occur.	More than 600 people	More than 600 people	No change from baseline	No change from baseline	0	Application in PU4: Less than 600 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£230k	At least 5 times baseline	Greater than £535k	£535k	£230k	£0	Application in PU4: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** o Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. The A303 extends through the policy unit. There is an opportunity to work with Highways Authority to ensure that the road is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 33 non-residential properties are currently at risk from flooding. The A303 extend through the policy unit and is at a low risk of flooding. 56 recorded incidents of surface water flooding.	More than 33 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	Application in PU4: Less than 33 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** o Annual average damage of agricultural land caused by flooding. o Length of flooding of agricultural land. **Targets** o No increase in the annual average damage of agricultural land caused by flooding. o Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£55k	At least 5 times baseline	Greater than £120k	£120k	£55k	£0	Application in PU4: Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** o Annual average cost of flood risk management activities (£). **Targets** o No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management.	Reduced expenditure against baseline.	No change.	Initial investment required to upgrade flood management system. Future annual average costs unlikely to change.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	Application in PU4: Significant initial costs.
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 4 is largely rural and watercourses typically have good connectivity with the floodplain. Limited channel maintenance is undertaken.	No maintenance will be undertaken.	Reduced maintenance.	No change from baseline.	Slight increase in maintenance.	Reduced connectivity through keeping floodwater in larger channels. Significant increase in channel maintenance.	Application in PU4: Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Application in PU4: Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	The south-western end of PU4 includes part of the Blackdown Hills AONB. There are 6 SSSI sites located in the policy unit. The majority of the SSSI sites are in favourable or unfavourable recovering condition. These sites are generally not suffering from flood related factors.	No change	No change	No change	No change	No change	Application in PU4: Not applicable.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU4 contains important habitat such as reedbed (near Chard) and floodplain grazing marsh, which is a UK BAP priority habitat. These habitats are vulnerable to changes in flood regime.	Negative change: A non-strategic reduction in maintenance of the river corridor may impact on BAP habitats.	Same as policy option 1.	No change.	Negative change: Some changes to the river corridor (including removal of important bank vegetation) will affect existing habitats.	Negative change: Major changes to river corridor (including removal of important bank vegetation) will affect existing habitats.	Application in PU4: Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-4	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 4	Upper Isle					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in large increases in annual average damage to residential and commercial property. Negative impact on agricultural production.	Rapid and non-strategic change in management / may impact on existing ecological system.	No management may result in a slight improvement in landscape character and amenity value.	Savings on maintenance costs. However average annual damages from flooding are likely to be greater than this saving.	No management may result in a slight improvement on existing ecological system.
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	Reduced management may result in a slight improvement on existing ecological system.
Policy Option 3	Some increase in social risks.	Increased economic damages from low baseline.	None identified	No change from baseline.	No change from baseline.	No change from baseline.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management systems.. Unlikely to be economic when compared to average damages.	Increased flood risk management likely to impact on existing environmental designations in the area.	No change from baseline.	No change to average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Large investment required to upgrade flood management systems. Significant ongoing costs to ensure no flood risk in a 1 per cent AEP flood event. Protection of large areas is unlikely to be economically viable.	Increased flood risk management likely to impact on existing environmental designations in the area.	Negligible risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	Unlikely to provide any significant benefit to people and property in communities downstream.	Unlikely to be economically viable when compared to average damages.	None identified.	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property.	None identified.	None identified.

Form B.12.8-4	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	No
If yes, take forward to Strategy study.	

Form B.12.9-4	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of properties with resistance/ resilience methods	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties. • Average annual damage of agricultural land caused by flooding (£). • Annual average cost of flood risk management (£).	
Environmental • Water quality testing.	

Form B.12.5-5	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 5	**Upper Cary**
Current responses to flood risk within the policy unit?	Policy Unit 5 includes the River Cary upstream of Henley. The policy unit is typified by disperse communities (such as Somerton, Charlton Adam, Charlton Mackrell, Keinton Mandeville, and parts of Castle Cary). Fluvial flooding to property is relatively limited in this policy unit. This reflects the relatively small watercourses which dominate the area. Flooding problems are generally isolated, although the exact mechanism of flooding is often poorly understood, and is probably a combination of surface water, fluvial and sewer problems. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. General routine maintenance in undertaken as required and households that are currently at risk from flooding are included on our flood warning system. Many of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme.
Standards of service that apply to flood defences within the policy unit?	Not applicable.
What is currently exposed to flooding?	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Sewer flooding has been recorded specifically in Somerton.
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 5 are people and property. No key infrastructure is at risk from fluvial flooding in this policy unit.
What are the key factors that could drive future flood risk?	Climate change, land-use change and inadequate investment in sewage/ highways drainage maintenance.
What are the possible future levels of flood risk under the main scenarios?	With current flood defences in place, the annual average damage is estimated as £61k to property and £31k to agricultural land. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. However the soils and the topography in this area are less sensitive than in other policy units (specifically, the Upper Parrett, Upper Isle and the Upper Tone). At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The disperse nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas.
What potential responses (or groups of responses) are being considered to manage flood risk?	Maintenance and flood warning must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff. However the soils and the topography in this area are less sensitive than in other policy units (specifically, the Upper Parrett, Upper Isle and the Upper Tone).
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Form B.12.6-5	**Screening of Policy Options against Appraisal Objectives**

This form:

(21) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(22) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(23) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(24) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(25) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 5	**Upper Cary**

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance (b) Automated warning systems to alert when water levels are too high. (c) Use of the development control process. Flood risk assumptions: (a) Fluvial flood risk is relatively limited in this policy unit, which reflects the relatively small watercourses which dominate the area. Flooding tends to be isolated, and generally results from combination of fluvial, surface water and sewer problems. (b) Sewer flooding has also been recorded specifically in Somerton.	KEY assumptions and limitations Possible future responses: (a) No in channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels (which become blocked with debris and silt). (b) Poor landuse and soil management will lead to increased runoff and surface water flooding.	KEY assumptions and limitations Possible future responses: (a) Reduce in channel maintenance. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: Similar to Option 1 though slightly reduced impact.	**KEY assumptions and limitations** Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) Slight increase in the frequency of flooding caused by the blockage of small culverted watercourses. (c) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) Individual flood defences constructed around properties to maintain standard of protection. (b) Channel modification to increase conveyance. (c) Improvements to road and sewer drainage system in problematic areas. (d) Improvements to farming soil management to reduce the rate of runoff from agricultural land. Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with more investment to ensure that current risk of flooding is reduced in the land use change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. It is unlikely that flood storage can be applied in this policy unit more generally because the economic benefit would be insufficient. Impact for other Policy Units: A reduction in flood flows from Policy Unit 5 is unlikely to have a significant impact on flooding in downstream Policy Units (8 and 9).

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 340 people are currently at risk from flooding.	More than 340 people	More than 340 people	No change from baseline	No change from baseline	0	Application in PU5: Less than 340 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£61k	At least 5 times baseline	Greater than £125k	£125k	£61k	£0	Application in PU5: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** o Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. A major national railway line extends through the policy unit. There is an opportunity to work with National Rail to ensure that the railway is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 5 non-residential properties currently at risk from flooding. A major railway line is located in this policy unit and is at low risk of flooding. 9 recorded incidents of surface water flooding.	More than 5 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	Application in PU5: Less than 5 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** o Annual average damage of agricultural land caused by flooding. o Length of flooding of agricultural land. **Targets** o No increase in the annual average damage of agricultural land caused by flooding. o Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£31k	At least 5 times baseline	Greater than £65k	£65k	£31k	£0	Application in PU5: Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** o Annual average cost of flood risk management activities (£). **Targets** o No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management.	Reduced expenditure against baseline.	No change.	Initial investment required to upgrade flood management system. Future annual average costs unlikely to change.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	Application in PU5: Significant initial costs.
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 5 is largely rural and watercourses typically have good connectivity with the floodplain. Infrequent in-channel maintenance.	No maintenance will be undertaken.	Reduced maintenance.	No change from baseline.	Slight increase in frequency of in-channel maintenance.	Reduced connectivity through keeping floodwater in larger channels. Increase in frequency of in-channel maintenance.	Application in PU5: Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	2 scheduled ancient monuments lie within the 1 per cent AEP floodplain.	No change.	No change.	No change.	No change.	No change.	Application in PU5: Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	There are 9 SSSI sites located in the policy unit. The majority of the SSSI sites are in favourable condition. Babcary Meadows is located within the 1 per cent AEP floodplain and is currently in favourable condition.	No change	No change	No change	No change	No change	Application in PU5: Not applicable.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU5 contains important habitat such as floodplain grazing marsh which is a UK BAP priority habitat. These habitats are vulnerable to changes in flood regime.	Negative change: A non-strategic reduction in maintenance of the river corridor may impact on BAP habitats.	Same as policy option 1.	No change.	Negative change: Some changes to the river corridor (including removal of important bank vegetation) will affect existing habitats.	Negative change: Major changes to river corridor (including removal of important bank vegetation) will affect existing habitats.	Application in PU5: Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-5	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 5	Upper Cary					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in large increases in annual average damage to residential and commercial property. Negative impact on agricultural production.	Rapid and non-strategic change in management / may impact on existing ecological system.	No management may result in a slight improvement in landscape character and amenity value.	Savings on maintenance costs. However average annual damages from flooding are likely to be greater than this saving.	No management may result in a slight improvement on existing ecological system.
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	Reduced management may result in a slight improvement on existing ecological system.
Policy Option 3	Some increase in social risks.	Increased economic damages from low baseline.	None identified.	No change from baseline.	No change from baseline.	No change from baseline.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management system. Unlikely to be economic when compared to average damages.	Increased flood risk management likely to impact on existing environmental designations in the area.	No change from baseline.	No change to average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure no flood risk in a 1 per cent AEP flood event. Protection of large areas is unlikely to be economically viable.	Increased flood risk management likely to impact on existing environmental designations in the area.	Negligible risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	Unlikely to provide any significant benefit to people and property in communities downstream.	Unlikely to be economically viable when compared to average damages.	Attenuation ponds may impact on the existing ecological system and priority habitat.	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property.	None identified.	None identified.

Form B.12.8-5	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	No
If yes, take forward to Strategy study.	

Form B.12.9-5	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of properties with resistance/ resilience methods	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties.	
Environmental • Water quality testing	

Form B.12.5-6	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 6	**Upper Tone**
Current responses to flood risk within the policy unit?	Policy Unit 6 includes the River Tone catchment outside of Taunton. The policy unit includes the Town of Wellington, and is typified by disperse villages and communities (such as Wiveliscombe, Milverton, Bishops Lydeard and Kingston St Mary). Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Some villages (such as Hillfarrance) situated on the lower part of the catchment have suffered fluvial flooding in the past, although work has been undertaken to address this particular risk. Our current level of investment in this area is low, and is focussed in areas where we have undertaken works. General routine maintenance in undertaken as required and households that are currently at risk from flooding are included on our flood warning system. Many of the risks in the catchment relate to sewer problems, and this is reflected in Wessex Water's capital programme.
Standards of service that apply to flood defences within the policy unit?	The Hillfarrance flood defence scheme was constructed in 2003 and provides protection to local properties for an event greater than 1 per cent AEP flood.
What is currently exposed to flooding?	Risks in this policy unit have historically been dominated by local surface water problems, exacerbated by some farming practices which have increased field runoff locally. Sewer flooding has been recorded specifically in Wellington and Wiveliscombe. Some isolated problems exist elsewhere
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 6 are people and property. There are no emergency services or medical facilities at risk in the policy unit; however, two water treatment works are located within the floodplain and are at risk.
What are the key factors that could drive future flood risk?	Climate change (increasing flows and rainfall runoff) and land use change.
What are the possible future levels of flood risk under the main scenarios?	With current flood defences in place, the annual average damage is estimated as £450k to property and £114k to agricultural land. At the present time we cannot generally justify increasing actions to address climate change or reduce flood risks further. The disperse nature of the problems makes such investment unlikely to be economic. However it is possible that there may be some opportunities to take further action in particular areas.
What potential responses (or groups of responses) are being considered to manage flood risk?	Maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment is appropriate, and the risks associated with this are limited. We are aware that in some locations sewer flooding is exacerbated by fluvial flooding and it is essential we work together with Wessex Water to ensure that effective projects are developed.

Form B.12.6-6 Screening of Policy Options against Appraisal Objectives

This form:

(26) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(27) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(28) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(29) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(30) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 6 Upper Tone

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance (b) Automated warning systems to alert when water levels are too high. (c) Use of the development control process. (d) Local flood defences schemes. (e) Local flood storage/ attenuation schemes. Flood risk assumptions: (a) Risks in PU6 have historically been dominated by local surface water problems that have been exacerbated by some farming practices, causing localised increases in field runoff. (b) Fluvial flood risk is relatively limited in this policy unit. Some villages (such as Hillfarrance) situated in the lower part of the catchment have suffered fluvial flooding in the past, though works have since been undertaken to address this particular risk. (c) Sewer flooding has been recorded specifically in Wellington and Wiveliscombe and some isolated problems exist elsewhere in the catchment.	KEY assumptions and limitations Possible future responses: (a) No in channel maintenance. (b) No flood warning. (c) Use of the development control process retained (d) No investment in flood defence schemes. (e) No investment in flood storage/ attenuation schemes. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels. (b) Poor landuse and soil management will lead to increased runoff and surface water flooding.	KEY assumptions and limitations Possible future responses: (a) Reduced in channel maintenance. (b) No flood warning. (c) Use of the development control process retained (d) Reduced investment in local flood defence schemes and attenuation options. Resultant assumed 2055 to 2100 future flood risk: Similar to Option 1 though slightly reduced impact.	**KEY assumptions and limitations** Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) Slight increase in the frequency of flooding caused by the blockage of small culverted watercourses. (c) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) More investment in individual flood defences constructed around properties to maintain standard of protection. (b) Channel modification to increase conveyance. (c) Improvements to road and sewer drainage system in problematic areas. (d) Improvements to farming soil management to reduce the rate of runoff from agricultural land. (e) Flood storage schemes may become cost effective to provide solutions for new development. Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with greater investment to ensure that current risk of flooding is reduced in the land use change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing or new online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. It is unlikely that flood storage can be applied in this policy unit more generally because the economic benefit would be insufficient. Impact for other Policy Units: A reduction in flood flows from Policy Unit 6 is unlikely to have any significant impact on flooding in downstream Policy Units (8 and 9).

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 800 people are currently at risk from flooding. Due to the steep nature of the surrounding topography, flood flows are considered hazardous when they occur.	More than 800 people	More than 800 people	No change from baseline	No change from baseline	0	Application in PU6: Less than 800 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£450k	At least 5 times baseline	Greater than £900k	£900k	£450k	£0	Application in PU6: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** o Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. A major national railway line extends through the policy unit. There is an opportunity to work with National Rail to ensure that the railway is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 25 non-residential properties are currently at risk from flooding. A major railway line is located in this policy unit and is at low risk of flooding. 134 recorded incidents of surface water flooding.	More than 25 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	<u>Application in PU6:</u> Less than 25 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** o Annual average damage of agricultural land caused by flooding. o Length of flooding of agricultural land. **Targets** o No increase in the annual average damage of agricultural land caused by flooding. o Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£114k	At least 5 times baseline	Greater than £200k	£200k	£114k	£0	<u>Application in PU6:</u> Less than baseline

Reduce the cost of flood risk management in the CFMP area.	**Indicators** O Annual average cost of flood risk management activities (£). **Targets** O No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management.	Reduced expenditure against baseline.	No change.	No change.	Further investment required to upgrade flood management system. Ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	Application in PU6: Significant initial costs.
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 6 is largely rural and watercourses typically have good connectivity with the floodplain. Infrequent in-channel maintenance is undertaken.	No maintenance will be undertaken.	Reduced maintenance.	No change from baseline.	No change from baseline. Slight increase in frequency of maintenance undertaken.	Reduced connectivity through keeping floodwater in larger channels. Significant increase in in-channel maintenance works.	Application in PU6: Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	1 scheduled ancient monument (the Bradford Bridge) lies within the 1 per cent AEP floodplain. This feature is located in the floodplain adjacent to the existing River Tone channel.	No change.	No change.	No change.	No change.	No change.	Application in PU6: Not applicable.

Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	The southern end of PU16 includes part of the Blackdown Hills AONB. There are 9 SSSI sites located in the policy unit and 3 SAC sites. Three sites are in declining in condition but all are located outside of the 1 per cent AEP floodplain and are not effected by flood risk issues..	No change	No change	No change	No change	No change	Application in PU6: Not applicable.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU6 contains important habitat such as important pasture, meadow land and floodplain grazing marsh which is a UK BAP priority habitat. These habitats, particularly the floodplain grazing marsh is vulnerable to changes in flood regime.	Negative change: A non-strategic reduction in maintenance of the river corridor may impact on BAP habitats.	Same as policy option 1.	No change.	Negative change: Some changes to the river corridor (including removal of important bank vegetation) will affect existing habitats.	Negative change: Major changes to river corridor (including removal of important bank vegetation) will affect existing habitats.	Application in PU6: Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-6	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 6	Upper Tone					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in large increases in annual average damage to residential and commercial property. Negative impact on agricultural production.	Rapid and non-strategic change in management / may impact on existing ecological system.	No management may result in a slight improvement in landscape character and amenity value.	Savings on maintenance costs. However average annual damages from flooding are likely to be greater than this saving.	No management may result in a slight improvement on existing ecological system.
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	Reduced management may result in a slight improvement on existing ecological system.
Policy Option 3	Some increase in social risks.	Increased economic damages from low baseline.	None identified	No change from baseline.	No change from baseline.	No change from baseline.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management system. Unlikely to be economic when compared to average damages.	Increased flood risk management likely to impact on existing environmental designations in the area.	No change from baseline.	No change to average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure no flood risk in a 1 per cent AEP flood event. Protection of large areas is unlikely to be economically viable.	Increased flood risk management likely to impact on existing environmental designations in the area.	Negligible risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	Unlikely to provide any significant benefit to people and property in communities downstream.	Unlikely to be economically viable when compared to average damages.	Attenuation ponds may impact on the existing ecological system and priority habitat.	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property.	None identified.	Attenuation ponds may impact on the existing ecological system and priority habitat.

Form B.12.8-6	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	No
If yes, take forward to Strategy study.	

Form B.12.9-6	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of properties with resistance/ resilience methods	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties. • Average annual damage of agricultural land caused by flooding (£). • Annual average cost of flood risk management (£).	
Environmental • Water quality testing.	

Form B.12.5-7	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 7	**Taunton**
Current responses to flood risk within the policy unit?	Policy unit 7 includes Taunton and the immediate surrounding urban area, west of the M5 motorway. The area is densely populated. The River Tone flows through the River Tone where it is joined by a number of smaller tributaries including the Hales Water, Back stream, Galmington Stream, Sherford stream and other smaller watercourses Historically flooding in Taunton has been dominated by the River Tone. Within the 20th century the 1960 flood event was the most severe reported to have flooded approaching 500 properties in the town. In response to this flooding the Taunton Flood Defence scheme was constructed in the 1960s and the scheme was further upgraded in the 1990s. Wessex Water have confirmed that the surface water sewer system in Taunton is relatively efficient and been subject to considerable investment in the past. Little further sewerage capital investment is envisaged in Taunton. Work is presently ongoing to address one of the main tributaries (the Halse Water) which flows through Norton Fitzwarren (north west of Taunton Town centre).
Standards of service that apply to flood defences within the policy unit?	Detailed studies have shown that the flood defences in Taunton provide about a 1% AEP standard of protection, although there are some slightly low spots in the defences. Since the scheme was constructed in the 1960s there have been no major flood events in Taunton although the defences were tested in October 2000. Significant risks to existing properties adjacent to the tributaries in Taunton remain. The scale of the risk is uncertain at the CFMP level, but is significant.
What is currently exposed to flooding?	Since the Taunton Flood Defence scheme was upgraded in the 1990s, most of the remaining risks in Taunton are related to tributary flooding. Areas such as Norton Fitzwarren, Bathpool and areas around Tangier are at risk. The level of flood risk to areas affected by tributary flooding is uncertain although significant.
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 7 are people and property, particularly those within Norton Fitzwarren, Bathpool and areas around Tangier in Taunton. Key infrastructure at risk from fluvial flooding in this policy unit include parts of the Bristol to Exeter main Railway line at Norton Fitzwarren.
What are the key factors that could drive future flood risk?	Climate change and land-use change as well as inadequate investment in sewage/ highways drainage maintenance. It is essential that flooding is not exacerbated by future development in the town. Sustainable drainage approaches should be adopted to minimise future changes in flood risk.
What are the possible future levels of flood risk under the main scenarios?	The current average annual damage to property in the policy unit with flood defences in place on the River Tone is £1185k. Tributary flooding is significantly more difficult to address and the risk is spread throughout the policy unit in many areas. Flood detention is being used to address flooding in Norton Fitzwarren (by constructing a flood detention dam within policy unit 6 in connection with development in Norton Fitzwarren).
What potential responses (or groups of responses) are being considered to manage flood risk?	Taunton is subject to major regeneration. Opportunities should (and are) being taken to address the deficiencies in the River Tone defences in connection with the redevelopment of the Town. We value the partnership with Taunton Deane Borough Council where we are working together to maximise this potential.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Economically it may be difficult to justify future schemes to address risks on the tributaries because of the disperse nature of flooding and the technical challenges. However there is sufficient information to justify more investigation. Recent work has shown that the River Tone defences do not provide the standard of service to which they were originally designed. However we

	believe the standard is still appropriate although this should be kept under review at regular intervals as further data becomes available.

Form B.12.6-7	Screening of Policy Options against Appraisal Objectives

This form:

(31) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(32) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(33) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(34) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(35) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 7	Taunton

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) In-channel maintenance (b) Automated warning systems to alert when water levels are too high. (c) Use of the development control process. (d) Local flood defences schemes. (e) Local flood storage/ attenuation schemes. Flood risk assumptions: (a) Risks in PU7 have historically been dominated by flooding from the River Tone and its tributaries. Areas particularly vulnerable include Norton Fitzwarren, Bathpool and areas around Tangier in Taunton. (b) Fifty five surface water flood events have been recorded in PU7, the majority of which resulted from blockage of gullies or culverts. Wessex Water has invested significantly in the sewer system in Taunton in recent years and it is therefore considered to be efficient.	KEY assumptions and limitations Possible future responses: (a) No in channel maintenance. (b) No flood warning. (c) Use of the development control process retained (d) No investment in flood defence schemes. (e) No investment in flood storage/ attenuation schemes. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels. (b) Increase in the frequency of flooding caused by the blockage of small culverted watercourses.	KEY assumptions and limitations Possible future responses: (a) Reduced in channel maintenance. (b) No flood warning. (c) Use of the development control process retained (d) Reduced investment in local flood defence schemes and attenuation options. Resultant assumed 2055 to 2100 future flood risk: Similar to Option 1 though slightly reduced impact.	**KEY assumptions and limitations** Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase slightly. (b) Slight increase in the frequency of flooding caused by the blockage of small culverted watercourses. (c) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) More investment in flood defences constructed around properties to maintain standard of protection. (b) Channel modification to increase conveyance. (c) Improvements to road and sewer drainage system in problematic areas. (d) Improvements to farming soil management to reduce the rate of runoff from agricultural land. (e) Flood storage schemes may become cost effective to provide solutions for new development. Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: Same as Option 4, with greater investment to ensure that current risk of flooding is reduced in the climate change future scenario. Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Use of existing or new online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. Resultant assumed 2055 to 2100 future flood risk: Use of on-line ponds for flood storage will have a small localised flood risk management benefit. Impact for other Policy Units: A reduction in flood flows from Policy Unit 7 is unlikely to have any significant impact on flooding in downstream Policy Units (8 and 9).

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 9750 people are currently at risk from flooding in PU7.	More than 9750 people	More than 9750 people	No change from baseline	No change from baseline	Less than baseline	Application in PU7: Less than 9750 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£1,885k	At least 5 times baseline	Greater than £5,000k	£5,000k	£1,885k	Less than baseline	Application in PU7: Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** o Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o No increase in the Infrastructure (motorway, 'A'roads and major railway lines) flooded during a 1 percent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. A major national railway line extends through the policy unit. There is an opportunity to work with National Rail to ensure that the railway is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 940 non-residential properties are currently at risk from flooding. A major railway line is located in this policy unit and is at high risk of flooding. 55 recorded incidents of surface water flooding.	More than 940 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	Less than baseline	Application in PU7: Less than 940 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** o Annual average damage of agricultural land caused by flooding. o Length of flooding of agricultural land. **Targets** o No increase in the annual average damage of agricultural land caused by flooding. o Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£30k	At least 5 times baseline	Greater than £80k	£80k	£30k	Less than baseline	Application in PU7: Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** o Annual average cost of flood risk management activities (£). **Targets** o No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A moderate proportion of this is spent in this policy unit.	Increased expenditure on flood risk management.	Reduced expenditure against baseline.	No change.	Initial investment required to upgrade flood management system. Future annual average costs unlikely to change.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure there is no flood risk during a 1 per cent AEP flood in the future.	Application in PU7: Significant initial costs.
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	PU 2 is largely urban and watercourses typically have moderate to low connectivity with the floodplain. Moderate amount of channel maintenance is undertaken.	No maintenance will be undertaken.	Reduced maintenance	No change from baseline.	Slight increase in maintenance.	Reduced connectivity through keeping floodwater in larger channels. Significant increase in channel maintenance.	<u>Application in PU7:</u> Potential to improve ecological value through creation of storage ponds. Improved connectivity through creation of online storage ponds.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	1 scheduled ancient monument lies within the 1 per cent AEP floodplain.	No change.	No change.	No change.	No change.	No change.	<u>Application in PU7:</u> Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	There are a number of important LNR and CWS in PU7. These non-statutory designations provide important habitat for a number of protected species along the River Tone, There are non statutory designated sites (SSSI or SAC) located within the policy unit.	Negative: Lake of maintenance may cause excess siltation along the existing tributaries. This will likely have a negative impact on ecological interests and status of the non-statutory designations along the river corridor.	Same as policy option 1 in a 2100 future time horizon.	No change from baseline.	No change from baseline.	Positive change: Slight improvement to baseline, through ecological enhancement works.	<u>Application in PU7:</u> Potential to improve environmentally designated sites through creation of online storage ponds.
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	PU7 contains important habitat such as floodplain grazing marsh which is a UK BAP priority habitat. Floodplain grazing marsh is vulnerable to changes in flood regime.	Negative change: A non-strategic reduction in maintenance of the river corridor may impact on BAP habitats.	Same as policy option 1.	No change.	Negative change: Some changes to the river corridor (including removal of important bank vegetation) will affect existing habitats.	Negative change: Major changes to river corridor (including removal of important bank vegetation) will affect existing habitats.	<u>Application in PU6:</u> Not applicable.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-7	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 7	Taunton					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Significant risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in large increases in annual average damage to residential and commercial property.	Rapid and non-strategic change in management / may impact on existing ecological system.	None identified.	Savings on maintenance costs. However average annual damages from flooding are likely to be greater than this saving.	None identified.
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.
Policy Option 3	Significant increase in social risks from baseline.	Significant increase in economic damages.	No change from baseline.	No change from baseline.	No change from baseline.	No change from baseline.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management system.	Increased flood risk management land changes to river corridor may affect existing habitats.	No change from baseline.	No change from baseline.	No change from baseline.
Policy Option 5	None identified.	Significant investment required to upgrade flood management system. Significant maintenance costs.	Increased flood risk management may impact on existing environmental designations and existing habitats in the area.	Reduced risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Improvement to baseline, through ecological enhancement works.
Policy Option 6	None identified.	Significant initial costs. Unlikely to be economically viable when compared to average annual damages.	None identified.	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property.	None identified.	Potential to improve and add new environmentally designated sites.

Form B.12.8-7	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	Yes
If yes, take forward to Strategy study.	

Form B.12.9-7	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of people exposed to deep and/or fast flowing floodwaters during a 0.1 per cent AEP flood.	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties.	
Environmental • Water quality testing	

Form B.12.5-8	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 8	**Somerset Levels and Moors**
Current responses to flood risk within the policy unit?	Policy unit is the lowland Somerset Levels and Moors area within the Parrett Catchment (strictly the reference to levels does not apply to this part of the Somerset Levels and Moors). The area includes the lower reaches of the River Parrett, River Tone, River Yeo, River Isle, King's Sedgemoor Drain and the Sowy River. Properties are generally disperse throughout the catchment, with villages and small communities often situated on land slightly above moor level or on the embankments which separate the rivers and the moors. These embanked watercourses act as 'high level carriers' taking water from the upper catchment through the low lying moor area. Drainage from the moors is often pumped up back up into the watercourses. Agricultural land is frequently flooded in the winter, with roads flooded disrupting communication across the area. Property flooding occurs because of high flood levels in the moors. However those properties along the top of the high level carriers are also at risk from high levels in the rivers caused by high tides in the Bristol Channel which propagate upstream and can be damaging particularly during periods of high flow combining with high tides. The extensive network of embankments is necessary to retain the current agricultural system and the associated environmental habitats. Modelling has shown that channels are often full (i.e. with water levels near to embankment crest levels) and their remains a risk of breaching of the embankments, although works continue to minimise the risk. The distribution of floodwater between moors can be determined to some extent by the use of sluices and other structures on the rivers. The distribution of floodwater has developed to some extent by historical 'accident' rather than design. When considering the distribution of assets across the policy unit it makes sense to direct water to areas which have limited assets at risk. This does not necessarily happen today. Sewer problems are limited in this policy unit, although Wessex Water continues to address risks where appropriate (they have worked planned for Langport, and Huish Episcopi for example).
Standards of service that apply to flood defences within the policy unit?	The Mulcheney embankments were built in 1992 and are designed to provide protection to Mulcheney from a 1 per cent AEP flood event. The Langport-Cocklemoor Bank was built in 1993 and is designed to provide protection from a 1 per cent AEP flood event.
What is currently exposed to flooding?	Infrastructure across the moors (such as railways and pylons) is reliant on the continued management of the system. Because of problems with safe access and high water levels it is unlikely that railways would be acceptable across the moors without this protection. Our broad scale modelling does not reflect this value, but it is very significant. We have international obligations to maintain and enhance the habitats and species in the Somerset Levels and Moors, and it is within this context that all flood management decisions have to be made
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 8 are international environmental designations and risk to people and property.
What are the key factors that could drive future flood risk?	Climate change will have impacts both in terms of higher river levels (due to higher tide levels in the River Parrett and higher flows) and also more frequent and longer flooding of the moors.
What are the possible future levels of flood risk under the main scenarios?	The current average annual damage is estimated as £631k to properties and £241k to agricultural land.

What potential responses (or groups of responses) are being considered to manage flood risk?	By redistributing flood water (primarily from upstream of Langport to the King's Sedgemoor Drain) the overall damage and disruption from flooding would be reduced. Other redistribution options may also be possible, although modelling has shown that technically not all options are feasible. We are doubtful that all the pumping stations on the Somerset Levels and Moors are required for flood risk management purposes. Many pumping stations are relatively old and in some cases difficult to maintain. It is necessary to decide which ones are necessary particularly in the context of redistributing water. Redistributing floodwater while logical in some areas may be difficult to promote because individual farms will be affected in different ways. From an agricultural perspective some may gain financially but some may also lose. We will need to work with our partners, particularly the Internal Drainage Board, to discuss the way forward.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	The Somerset Levels and Moors system is particularly complex. Technical options have to be considered very carefully to ensure that the system responds as expected. We are aware that challenging centuries of drainage operations may be difficult, and it requires good communication and cooperation between various authorities to take this further. Effective maintenance and upgrading of the Somerset Levels and Moors requires a robust economic, social and environmental case. Whilst our present investment strategy is focused on minimizing risk and is 'plan led', we feel that a more robust strategic plan is required in the future to ensure that the national priority of the area is reflected in national funding priorities. Providing a robust economic case for maintenance works on the Somerset Levels and Moors remains a challenge. We believe it is appropriate to look again at the benefits derived from our work, particularly focussing more on the infrastructure and the environmental benefits, which previous studies have probably underestimated.

Form B.12.6-8 Screening of Policy Options against Appraisal Objectives

This form:

(36) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(37) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(38) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(39) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(40) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 8 Somerset Levels and Moors

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	KEY assumptions and limitations Current responses: (a) Considerable capital and maintenance investment in embankments, pumps, sluices and other infrastructure (b) Automated warning systems to alert when water levels are too high. (c) use of the development control process. Flood risk assumptions: (a) Somerset Levels and Moors act as a large flood storage area, significant damage to agricultural land and dispersed properties	KEY assumptions and limitations Possible future responses: (a) abandon all defences (b) No pumping stations or sluices operated (c) No flood warning Resultant assumed 2055 to 2100 future flood risk: (a) Major increase in flood risk in comparison with baseline. (b) Change from freshwater to saline/brackish habitats (c) Loss of current agricultural production (d) loss and/or isolation of communities	KEY assumptions and limitations Possible future responses: (a) Reduced maintenance of embankments pumps and sluices. (b) No flood warning. (c) Use of the development control process retained Resultant assumed 2055 to 2100 future flood risk: (a) Increasing risk over baseline (b) breach risks increase (with associated risk to life) (c) pumping stations become unreliable	KEY assumptions and limitations Possible future responses: Same as baseline. This is the future baseline given that the current flood management responses are continued. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of fluvial flooding likely to increase.	KEY assumptions and limitations Possible future responses: In addition to baseline; (a) Raised and improved embankments (b) New/upgraded pumping stations Resultant assumed 2055 to 2100 future flood risk: (a) Same as baseline.	KEY assumptions and limitations Possible future responses: (a) Same as Option 4, with further investment to ensure that current risk of flooding is reduced Resultant assumed 2055 to 2100 future flood risk: (a) No properties or roads affected by flooding. In practice this would be difficult to achieve given existing constraints	**KEY assumptions and limitations** Possible future responses: (a) Flood storage in the moors to be directed to areas of lowest potential damage, by use of sluices and other controls. Resultant assumed 2055 to 2100 future flood risk: (a) Reduced flood risk to some areas (particularly communities and built environment) with increase risks to some agricultural land Impact for other Policy Units: No significant impact

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 8600 people are currently at risk from flooding.	The majority of people identified within the baseline would have to abandon properties	More than 8600 people	As baseline in early years increasing in the future	No change from baseline	0	Less than 8600 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£631k	At least 5 times baseline	Greater than £1,400k	£1,400k	£631k	£0	Possibly reduce baseline by 25%

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** O Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O Length of motorway and 'A'road flooded during a 1 percent AEP flood event. **Targets** O No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O No increase in the length of motorway and 'A'road flooded during a 1 per cent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. A major national railway line extends through the policy unit. There is an opportunity to work with National Rail to ensure that the railway is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 150 non-residential properties are currently at risk from flooding.	The majority of properties within the baseline would be abandoned	More than 150	Increase from baseline	No change from baseline	0	Less than 150
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** O Annual average damage of agricultural land caused by flooding. O Length of flooding of agricultural land. **Targets** O No increase in the annual average damage of agricultural land caused by flooding. O Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£240k	Agricultural production as presently undertaken would be lost	Greater than £560k	Greater than £560k	£240k	£0	Impact varies within policy unit. Net change probably neutral when considered against baseline.
Reduce the cost of flood risk management in the CFMP area.	**Indicators** O Annual average cost of flood risk management activities (£). **Targets** O No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A large proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management	Reduced expenditure against baseline	No change from baseline.	Significant investment required in response to climate change	Very large investment required	Significant investment required if policy is to be achieved and works undertaken to address climate change
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	The Somerset Levels and Moors includes embanked channels and soft edged rhynes	No maintenance will be undertaken, with large scale changes in river processes	No change from baseline.	No change from baseline.	No change from baseline.	Probably some increase in channel maintenance	No change from baseline
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.		13 scheduled ancient monuments lie within the 1 per cent AEP floodplain.	Features of cultural heritage may be lost or damaged. Impact on access	No change from baseline.	No change from baseline.	No change from baseline.	No change from baseline	No change from baseline
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	Environmental interests fundamentally rely on good water level management practices. Ongoing works are supporting improvements to environmentally designated sites	Rapid and irreversible change to environmentally designated sites (in breach of European regulations)	Possibly some negative impact due to increased deep and prolonged flooding.	No change from baseline	No change from baseline	No change from baseline	No change from baseline
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	Important wetland habitats and species	Rapid and irreversible change of habitats (in breach of European regulations)	Possibly some negative impact on habitats due to increased deep and prolonged flooding.	No change from baseline	No change from baseline	No change from baseline	No change from baseline
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-8	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 8	Somerset Levels and Moors					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences, eventual loss of communities	No active intervention will result in large increases in annual average damage to residential and commercial property, eventually leading to abandonment in many places	Rapid deterioration of protected habitats	None identified	Savings on maintenance costs will be negligible in comparison with losses	**New habitats would develop**
Policy Option 2	Risk of serious injury or harm caused through deterioration of existing structures and defences.	Increasing economic damage	Some deterioration of protected habitats due to deep and prolonged flooding	None identified	As Option 1	Some habitat change may be considered beneficial
Policy Option 3	Some increase in risks of injury and harm	Would require considerable on-going low investment to continue maintenance and to upgrade structures	None identified	No change to existing situation.	No change to existing situation.	No change to existing situation.
Policy Option 4	No change to existing situation.	Would require investment to enhance system.	No change to existing situation	No change to existing situation.	No change to average annual damages.	Increased flood risk management/ water level management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Very large investment required to upgrade flood management system. Significant ongoing costs Protection of large areas is unlikely to be economically viable.	Uncertain, but the large scale changes in flood risk management infrastructure may impact on habitats	Very low risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management/ water level management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	None identified	Financial implications vary geographically, with some land owners potentially losing out	None identified.	Reduced risk of serious injury. Communities better supported by reducing period of local road flooding	Economic gains over baseline providing option undertaken with other improvements to infrastructure.	Potential to improve distribution and management of water

Form B.12.8-8	Requirements for further policy development and appraisal
Is there a need for further policy development?	Yes
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	Yes
If yes, take forward to Strategy study.	

Form B.12.9-8	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of people exposed to deep and/or fast flowing floodwaters during a 0.1 per cent AEP flood.	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties. • Average annual damage of agricultural land caused by flooding.	
Environmental • Condition of environmentally designated sites. • Habitat/river corridor scores.	

Form B.12.5-9	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 9	**Bridgwater**
Current responses to flood risk within the policy unit?	This policy unit includes Bridgwater and the immediate urban area. Flood risks in Bridgwater are dominated by high tides in the Bristol Channel propagating up the Parrett Estuary. Fluvial flood risks are considered to be low today but will increase significantly in the future. Records show some sewer flooding problems and some limited fluvial problems which probably occur during high tides and high intensity rainfall. Modelling has shown that existing risks due to high tide levels are low, and the current flood defences in Bridgwater are generally in good condition.
Standards of service that apply to flood defences within the policy unit?	The flood defences through Bridgwater provide protection up to a 0.5 per cent AEP flood event.
What is currently exposed to flooding?	Flood risks in Bridgwater are dominated by high tides in the Bristol Channel propagating up the Parrett Estuary. The town is relatively low lying and protected from tidal flooding by flood embankments and walls through Bridgwater. Modelling has shown that existing risks due to high tide levels are low, and the current flood defences in Bridgwater are generally in good condition.
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 9 are people and property located within Bridgwater.
What are the key factors that could drive future flood risk?	Climate change resulting in sea level rise. An expected deterioration in the standard of the defences.
What are the possible future levels of flood risk under the main scenarios?	The current average annual damage to property in this policy unit with the tidal defences in place is £1130k. Economically taking action in the future should be viable due to high risks in the future. It is essential that flooding is not exacerbated by future development in the town. Sustainable drainage approaches should be adopted to minimise future changes in flood risk.
What potential responses (or groups of responses) are being considered to manage flood risk?	Works to sure up the defences will be required within 20-30 years if risks are to be maintained at an acceptable level. Some limited works have been identified by Wessex Water to relieve surface water flooding problems.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	It is clear that sea level rise will require significant investment if the flood risks to Bridgwater are to be maintained at an acceptable level. Opportunities have and continue to be taken in relation to improving flood walls and banks as part of the regeneration of parts of Bridgwater. However we are aware that it will become increasingly difficult to raise defences in Bridgwater in the future, because of the existing infrastructure levels (e.g. bridges) and the potential damage to the urban landscape by constructing high walls along the river frontage. A step change may be required in the future by excluding high tides from the Town, with the use of a tidal sluice. This poses a dilemma in terms of our (and our partners) investment strategy. The step change is not required from a flood risk management perspective now, and flood risk management investment would not be forthcoming. We are aware that our partners have an emerging vision which sees a tidal sluice as a component, but there is significant uncertainty regarding funding and the environmental and social implications. We do see the potential for significant improvements associated with a sluice, although the environmental risks are significant

Form B.12.6-9 Screening of Policy Options against Appraisal Objectives

This form:

(41) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(42) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(43) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(44) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(45) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 9 Bridgwater

			Policy Options						
			Baseline	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100
Catchment objectives	Indicators (and targets)	Opportunities & constraints	**KEY assumptions and limitations** **Current responses:** **(a) Maintenance of extensive flood walls and embankments in Bridgwater** **(b) Automated warning systems to alert when water levels are too high.** **(c) use of the development control process.** **Flood risk assumptions:** **(a) Main risks are from high tide levels in the Parrett estuary** **(b) some limited fluval risk**	**KEY assumptions and limitations** **Possible future responses:** **(a) No maintenance of defences** **(b) No flood warning.** **(c) Use of the development control process retained** **Resultant assumed 2055 to 2100 future flood risk:** **(a) large scale flooding of Bridgwater due to increasing tide levels and deteriorating defences** **(b) Probable abandonment of large areas of the town**	**KEY assumptions and limitations** **Possible future responses:** **(a) Reduced defence maintenance** **(b) No flood warning.** **(c) Use of the development control process retained** **Resultant assumed 2055 to 2100 future flood risk:** **(a) significantly increased risk over baseline**	**KEY assumptions and limitations** Possible future responses: Same as baseline. Resultant assumed 2055 to 2100 future flood risk: (a) Frequency, depth and duration of tidal flooding will increase very significantly in the future due to sea level rise (b) The number of surface water incidents will also increase.	**KEY assumptions and limitations** Possible future responses: In addition to baseline; (a) Raise tidal walls and embankments (b) As a long term alternative to raising walls and embankments, construct a new tidal barrier Resultant assumed 2055 to 2100 future flood risk: Same as baseline.	**KEY assumptions and limitations** Possible future responses: (a) Similar to Option 4, with more investment undertaken in the near future (b) Further works to address surface water probelsm Resultant assumed 2055 to 2100 future flood risk: No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** Possible future responses: (a) Localised storage potential to reduce implications of 'tide lock' (b) Storage in the Parrett estuary areas (within the shoreline management plan and a small proportion of policy unit 10) may help mitigate increased sea level rise Resultant assumed 2055 to 2100 future flood risk: Use of this approach in isolation has a small impact. Damages similar to baseline. Impact for other Policy Units: None

Social objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** O Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** O No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 20,000 people are currently at risk from flooding. Risk to people will increase significantly to to increasing tide levels	More than 20,000 people	More than 20,000 people	No change from baseline, but increase due to increasing tide levels	No change from baseline, but expected future increase will be avoided	0	Less than 20,000 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** O Annual average damage of property to flooding. **Targets** O No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£1,130k	At least 5 times baseline	Greater than £10,000k	£10,000k	£1,300k	£0	Marginally less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** O Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O Length of motorway and 'A'road flooded during a 1 percent AEP flood event. **Targets** O No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. O No increase in the length of motorway and 'A'road flooded during a 1 per cent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. A major national railway line extends through the policy unit. There is an opportunity to work with National Rail to ensure that the railway is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 830 non-residential properties are currently at risk from flooding. This will increase significantly in the future limited recorded incidents of surface water flooding.	More than 830 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	Less than 830 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** O Annual average damage of agricultural land caused by flooding. O Length of flooding of agricultural land. **Targets** O No increase in the annual average damage of agricultural land caused by flooding. O Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£23k, negligible in this unit when compared with other economic damages	At least 5 times baseline	Greater than £225k	£225k	£23k	£0	Less than baseline
Reduce the cost of flood risk management in the CFMP area.	**Indicators** O Annual average cost of flood risk management activities (£). **Targets** O No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit, although significant maintenance works may be required in the medium term	Minimal expenditure on flood risk management	Reduced expenditure against baseline	No change from baseline.	Significant investment required in response to climate change	Very large investment required	Significant initial costs
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** O Length of natural, soft edged river connected to floodplain (km). O Flood related maintenance to channels. **Targets** O Increase in length of natural soft edged river connected to floodplain (km). O Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	Existing defences provide a hard river edge	No maintenance will be undertaken.	Same as policy option 1 in a 2100 future time horizon.	No change from baseline.	Some scope to provide soft edged river in connection with tidal barrier	Some scope to provide soft edged river in connection with tidal barrier	Not applicable.
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** O Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** O No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	1 scheduled ancient monuments lie within the 1 per cent AEP floodplain.	Significant loss of cultural heritage in Bridgwater	Potential loss of cultural heritage in Bridgwater	Little change over baseline	No change from baseline	No change from baseline	Not applicable.
Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** O Condition of environmentally designated sites. **Targets** O Maintain or improve the condition of environmentally designated sites.	Primarily an urban unit with no environmentally designated sites	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** O Habitat and river corridor survey scores. **Targets** O Maintain or improve Habitat and river corridor survey scores.	Primarily an urban unit, with some floodplain grazing marsh. Limited opportunities	Grazing marsh retained	Freshwater habitats will be replaced by saline/brackish habitats	Little change over baseline in the short term. Saline/brackish habitats in the long term	Little change over baseline in the short term. Saline/brackish habitats in the long term	No change over baseline	No change over baseline	Not applicable
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)				Unacceptable impact on town	Unacceptable impact on town	Unacceptable impact on town			

Form B.12.7-9	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 9	Bridgwater					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences, eventual loss of town	No active intervention will result in large increases in annual average damage to residential and commercial property, eventually leading to abandonment in many places	Some loss of BAP habitat	None identified	Savings on maintenance costs will be negligible in comparison with losses	**Some new habitats would develop**
Policy Option 2	Risk of serious injury or harm caused through deterioration of existing defences and sea level rise.	Increasing economic damage	Some loss of BAP habitat	None identified	As Option 1	Some habitat change may be considered beneficial
Policy Option 3	Risk of serious injury or harm caused by increasing sea levels.	Increasing economic damages	None identified	None identified	None identified	Some habitat change may be considered beneficial
Policy Option 4	No change to existing situation.	Would require very significant investment in response to rising sea levels	No change to existing situation	No increase in risks associated with rising sea levels	No increase in damages associated with rising sea levels	No change to existing situation
Policy Option 5	No change to existing situation.	Would require very significant investment in response to rising sea levels undertaken in the near term	No change to existing situation	No increase in risks associated with rising sea levels	No increase in damages associated with rising sea levels. Other secondary risks also addressed	No change to existing situation
Policy Option 6	Some reduction in risk over policy option 3	Would require technically complex and potentially expensive works in policy unit 10	None identified.	Reduced risks when compared with option 3	Uncertain, some benefits over option 3	No change to existing situation

Form B.12.8=9	Requirements for further policy development and appraisal
Is there a need for further policy development?	Yes
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	Yes
If yes, take forward to Strategy study.	

Form B.12.9-9	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties.	
Environmental • Water quality testing.	

Form B.12.5-10	Summary of current and future levels of and responses to flood risk
This form summarises the current levels of flood risk, current flood risk management responses, drivers of future flood risk, and possible responses for the named policy unit.	
Policy unit: 10	**North West Parrett**
Current responses to flood risk within the policy unit?	This policy unit includes two distinct areas. The majority of the area includes disperse communities on the high ground just north east of the Quantock hills including Nether Stowey, Spaxton and Goathurst. A very small part of the policy unit includes lowland areas protected by tidal embankments along the Parrett estuary. Generally occupation in this lower area is limited to occasional farms but Cannington is just on the edge of this lowland area. Fluvial flooding is relatively limited in this policy unit. This reflects the relatively small and steep watercourses which dominate the area. Limited sewer flooding has been recorded Our current level of investment in this area is generally low, and is focused in areas where we have undertaken works, specifically the tidal; embankments which protect parts of Bridgwater. General routine maintenance in undertaken as required and households that are currently at risk from flooding are included on our flood warning system.
Standards of service that apply to flood defences within the policy unit?	The defences built at Ashford Mill in 1987 provide protection from a 5 per cent AEP flood event.
What is currently exposed to flooding?	Flooding in the higher areas in this policy unit have been limited to local surface water problems. In the lower area there are very limited assets at risk. However the tidal embankments do protect some low suburbs of Bridgwater from flooding as well as the occasional farm.
Who and what are currently most vulnerable to flood damage and losses?	The main receptors to flood risk in policy unit 10 are people and property, particularly those within Cannington. No key infrastructure is at risk from fluvial flooding in this policy unit.
What are the key factors that could drive future flood risk?	Climate change (increasing flows, rainfall runoff and sea level rise) and land use change.
What are the possible future levels of flood risk under the main scenarios?	With current flood defences in place, the annual average damage is estimated as £120k to property and £30k to agricultural land.
What potential responses (or groups of responses) are being considered to manage flood risk?	Maintenance and flood warning role must continue in this policy unit. As our current investment in the area is relatively low, it will not be possible to reduce it further without undermining our maintenance and flood warning role. Opportunities are likely to found primarily in partnership with others. However it does not appear that Wessex Water have any immediate plans in this area. Work continues in the catchment to promote catchment sensitive farming. This provides both water quality improvements and helps to reduce runoff.
What gaps and uncertainties are there in knowledge, and what assumptions have been made?	Our current low level of investment across the higher areas is appropriate, and the risks associated with this are limited. The risks to the tidal embankments will increase over time. Our assessment probably underestimates the importance of managing the tidal embankments to protect properties on the periphery of Bridgwater.

Form B.12.6-10	Screening of Policy Options against Appraisal Objectives

This form:

(46) summarise the key policy appraisal objectives for the catchment, based on those identified in the scoping stage and refined in the draft CFMP stage;
(47) indicates the general assumptions made relating to the application of the policy within the policy unit being considered;
(48) indicates for each policy option:
- the potential positive, neutral, or negative implications (or impacts) that each policy option could have on each of the objectives;
- the size, significance and scale of the policy implications (or impacts);
- a comment on the location of gains and losses relating to each policy; and
- the opportunities that could be created, the constraints that could apply to policy implementation, and the uncertainties.

(49) comments on the sensitivity of the responses to different future scenarios, and records the implications of each scenario; and
(50) considers whether or not a risk to the Environment Agency could arise, and indicate the decision whether or not to appraise policy further.

NOTE: The policies which are consistent with the catchment objectives (social, economic, environmental) are highlighted.

Policy unit: 10	North West Parrett

Catchment objectives	Indicators (and targets)	Opportunities & constraints	Policy Options						
			Baseline	P1	P2	P3	P4	P5	P6
			Now	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100	2055-2100

			KEY assumptions and limitations <u>Current responses:</u> (a) In-channel maintenance (b) Maintenance of the tidal embankments (b) Automated warning systems to alert when water levels are too high. (c) Use of the development control process. <u>Flood risk assumptions:</u> (a) Fluvial flood risk is relatively limited in this policy unit due to the presence of only small steep streams (b) Tidal embankments protect a very small proportion of the unit from high tidal levels in the River Parrett (b) Surface water flooding has not generally been identified as a significant issue (c) Sewer flooding has not generally been identifies as a significant issue	KEY assumptions and limitations <u>Possible future responses:</u> (a) No in channel maintenance. (b) No maintenance of tidal embankments (c) No flood warning. (d) Use of the development control process retained <u>Resultant assumed 2055 to 2100 future flood risk:</u> (a) Frequency, depth and extent of flooding likely to increase due to under capacity of existing channels (which become blocked with weed and silt). (b) Tidal embankments would fail flooding both properties and farmland behind the defences and some lower parts of Bridgwater (in policy unit 9) (b) Poor landuse and soil management will lead to increased runoff and surface water flooding.	KEY assumptions and limitations <u>Possible future responses:</u> (a) Reduce channel maintenance. (b) reduced maintenance of tidal embankments (b) No flood warning. (c) Use of the development control process retained <u>Resultant assumed 2055 to 2100 future flood risk:</u> Similar to Option 1 although most severe impacts in the small areas defended by tidal embankments will occur much later	**KEY assumptions and limitations** <u>Possible future responses:</u> Same as baseline. This is the future baseline given that the current flood management responses are continued. <u>Resultant assumed 2055 to 2100 future flood risk:</u> (a) Frequency, depth and duration of fluvial flooding likely to increase very slightly. There are few receptors in this unit. (b) Tidal embankments would fail in the future (b) Slight increase in the frequency of flooding caused by the blockage of small watercourses and bridges. (c) The number of surface water incidents will also increase.	**KEY assumptions and limitations** <u>Possible future responses:</u> In <u>addition</u> to baseline; (a) Individual flood defences constructed around properties to maintain standard of protection. (b) Upgrading and raising of tidal embankments (c) Channel modification to increase conveyance. (e) Improvements to road and sewer drainage system in problematic areas. (f) Improvements to farming soil management to reduce the rate of runoff from agricultural land. <u>Resultant assumed 2055 to 2100 future flood risk:</u> Same as baseline.	**KEY assumptions and limitations** <u>Possible future responses:</u> Same as Option 4, with more investment to ensure that current risk of flooding is reduced. Investment may be brought forward in comparison with option 4 <u>Resultant assumed 2055 to 2100 future flood risk:</u> No properties or roads affected by surface or river flooding.	**KEY assumptions and limitations** <u>Possible future responses:</u> (a) Use of existing online storage, such as at a local scale (individual farms), where ponds can be used to attenuate high flows. (b) Use of storage capacity within the tidal estuary to reduce peak tide levels (of particular benefit to Bridgwater) <u>Resultant assumed 2055 to 2100 future flood risk:</u> Use of on-line ponds for flood storage will have a small localised flood risk management benefit. It is unlikely that fluvial storage can be applied in this policy unit more generally because the economic benefit would be insufficient. <u>Impact for other Policy Units:</u> Use of storage in the tidal estuary will have a small impact in reducing tidal peaks which would help to mitigate increased sea level rise to the benefit of Bridgwater (this would also apply to areas within the estuary within the shoreline management plan area).
<u>Social objectives</u>	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**

Reduce the risk of serious injury/harm to people caused by flooding.	**Indicators** o Number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood. **Targets** o No increased in number of people exposed to deep and/or fast-flowing floodwaters during a 0.1 per cent AEP flood.	To reduce the risk of flooding to people by guiding development away from the floodplain and ensuring that new development does not increase flood risk onsite or in the surrounding area. There is continual improvement in flood warning systems. There is an opportunity to reduce flood risk through improved response systems, increased accuracy of flood warning and increased flood warning time. Flood risk centred on principal urban areas, however flood risk to all people should be considered.	Approximately 1150 people are currently at risk from flooding. Due to the steep nature of the surrounding topography, flood flows are considered hazardous when they occur, although there are relatively few people at risk	More than 1150 people	More than1150 people	No change from baseline	No change from baseline	0	Less than 1150 people
Economic objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Reduce the economic damage to properties caused by flooding.	**Indicators** o Annual average damage of property to flooding. **Targets** o No increase in the annual average damage of flooding to property.	To reduce economic damages through the development planning process and through greater integration of flood management in local plans. Working with Wessex Water and Local Authorities to analyse the urban drainage system, and develop more effective flood management systems. Working with farmers through the catchment sensitive farming scheme to improve land management practices to help reduce surface water runoff. Although flood risk in the catchment is centred on principal urban areas, it should be recognised that there is significant risk to isolated properties and communities.	£120k	At least 5 times baseline	Greater than £1,000k	£1,000k	£120k	£0	Less than baseline

Reduce the economic damage to local industry (non-agricultural, including tourism) caused by flooding.	**Indicators** o Number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o Length of motorway and 'A'road flooded during a 1 percent AEP flood event. **Targets** o No increase in the number of non-residential properties that lie within the floodplain of a 1 per cent AEP flood. o No increase in the length of motorway and 'A'road flooded during a 1 per cent AEP flood event.	Tourism is an important industry for the catchment. Negative publicity of flooding can have long lasting effects. Consideration should be given to the loss or damage of transport links during flooding. A major national railway line extends through the policy unit. There is an opportunity to work with National Rail to ensure that the railway is not affected by flooding and does not contribute to increased flood risk in the catchment. Rural business is important both socially and economically in the region and should be enhanced where possible.	Approximately 11 non-residential properties are currently at risk from flooding. 1 recorded incident of surface water flooding.	More than 11 non-residential properties	Similar to Option 1 though slightly reduced.	No change from baseline	No change from baseline	0	Application in PU10: Less than 11 properties.
Reduce the economic damage to agricultural production caused by flooding.	**Indicators** o Annual average damage of agricultural land caused by flooding. o Length of flooding of agricultural land. **Targets** o No increase in the annual average damage of agricultural land caused by flooding. o Limit the increase in the length of flooding of agricultural land.	Agricultural production is important socially and economically to the CFMP area. Improved land management practices will help improve the productivity of the land for agricultural purposes.	£30k	At least 5 times baseline	Greater than £250k	£250k	£30k	£0	Application in PU10: Less than baseline

Reduce the cost of flood risk management in the CFMP area.	**Indicators** o Annual average cost of flood risk management activities (£). **Targets** o No increase in annual average cost of flood risk management activities (£).		Currently £1.4M is spent on flood risk management (FRM) in the CFMP area each year. A small proportion of this is spent in this policy unit.	Minimal expenditure on flood risk management	Reduced expenditure against baseline	No change.	Generally little increase over baseline. More investment would be directed at the tidal embankments (a small part of the unit)	Significant investment required to reduce risks to very low level	Farm scale ponds would require significant investment to have a measurable effect. To utilise the storage capacity within the estuary will require considerable investment to ensure stability of embankments
Environmental objectives	Indicators (and targets)	Opportunities & constraints	**Baseline**	**P1**	**P2**	**P3**	**P4**	**P5**	**P6**
Maintain / restore natural river processes and linkages with the floodplain where appropriate.	**Indicators** o Length of natural, soft edged river connected to floodplain (km). o Flood related maintenance to channels. **Targets** o Increase in length of natural soft edged river connected to floodplain (km). o Reduction in flood related maintenance to channels.	Enhancement of river corridors, floodplain and wetland areas where possible will improve ecological value and biodiversity in the area including BAP habitats.	This policy unit is largely rural and watercourses typically have good connectivity with the floodplain.	No maintenance will be undertaken.	Reduced maintenance over baseline	No change from baseline.	Increased maintenance to banks – but little environmental disbenefit	Reduced connectivity through keeping floodwater in larger channels. Some increased maintenance	Some potential improvements in linkages with rivers and floodplain
Protect / improve features of cultural heritage that are affected by flooding.	**Indicators** o Number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain. **Targets** o No increase in the number of scheduled ancient monuments that lie within the 1 per cent AEP floodplain.	Not applicable	No scheduled ancient monuments lay within the 1 per cent AEP floodplain.	No change.	No change.	No change.	No change.	No change.	No change

Seek to maintain / improve the condition of environmentally designated sites.	**Indicators** o Condition of environmentally designated sites. **Targets** o Maintain or improve the condition of environmentally designated sites.	Much of the CFMP area is under environmental designation, or a recognised landscape of biodiversity value. The aims of objectives and targets for these areas must be considered when appraising CFMP policies. Protected and designated sites are vulnerable to changes in water levels and/or the frequency, depth and duration of flooding.	The unit includes the Quantock SSSI & AONB. It is unlikely that changes in flood management will have any measurable impact on these areas	No change	No change	No change	No change	No change	No change
Seek to help protect and improve biodiversity habitats, where appropriate.	**Indicators** o Habitat and river corridor survey scores. **Targets** o Maintain or improve Habitat and river corridor survey scores.	Improve ecological values in the area, including BAP habitats.	The policy unit contains important habitat such as coastal floodplain grazing marsh which is a UK BAP priority habitat (this is focused on a small area within the estuary floodplain)	Significant negative change to grazing marsh BAP habitat, elsewhere changes are likely to be minimal	Same as policy option 1, although impact would occur later	Same as policy option 1, although impact would occur later	Some changes to the river corridor (including removal of important bank vegetation) could affect existing habitats.	Some changes to the river corridor (including removal of important bank vegetation) could affect existing habitats	Some potential improvements to habitats at farm scale. Changes in tidal flooding will impact on habitats.
Any significant risks to the Environment Agency and others attached to promotion of policy option? (Yes/No)		Not applicable							

Form B.12.7-10	Summary of the relative overall losses (including flood risk management costs) and gains (including flood alleviation benefits), thus demonstrating the rationale behind selecting the preferred option

This form summarises the gains (or +ve implications) and losses (or –ve implications) identified against each Policy Option in Form B.6 (above).

The preferred policy option for this policy unit is highlight below in blue.

Policy unit: 10	North West Parrett					
Policy Options	**Losses**			**Gains**		
	Social	**Economic**	**Environmental**	**Social**	**Economic**	**Environmental**
Policy Option 1	Risk of serious injury or harm caused through deterioration of existing structures and defences.	No active intervention will result in increases in annual average damage to residential and commercial property, particularly within the tidal estuary Negative impact on agricultural production.	Rapid and non-strategic change in management / may impact on existing ecological system.	No management may result in a slight improvement in landscape character and amenity value.	Savings on maintenance costs. However average annual damages from flooding will be greater than this saving.	No management may result in a changing ecological system, which may be considered beneficial
Policy Option 2	As Option 1.	As Option 1.	As Option 1.	As Option 1.	As Option 1.	Reduced management may result in a slight improvement on existing ecological system.
Policy Option 3	Generally there will be little change from baseline. The exception is the small area of tidal estuary where risks would increase significantly	Generally there will be little change from baseline. The exception is the small area of tidal estuary where economic losses would increase significantly	As option 1 within the tidak estuary, elsewhere the impact will probably be small	No change from baseline.	No change from baseline	No change from baseline.
Policy Option 4	No change from baseline.	Would require investment to upgrade flood management system. Unlikely to be economic when compared to average annual damages. Work to the small tidal estuary area will be beneficial	Increased flood risk management may impact on existing environmental designations in the area.	No change from baseline.	No change to average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 5	None identified.	Large investment required to upgrade flood management system. Significant ongoing costs to ensure no flood risk in a 1 per cent AEP flood event. Protection of large areas is unlikely to be economically viable.	Increased flood risk management likely to impact on existing environmental designations in the area.	Small risk of serious injury and/or loss of life during future flood events.	Reduction in average annual damages.	Increased flood risk management may result in a slight improvement on condition of existing environmental designations in the area.
Policy Option 6	Farm scale storage unlikely to provide any significant benefit to people and property. Storage in the tidal estuary may be of benefit to Bridgwater	Unlikely to be economically viable when compared to average annual damages. Storage in the tidal estuary may be of benefit to Bridgwater	Potential losses if farm scale pond used, but probably marginal If storage in the tidal estuary is utilised then potential significant environmental change and impact on BAP habitats (within that small area)	Use of on-line ponds for flood storage will have a small localised flood risk management benefit and would protect a small number of people and property. Some reduction of risks to Bridgwater are possible	Small reduction in average annual damages	Potential environmental benefits associated with farm scale ponds. Changing habitats in the tidal estuary may be considered beneficial.

Form B.12.8-10	Requirements for further policy development and appraisal
Is there a need for further policy development?	No
If yes, then mark Policy Options for more detailed development. Some complex policies may require more detailed development, probably at Strategy Plan level.	
Is there a need for further more detailed appraisal?	No
If yes, take forward to Strategy study.	

Form B.12.9-10	Indicators for Monitoring, Review and Evaluation
This form sets out the indicators that need to be included in the policy implementation plan, for policy monitoring, drawing on the residual risks and likely impacts identified above. This will allow better review and evaluation of the policy when implemented.	
Indicators to be included in the policy unit 1 Implementation Plan are:	
Social • Number of properties with resistance/ resilience methods.	
Economic • Annual average damage of flooding to property (£). • Annual average damage of flooding to non-residential properties. • Average annual damage of agricultural land caused by flooding (£).	
Environmental • Water quality testing.	