SOUTH WEST REGIONAL FLOOD RISK APPRAISAL

February 2007

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1. Introduction

The purpose of this Regional Flood Risk Appraisal is to provide a broad regional understanding of the risk that flooding creates in South West England. It will assess how flood risk has been taken into account during the planning process and the Regional Spatial Strategy. It will furthermore provide supplementary guidance and help to Strategic and Local Authorities by presenting the strategic areas significantly at risk in each of the sub-regions. By considering the various courses of flooding in the 9 sub-regions the RFRA aids to the completion of the Local Planning Authorities' individual Strategic Flood Risk Appraisals.

2. Executive Summary

Government guidance (PPS25) requires the Regional Planning Body to carry out a Regional Flood Risk Appraisal (RFRA) in consultation with the Environment Agency (EA). The RFRA must feed into the Strategic Sustainability Assessment (SSA) and finally the Regional Spatial Strategy (RSS) and should especially be used to determine the broader regionally significant locations for development.[1]

The RFRA provides a broad overview of the source and significance of all types of flood risk across a region. This will be used to assess and influence housing and employment as well as to identify where flood risk management measures may be functional at a regional level. The main aim of the RFRA however is to direct development away from areas at highest risk of flooding.

An appraisal of flood risk has been carried out on each of the 9 sub-regions in the South West. All sources of flooding, for which the Environment Agency has sufficient data, have been considered and the impacts of these are determined individually in each sub-region. Flood risk for Strategically Significant Towns and for Market Towns is also considered.

Through the sub-regional appraisals it can be concluded that areas which suffers from regionally significant flood risk include **Somerset Levels and Moors, Avonmouth, Weston-super-Mare, Exeter, Bridgwater, Taunton, Christchurch, Poole, Weymouth** and **Truro**.

The outcome of the sub-regional flood risk appraisal is:

1. **West of England.**
   Weston-super-Mare and Avonmouth are at significant risk from tidal and fluvial flooding and parts of Bristol City are affected by tide locking. Surface water drainage is affected by tide locking.
2. **Swindon**
   Properties in specific parts of Swindon are at risk from fluvial flooding.
3. **Gloucester and Cheltenham**
   Gloucester is affected by tidal and fluvial flooding and surface and ground water flooding. Climate change will have an impact on tidal flooding in Gloucester.
4. **Exeter**
   The Rivers Exe and Clyst have large floodplains whilst the new Cranbrook community lies outside the floodplain. Parts of Exeter itself are furthermore at significant risk from flooding.
5. **Taunton and Bridgwater**
   Severe tidal flooding events affecting Bridgwater will become significantly more likely with sea level rise. The River Tone presents significant flood risk to the town of Taunton.
6. **South East Dorset**
   There are significant fluvial and tidal flood risks in Christchurch and Poole. Groundwater flooding is also of concern in this Sub-Region.

[1] *Planning Policy Statement 25*, December 2006 (Para 24)

7. **Plymouth, South East Cornwall and West Devon**
   The effect of sea level rise on areas of Plymouth is of concern, as is the existing tidal and fluvial flood risk.
8. **Torbay**
   Surface water flooding affects the flashy catchments of the Torbay area, and there is tidal flooding along the Torbay coast.
9. **Cornwall Towns**
   Truro is at significant risk from fluvial and tidal flooding. Sea level rise is of concern, with the frequency of severe tidal flooding events increasing significantly.

At a local level Local Planning Authorities (LPAs) will prepare Strategic Flood Risk Appraisals (SFRAs) and will use the sequential test as outlined in PPS25 to guide development away from current or future flood risk areas and flood plains. To achieve this LPAs must take account of climate change and the increasing risk of coastal and river flooding. They must furthermore aim to defend existing properties and locate new development in places with little or no risk of flooding. They must also ensure that proposed development does not create an increased risk of flooding elsewhere.

The RFRA however, is carried out at a regional level and considers regionally significant flooding. The nature of flooding in the South West region is such that flood events rarely have a region-wide impact, although this does occur (e.g. the floods in 2000). Occasionally events cover groups of river catchments in the region but more usually floods tend to affect individual river catchments and very rarely affect the entire region at one particular time, although this can happen in extreme course of events.

Climate change could potentially have major impacts for the region's coastline, low lying areas, infrastructure and major coastal towns and cities, and could cause further effects in future years as climate change is expected to accelerate. The long-term effects are therefore an important consideration for the RFRA and RSS as well as for any future development.

3. Methodology

3.1 Conducting the South West RFRA

Government guidance PPS25 on development and flood risk was after the draft South West Regional Spatial Strategy was made publicly available. As a result of this, the procedural approach put forward in the guidance was not followed and the Regional Flood Risk Appraisal has been developed after the publication of the draft South West Regional Spatial Strategy.

However policy on flooding has been included in policy F1 and in paragraphs 7.2.18 – 7.2.21 in the draft RSS. Flood risk has also been considered as part of the Joint Study Area (JSA) work submitted to the Regional Planning Body by the 9 sub-regional strategic authorities. The JSA work identified flood risk areas, and subsequently assessed and implemented mitigation measures. As a result, most of the significant flood risks to development within the region have been managed, which the sub-regional flood risk appraisals will support. The JSA work informed the Strategic Sustainability Report and finally the Regional Spatial Strategy, aiding in particularly to the regional policy (F1) on Flood Risk.

Much of the data on flooding has been provided by the Environment Agency, although this is restricted to fluvial and tidal flooding and ad hoc knowledge of groundwater flooding. Other data on pluvial, highway, surface water and sewer flooding has been provided through interviews with local authorities. Environment Agency flood risk mapping data is due to be updated during 2007 and this will be based on new data and new models.

The properties at risk maps have been included to give a contextual indication of locations and numbers of properties at risk. They should not be used to calculate specific numbers of properties at risk.

3.2 Significance of flood risk

The aim of the Regional Flood Risk Appraisal is to identify and evaluate flood risk at broad regionally strategic locations in order to inform the Regional Spatial Strategy. The detailed assessment of risk including technical work and potential mitigation plans will be addressed at strategic and site specific levels.

At a strategic level, flood risk can be considered either as an absolute or significant constraint, depending on its spatial implications.

If mitigation measures cannot eliminate or substantially reduce the element of flood risk flooding can become a fundamental cause for the dismissal of broader strategic plans, thereby making the significant flood risk an absolute constraints.

Flood risk can however also be a significant but resolvable issue. With mitigation measures put in place and careful master planning through Local Development Documents, flood risk can be accommodated and addressed,

allowing development to come forward. This would be a key focus for more detailed technical work as it may influence the scale and direction of growth in Local Development Documents.

4. What is Flood Risk?

Flooding is a natural process. However it can endanger lives, damage buildings and infrastructure, historic structures, archaeology and settlements. It can adversely affect the characteristics of landscapes and habitats as well as affect health and disrupt the lives and livelihoods of those people affected. Poorly designed development in a floodplain area can reduce the space available to store floodwater, affecting not just the development itself but also surrounding areas.

Nationally, around 5 million people, in 2 million properties, live in flood risk areas in England and Wales. However climate change could see the number of people at 'high' risk of flooding rising from 1.5 million to 3.5 million by 2040. Damage caused by flooding currently cost around £1 billion a year and it is predicted that the Environment Agency's flood risk management prevents further yearly damage of £3.4 billion. However, damage costs are predicted to increase to as much as £25 billion under the worst-case climate change scenario.

4.1 Flood Risk in the South West

The South West Region is the largest region in England and is surrounded by 1130km of coastline. It has a total population of around 5 million inhabitants of which more than 3 million people live within 10km of the coastline. Around 100,000 properties in the South West region are at risk from the most serious floods (100 year fluvial or 200 year tidal flood[2]). Areas at particular risk of flooding include the Somerset Levels and Moors, Weston-super-Mare, Exeter, Bridgwater, Taunton, Christchurch, Poole, Weymouth and Truro.

Flood defence schemes reduce the risk of flooding around many of the region's rivers, estuaries and low-lying coastlines. Flood defences do not however eliminate the risk as they may be overtopped or breached. A consistent approach to flood risk management is lacking for other sources of flooding such as sewers, surface water and groundwater, which can have a significant impact. Flood risk therefore remains in the region especially for the region's many isolated properties and smaller communities that do not have any form of flood defences.

The number of properties affected by river and tidal floods varies widely between years but 200-400 properties are flooded in a typical year. 2000/01 was a particularly serious year in the South West, with approximately 1,300 properties affected. In October 2005 approximately 270 properties were affected by a coastal flood event and the Boscastle event of August 2004 attracted international attention.

The nature of flooding in the South West region is such that a flood event rarely has a region-wide impact, although this does occur (e.g. the floods in

[2] Refers to the likelihood of a flood event, often described as a 'return-period', i.e. the probability of a flood event occurring in an area over time. If the return-period is 100 years, it means that a flood event is likely to occur once in a 100 years, or there is a 1% chance of flooding.

2000). Occasionally events cover groups of river catchments in the region but more usually floods tend to affect individual river catchments. This appraisal concentrates on flooding that would be of significance to the region and does not go into detail of more minor scale events. Of course, local flooding can disrupt the regional rail network and this could have a regional impact. Further detail should be considered in Strategic Flood Risk Appraisals.

4.2 Strategically Significant Towns

Section 8 of this appraisal considers how flood risk has been addressed in each JSA area. The following Strategically Significant Towns (SSTs) are not within the areas covered by the JSA studies. Therefore they are considered in less detail by this appraisal. SFRAs have been produced for Weymouth and for Trowbridge but the other towns do not have SFRAs, although the Salisbury SFRA is about to be started.

Barnstaple
There are flood risks in the town and flood incident management is provided in the form of flood warning to properties. There is flood management infrastructure in the town. There are potential issues relating to the effect of climate change and sea level rise in the town.

Chippenham
There are flood risks in the town and flood incident management is provided in the form of flood warning to properties. There is flood management infrastructure in the town.

Dorchester
There are flood risks in the town, mainly confined to the immediate river corridor, and flood incident management is provided in the form of flood warning to properties. There is flood management infrastructure in the town.

Salisbury
There are flood risks in the town and flood incident management is provided in the form of flood warning to properties. There is flood management infrastructure in the town. Due to the nature of the rivers around Salisbury, they are slow to respond initially but once water levels are raised flood events are sustained and could last many weeks.

Trowbridge
There are flood risks in the town and flood incident management is provided in the form of flood warning to properties and by flood defences. There is also flood management infrastructure in the town.

Weymouth
There are flood risks in the town and flood incident management is provided in the form of flood warning to properties. There is flood management infrastructure in the town. There are potential issues relating to the effect of climate change and sea level rise in the town. The SFRA that covers the town explains that flooding is an issue with varying levels of severity across most of the study area, with 13% of properties within the borough located in areas

currently at risk of flooding. Significant flooding in the area is mainly caused by overtopping of river banks, whilst less severe flooding generally in Weymouth itself is predominantly from surface water run off and the blockages of drains and culverts.

Yeovil
There are flood risks in the town and flood incident management is provided in the form of flood warning to properties.

4.3 Market Towns

Although the RFRA does not deal specifically with the region's market towns, should be noted that the majority of the 100 or so market towns in the South West have a degree of fluvial flood risk. This is because they are typically sited across or near rivers, which historically have been routes of transport. In line with this, SFRAs will determine flood risk in more detail in these areas and inform development allocation.

4.4 Flood Risk to Road and Rail Infrastructure

Flooding is also a risk for certain parts of the sub-regional transport infrastructure. Network Rail has special management procedures to manage rail traffic during floods, relying upon Environment Agency Flood Warnings to trigger actions. Flood Warnings only trigger actions on the 12 most vulnerable structures in the south west, but this does not apply to any of the track infrastructure. Significant flooding across the infrastructure would lead to a major decrease in the capability of the route, which would lead to reduced timetables for indeterminate periods of time.

One of the weakest links in the region's rail network is the 4-mile stretch of railway along the sea wall at Dawlish. It appears that climate-change induced sea-level rise and changes in storm patterns could overwhelm the defences, and Network Rail is to consider renewing major sections of the wall. This renewal work will factor in climate-change effects and mitigation.

Network Rail is currently commissioning a study into future renewals works at Dawlish sea wall.

The Environment Agency includes the M5 in flood risk mapping but the embankment[3] is not considered as a flood defence. This is true for many road and railway embankments in the region. The Highways Agency is undertaking a flood risk assessment of its assets in the region.

[3] There are numerous culverts, roads and railway crossings through the embankment and many of these will be included in the model to allow floodwater to pass through.

5. Flood Risk, Government Planning Statement and the draft Regional Spatial Strategy

5.1 Government Planning Statement

National Planning Policy Statement 25 (PPS25) on Development and Flood Risk was published in December 2006. The main aim of PPS25 is to guide and assist regional and local authorities on the matte of sustainable planning for development and flood risk. One of the strategic principles of the guidance is to avoid additional development in areas with large risk of flooding, i.e. in Flood Zones 2 and 3. Where this is not possible, development needs to be of a design and with an appropriate level of protection to ensure that the risk of damage from flooding is minimised, while not increasing the risk of flooding elsewhere. The guidance furthermore encourages the use of a risk-based approach to planning. In line with this flood risk appraisals and various tests must be applied in order to consider the most appropriate forward planning. [4]

The regional Planning Body's (RPB) have a responsibility to take flood risk into account when making explicit planning considerations in the relevant Regional Spatial Strategy.

5.2 Draft South West Regional Spatial Strategy

Within the draft Regional Spatial Strategy (dRSS) and in line with PPS25, policy F1 explains the actions to be taken to manage flood risk

Policy F1: Taking account of climate change and the increasing risk of coastal and river flooding, the priority is to:

- Defend existing properties and locate new development in places with little or no risk of flooding
- Protect flood plains and land liable to tidal or coastal flooding from development
- Follow a sequential approach to guide development away from flood risk areas
- Use development to reduce the risk of flooding through location, layout and design
- Relocate existing development from areas of the coast at risk, which cannot be realistically defended, and
- Identify areas of opportunity for managed realignment to reduce the risk of flooding and create new wildlife areas[5]

The dRSS states that, in implementing Policy F1 Local Development Documents (LDDs) will need to:

- Require strategic flood risk assessments to guide development away from floodplains, areas at risk or likely to be at risk in future from flooding, or where development would increase the risk of flooding elsewhere
- Ensure that the location of new development is compatible with relevant Shoreline Management Plans (SMPs) and Catchment

[4] *Planning Policy Statement 25: Development and Flood Risk*, December 2006 (Para 17 and 22)
[5] *Draft South West Regional Spatial Strategy*, April 2006 (Page 151)

Flood Management Plans (CFMPs), and other existing relevant strategies, and takes account of the Environment Agency's Flood Map

- Seek to reduce the causes of flooding by requiring that all developments and, where subject to planning control, all land uses (including agricultural activities and changes to drainage in existing settlements) should not add to the risk of flooding elsewhere, and should follow the Government Practice Guide on the application of PPS25 including reducing flooding pressures by using appropriate Sustainable Drainage Systems (SUDS)
- Require that all developments within or on the perimeter of towns and villages take account of local flooding risks from agricultural run-off
- Ensure that development proposals do not prejudice future coastal management or the capacity of the coast to form a natural sea defence, or to adjust to changes, without endangering life or property
- Include proposals that allow for the relocation of existing development from areas of the coast at risk, which cannot be realistically defended[6]

[6] *Draft South West Regional Spatial Strategy*, April 2006 (Para 7.2.21)

6. Climate Change

6.1 The South West Region

The draft RSS states[7] that climate change[8] is already affecting life in the South West. The region's average air temperature has increased by about 1^{o}C since the 1960s, and sea level is continuing to rise. This could potentially have major impacts for the region's coastline, low lying areas, infrastructure and major coastal towns and cities, and there will be further effects in future years as climate change is expected to accelerate. The long-term effects are therefore an important consideration for the RSS and RFRA and any future development.

6.2 Tidal flooding

The impact of climate change on future flood risk is a serious concern for coastal areas of the South West. The Environment Agency is developing models of increased tidal floodplains due to sea level rise. Data is available for the south coast at this time and detail is given in the relevant sub regions. North coast data will be available in 2007. The Agency has also produced estimates that show increased frequency of severe tidal flooding due to the impact of climate change. This will mean that coastal communities with existing defences become increasingly vulnerable. Other communities not currently at risk from coastal flooding may become so if there are changes in wave direction due to climate change. Increased wave heights will result in an increase in structural loading on sea defences and could compromise their effectiveness. Communities that are of particular concern are Christchurch, Poole, Bridgwater and Weston-super-Mare.

Defra has published guidance[9] which encourages an *adaptive management* approach, which reinforces the need to consider longer-term adaptation and supports a *precautionary approach*. Detailed regional sea level rise allowances are given *(table 1)*, together with advice on sensitivity testing for tidal (and fluvial) flooding. These new allowances are significantly higher than in previous guidance and also allow for an exponential rise in sea level (previous allowances were constant). The previous allowance for sea level rise in the South West was 5mm per year and the new regional sea level rise allowances are as follows:

[7] *Draft South West Regional Spatial Strategy*, April 2006, (Para 1.6.9)
[8] Climate change is principally caused by the emission of greenhouse gasses from human activity.
[9] *Defra supplementary note: 'Climate Change Impacts'*, October 2006

Table 1 *Defra Guidance on sea level rise for the South West (from* Defra PAG supplementary note October 2006)

Years	Increase
1990-2025	3.5mm / year
2025-2055	8.0mm / year
2055-2085	11.5mm / year
2085-2115	14.5mm / year
NB Baseline date is always 1990	
Calculations and comparisons	
1990 to 2040 *Old guidance 250mm total rise* *New guidance 242.5mm total rise*	
1990 to 2115 *Old guidance 625mm total rise* *New guidance 1142.5mm total rise*	

One of the most striking effects of sea level rise is the consequent increase in the frequency of flooding. This increased frequency varies around the coastline due to the complexity of the coastline, tidal range and exposure. *Figure 1* show how a 0.5% chance in any given year today would change by the 2060s given estimated net sea level rise. For example the 2002 0.5% event in Poole Harbour would become as frequent as a 16% chance event in 2060. This is an increase in likelihood of thirty two times for this particular extreme sea level. In large lowland areas such as the Somerset Levels and Moors a rise in sea levels would also result in floods being of longer duration.

Figure 1 *Estimated increased frequency of severe tidal flooding in 2060*

This RFRA does not consider the impact of climate change on waves or rivers, as there is no data that considers these areas for the whole of the

South West. Defra have nevertheless provided guidance to assist with these issues[10] and the climate change impact of increased wave heights and river flows should be assessed in site specific Flood Risk Appraisals and detailed design.

6.3 Future Development

Government guidance (PPS25) stresses that growth and development should not be directed into already vulnerable areas against a background of rising sea levels and increased frequency of flooding, unless no alternative lower risk sites are available.

Climate change could potentially have major impacts for the region's extensive coastline, low lying areas, infrastructure and major coastal towns and cities, and it is predicted that there will be further effects in future years as climate change is expected to accelerate. The long-term effects are therefore an important consideration for the RSS and any future development.

Coastal flood risks have been highlighted in the sub-regional appraisals. In these areas new and improved defences are necessary to maintain existing levels of protection against flooding in response to climate change. Improvement of existing and provision of new defences will need to be tested for economic viability. It is however vital to keep in mind that defences cannot eliminate risk and new development should therefore be guided away from flood risk areas. A precautionary assessment of risk should therefore be undertaken for proposed new developments. This assessment should not regard existing defences as an indicator of suitability for further development but should be informed by a more detailed flood risk appraisal (FRA) of the actual site.

[10] ***Table 2*** *Defra guidance on sensitivity ranges for wave heights due to climate change (from Defra PAG supplementary note October 2006)*

Sensitivity ranges	Offshore windspeed +10%
	Extreme wave height +10%

Table 3 *Defra guidance on sensitivity ranges for increased fluvial flow due to climate change (from Defra PAG supplementary note October 2006)*

Sensitivity ranges	Peak rainfall intensity +10%
	Peak river flow volume +20%

7. The Flood Risk Appraisal Hierarchy

7.1 Regional Flood Risk Appraisals

Regional Flood Risk Appraisals (RFRAs) provide a broad overview of the source and significance of all types of flood risk across a region and highlights areas of concern relative to major development. They provide the context for Strategic Flood Risk Appraisals and site specific Flood Risk Appraisals.

Government policy (PPS25) requires that the Regional Spatial Strategy is supported by a RFRA and requires that the planning system operates at all levels to reduce flood risk. Regional strategic decisions on the scale and broad locations for growth should not force lower level plans to direct growth into areas where residual risk cannot be realistically controlled and where alternative lower risk sites are available.

The approach of identifying, allocating and developing a certain type of land before others in order to avoid development in flood risk areas is called the Sequential Test. Government Policy (PPS25) requires that the RFRA can justify that the *Sequential Test* approach has been satisfied during the allocation of broad regionally strategic development areas.

7.2 Strategic Flood Risk Appraisals

Strategic Flood Risk Appraisals (SFRAs) assess strategic flood risk on a local planning authority level. It is the responsibility of those allocating land for development to demonstrate that the flood risk to and from development will be acceptably safe throughout the lifetime of the proposed development, while taking account of climate change. Local Planning Authorities (LPAs) should prepare SFRAs in consultation with the Environment Agency and other stakeholders to determine flood risk across the area.

7.3 Flood Risk Appraisals

Flood Risk Appraisals (FRAs) are site or project specific and provide appraisals of all types of flood risk associated with development. FRAs identify the source of the risk, how this will change over the lifetime of the development, the impact of development and the residual risks that will remain after flood management measures are put in place. Planning applications for major development proposals in Flood Zone 1 and 2 and all proposals for development located in Flood Zones 2 and 3 need to be accompanied by a FRA[11].

There is a 2-way feedback process between this suite of Flood Risk Appraisals. As technical data becomes available through the detailed study of a FRA this will be fed into SFRAs and the RFRA. In turn, policy changes from the RFRA and SFRA will be fed into FRAs.

[11] For definitions of flood zones please see Planning Policy Statement 25: Development and Flood Risk, Appendix D.

8. Sub-Regional Flood Risk Appraisals

In this section an appraisal of regionally significant flood risk has been carried out, where data is available[12], on each of the sub-regions. All sources of flooding have been considered and the impacts of these are determined individually in each sub-region indicating the following:

- Where existing flood risk is a significant issue in the sub-region
- Where in the sub-region the future problem of flood risk is likely to be greatest
- How much of the sub-region is protected by major flood risk management infrastructure, including drainage infrastructure and emergency planning procedures
- Whether new development in the sub-region is likely to add to flood risk

There is also a section in each sub regional appraisal to explain how the sequential test or similar methodology has been applied when allocating development in these areas.

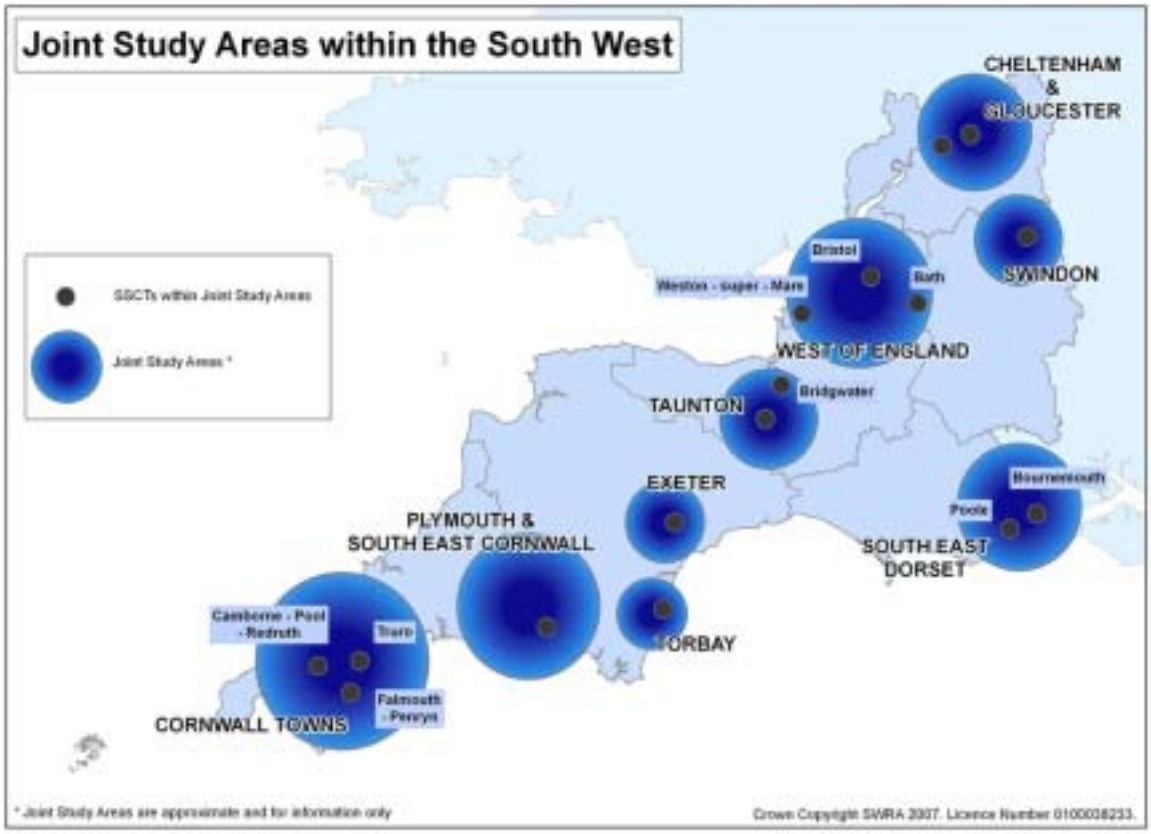

Figure 2 *Map of South West Region indicating the 9 Sub-Regions*

[12] The majority of data has been obtained from the Environment Agency, with ad-hoc and local information provided by individuals at district councils following brief discussions. *(Appendices B and C*)

8.1 West of England

Figure 3 *West of England Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

This part of the region is the focus of substantial growth. Significant population centres such as Weston-super-Mare lie within the coastal floodplain and many people already live within defended areas subject to residual flood risks. Land allocations in this area must be sited and designed to avoid, and if this is not possible, minimise these risks. As sea levels rise investment in existing infrastructure will be necessary to maintain existing levels of protection from flooding.

Substantial coastal flood risks are a characteristic of this sub region. Avonmouth, Severnside and Royal Portbury Docks are highlighted as requiring investment in coastal defences in order to realise the economic potential of these areas.

There are significant flood risks in Weston-super-Mare, Bristol and Avonmouth, where property is at risk from tidal and fluvial flooding. Surface water drainage is also affected by tide locking at high tides. There is however significant tidal and fluvial flood risk management infrastructure in much of the West of England sub-region.

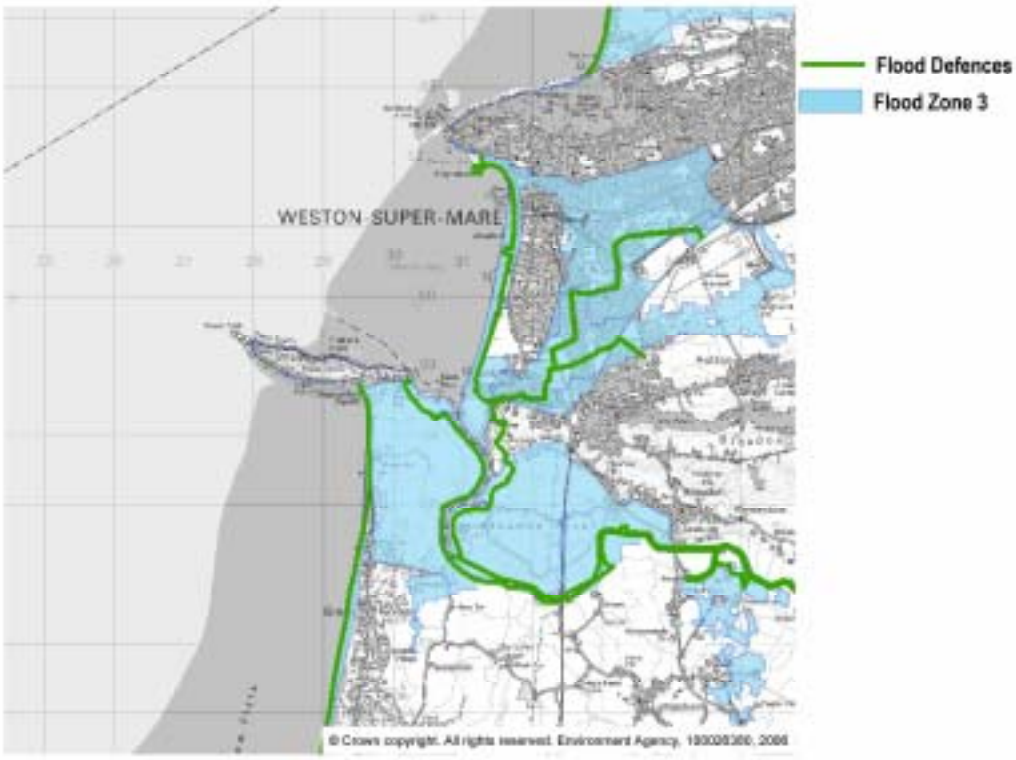

Figure 4 *Weston-super-Mare existing floodplain (Flood Zone 3) and flood defences*

Tidal defences are planned for Weston-super-Mare, which is expected to protect 4562 properties.

The existing fluvial flood risk to Weston-super-Mare is currently being quantified through a partnership flood study (the Weston Vision), which identifies existing flood risk and the necessary mitigation that would form part of the new development strategy. The study will address the necessary flood risk management infrastructure requirement for the Weston regeneration scheme being delivered through the Weston Vision. All new flood risk management infrastructure will be provided by the new development.

There are major flood management issues associated with redevelopment opportunities along the tidal reaches of the River Avon and within Bristol's Floating Harbour. There are also major proposals to develop areas within the city of Bath adjacent to the River Avon. These sites will need substantial fluvial flood mitigation measures in order to bring them forward for development. Further mixed-use development has been proposed in the River Avon corridor as a consequence of limited development opportunities elsewhere in the city.

In Bristol, Areas of Search A, B and C are not shown on flood maps as having a flood risk at this time. However development in these could lead to significant flood risk increase. On and off site flood mitigation works would be required should development occur in these areas.

Existing flood risks through Bath are shown in Figure 5.

Figure 5 *Bath existing floodplain (Flood Zone 3)*

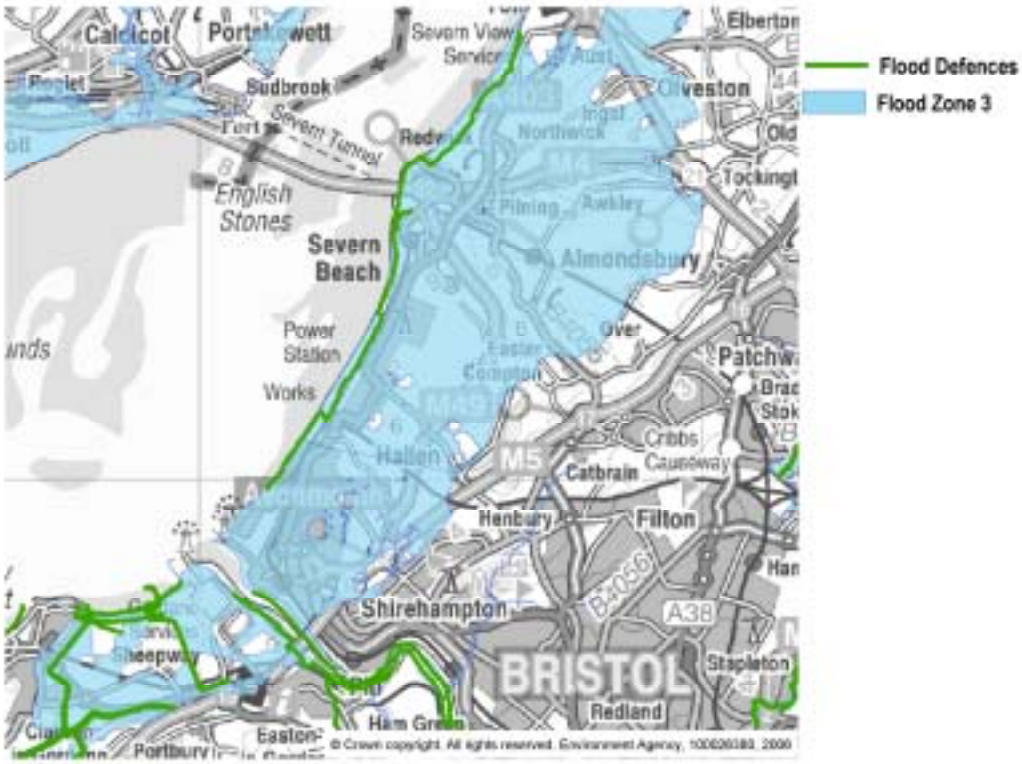

Figure 6 *Avonmouth existing floodplain (Flood Zone 3) and flood defences*

Between Avonmouth and Severn Beach there are tidal flood defences that protect up to a 100-year standard. There is currently a feasibility study underway to increase the protection to a 200-year standard. This area is affected by tidal flooding from the Severn Estuary. It is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

Flood incident management is provided in the form of flood warnings to properties in Bristol, Weston-super-Mare, Severn Beach and Area of Search F to the East of Weston-super-Mare. There are Major Incident Plans containing

specific arrangements for warning the public in areas particularly susceptible to flooding in Bath, areas of Bristol, Weston-super-Mare and Uphill.

The effect of climate change and sea level rise is a major concern for Weston-super-Mare, areas of Bristol, Avonmouth and the tidal River Severn. It is estimated that climate change and sea level rise will mean that severe tidal flooding events at Weston-super-Mare and Avonmouth will be six times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 33 year event (3%)).

There are SFRAs in progress for Avonmouth, Severnside and for areas of Weston-super-Mare. A catchment flood management plan is in progress for the River Severn Tidal Tributaries after the Severn Tidal Strategy was made public in March 2006. A Shoreline Management Plan for the Severn Estuary was published in 2001 and a revision is due to start in 2007.[13]

8.1.1 Considering Flood Risk

Flood risk considerations have been a key factor in shaping the emerging spatial strategy for the sub-region. A sieve mapping technique was used at the initial stage of strategy preparation, in particular to identify potential development locations and their capacity.

Areas at risk from flooding, both Flood Zones 2 and 3 identified in the Environment Agency Flood Map, were excluded from further considerations, alongside other national and international environmental designations, other key environmental constraints and steep slopes.

Alternative combinations of potential development locations were then combined to form a range of spatial strategy options that reflected the choices available for meeting future development requirements. From this range of spatial strategy options, a preferred strategy was then selected by reference to the spatial priorities of the West of England Partnership and sustainability assessments.[14]

[13] Appendix C has further data for this Sub-Region.
[14] As per comments from Simon Birch , West of England Partnership and Richard Daone, Bath & North East Somerset Borough Council, January 2007.

8.2 Swindon

Figure 7 *Swindon Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

Flood risk management issues arise across the favoured development areas in this sub-region. Swindon is highlighted as being an area of major urban expansion in or close to important floodplains. Rivers were modified as this town grew rapidly between the 1950s and 1990s, which has led to numerous localised flood risk problems. The River Ray floodplain lies in the eastern development area and detailed layouts will therefore be needed to protect the natural floodplain and a way to ensure this could be to utilise this space as green infrastructure in the development. Significant surface water run-off attenuation will also be necessary to manage any run-off at source and limit risks of flooding further downstream.

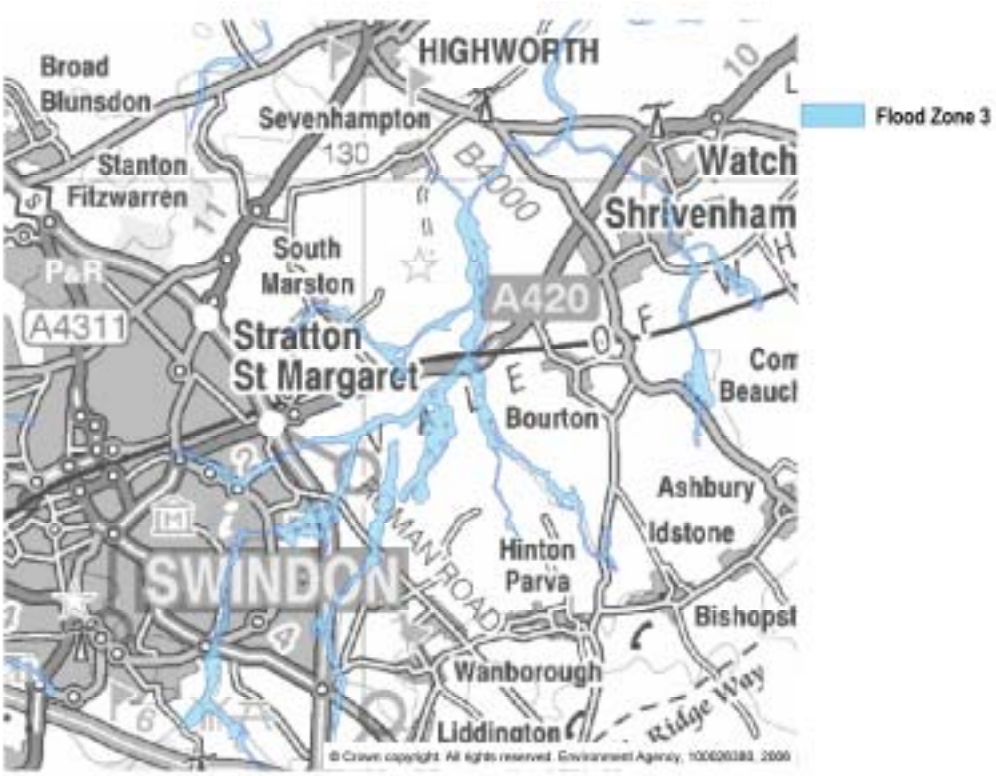

Figure 8 *Area of Search G existing floodplain (Flood Zone 3)*

There are flood risks in Swindon and in Area of search G to the East of Swindon, where properties are at risk from fluvial flooding from the Rivers Ray and Cole. This flood risk is likely to increase as a result of climate change. There are very few formal flood defence walls or embankments in this sub-region, but there are some significant culverts and trash screens and also some flood storage areas. At the present time there are no new flood risk management schemes planned in this area.

Flood incident management is provided in the form of flood warnings to properties in Swindon and Area of Search G. There is a Major Incident Plan containing specific arrangements for warning the public in areas particularly susceptible to flooding in Swindon. There are however currently no SFRAs for this sub-region although this is soon forthcoming. [15]

8.2.1 Considering Flood Risk

The Swindon Joint Study assessed the risk of flooding on the scale and location of growth at Swindon. The Environment Agency was involved in this work and commented on the three locations considered for long-term growth at Swindon (South-west, North-west and East of Swindon), highlighting that the area to the East of Swindon was associated with the highest level of flood risk. The Joint Study took a holistic approach in its consideration of issues ranging from transport and housing to culture and sport and concluded that the area to the East of Swindon was the most sustainable strategic area for future growth in Swindon. Flood risk in this area is indeed a constraint that will influence the shape of future development, but is not considered irresolvable.

[15] Appendix C has data for this Sub-Region.

The Environment Agency agreed with the interpretation of this advice in July 2006.

The Environment Agency recommended that Swindon should undertake a SFRA for the Joint Study Area in order to explore the different options available to them. In light of the results of the Swindon Joint Study, it was however considered that such an assessment would not be necessary and that a more detailed FRA would be made in the proposed Area of Search. Discussion with the Environment Agency also established that when Government guidance (PPS25) is applied to the development of Area of Search G, much of the flood risk to areas further down streams would be avoided. Most of the development is on Greenfield land and will therefore require greenfield runoff control thereby limiting flood risk. Retention of river corridors will furthermore reduce the need for future intervention. [16]

[16] As per comment from Phil Smith, Swindon Borough Council on January 2007.

8.3 Gloucester and Cheltenham

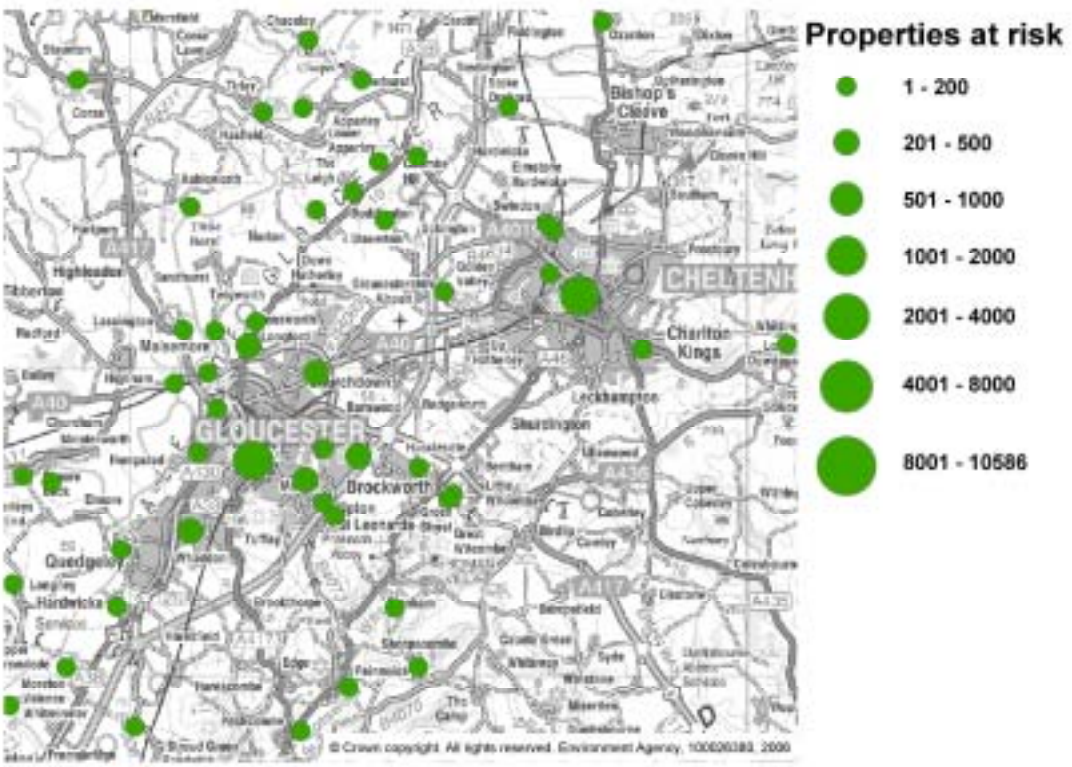

Figure 9 *Gloucester and Cheltenham Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

The River Severn and its tributaries present risks to the city of Gloucester as well as to the Area of Search H to the north of the city. The Area of Search H runs into higher ground[17] suggesting that risks could be avoided by careful layout and the use of Sustainable Drainage Systems (SuDs). Further work has been carried out through a site specific flood risk appraisal on the flood risk to the north of Gloucester. This work shows that significant parcels of land to the north are at low risk from flooding and thereby compatible with the Environment Agency's requirements.[18]

The floodplain in the Gloucester area is flat and broad, so floodwaters can extend some distance away from the river. In a 1 in a 100 year event, it is estimated that nearly 3,000 properties in Gloucester and the surrounding areas would be affected from both the Severn and its tributaries. A recently completed flood alleviation scheme at Alney Island has improved protection for approximately 50 properties. Removal of a redundant railway bank has had flood alleviation benefits, although this work was instigated as floodplain mitigation measures as part of the Gloucester South West By-Pass and Gloucester Quay development works.

[17] For more information see *Technical Paper*, from CGJSA Constraints Officer Working Group on http://www.gloucestershire.gov.uk/environment/vision2026/

[18] See Capita Symonds flood risk assessment version 2, 'Land at Longford proposal flood risk assessment: existing flooding regimes', 2004.

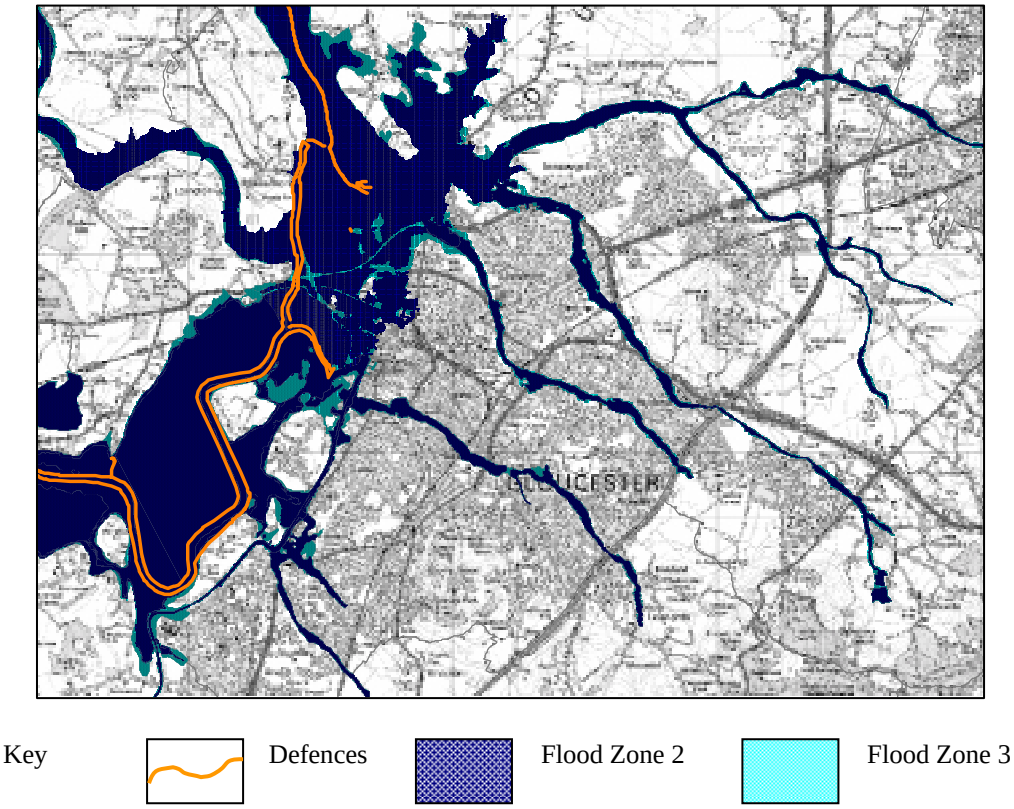

Figure 10 *Gloucester existing floodplain (Flood Zones 2 and 3) and flood defences*

There are no flood defences in Gloucester city, although fluvial defence works have recently been completed to a 75-year standard in the Alney Island part of the city. Most of the flood defence works in Gloucester have been completed by the removal of obstructions in the floodplain. It is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

It is estimated that climate change and sea level rise will mean that a severe tidal flooding event at Gloucester will be twenty times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 10 year event (10%))[19].

Although not within this sub region, the Stroud Valleys and the Forest of Dean have significant flood risk challenges. The Stroud Valleys, River Frome and River Little Avon catchments have significant fluvial and tidal flood risk issues and these areas contain a number of rural centres. In the Forest of Dean urban conurbations border tidally defended areas.

[19] See figure 1 page 16 for map of estimated increased frequency of severe tidal flooding in 2060.

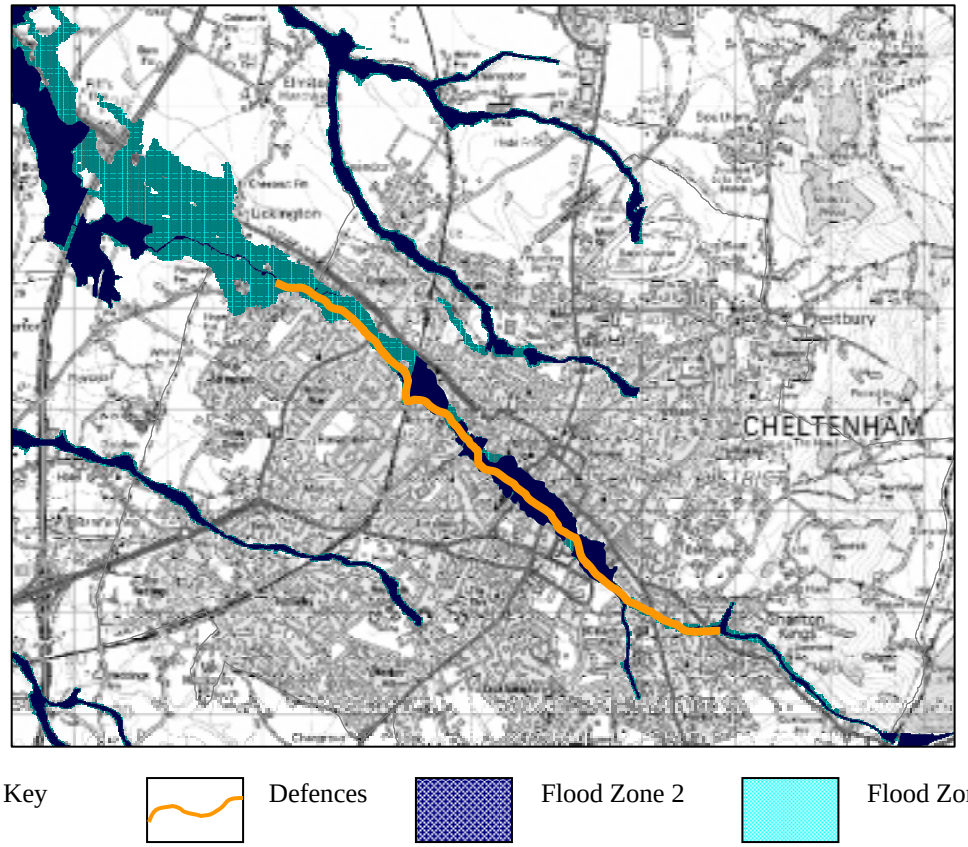

Figure 11 *Cheltenham existing floodplain (Flood Zones 2 and 3) and flood defences*

There are no major flood defence works planned for Cheltenham or Gloucester in the immediate future, although further sections of the railway embankment will be removed as part of the redevelopment of Gloucester Quays.
Surface water flooding associated with poor urban drainage and backing up within urban drainage system under high fluvial flows also affect Gloucester.
Flood incident management is provided in the form of flood warnings to properties in Gloucester from the River Severn and also on the River Severn from Tewkesbury to upstream of Gloucester.[20]

Although the Severn Tidal Strategy was published in March 2006 and the Severn CFMP was published in June 2005, there are currently no SFRAs in this sub-region.

Proposed development in the West Midlands will not have a significant effect on flood risk in the South West Region and in this sub-region in particular. The application of Government policy (PPS25) should ensure that development is

[20] Appendix C has further data for this Sub-Region.

guided away from flood risk areas and that surface water runoff from new developments should not exceed Greenfield runoff rates.

8.3.1 Considering Flood Risk

The Cheltenham and Gloucester Joint Study Area group has assessed a wide range of issues as part of the considerations of future development options. Amongst these issues were transport, the economy, population growth and key constraints such as flooding.

Flooding is as indicated on the maps a problem to the north and northwest of Gloucester, amongst other areas of the SSCT. While the County Council has consulted the Environment Agency on such problems, it is believed that further work is required to fully understand the impacts of development in this location.

For Cheltenham the most extensive area at risk from flooding is that around the River Chelt as shown on the map. The South West Regional Assembly has been advised as to further work needed in this area.[21]

[21] As per comment from David Oakhill, Gloucestershire County Council, January 2007.

8.4 Exeter

Figure 12 *Exeter Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

There are significant flood risks in Exeter urban area and also at Marsh Barton. The River Clyst floodplain covers a large area between Broadclyst and Topsham and this affects the Area of Search K to the east and southeast of Exeter. The New Community (Cranbrook) to the east of Exeter has had considerable scrutiny on flood risk, which shows that the site lies outside the floodplain.

There are flood defences providing alleviation to many communities in the Exeter urban area. The tidal reach on the River Clyst up to Clyst St Mary is being considered for managed set back of defences that currently reduce flooding on agricultural land. It is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

Flood incident management is provided in the form of flood warnings to properties in the Exeter urban area on the Rivers Exe, Clyst and Creedy and also on the coast. There is furthermore a Major Incident Plan containing specific arrangements for warning the public in areas particularly susceptible to fluvial and tidal flooding in Exeter. There are however no SFRAs in this sub-region at present.

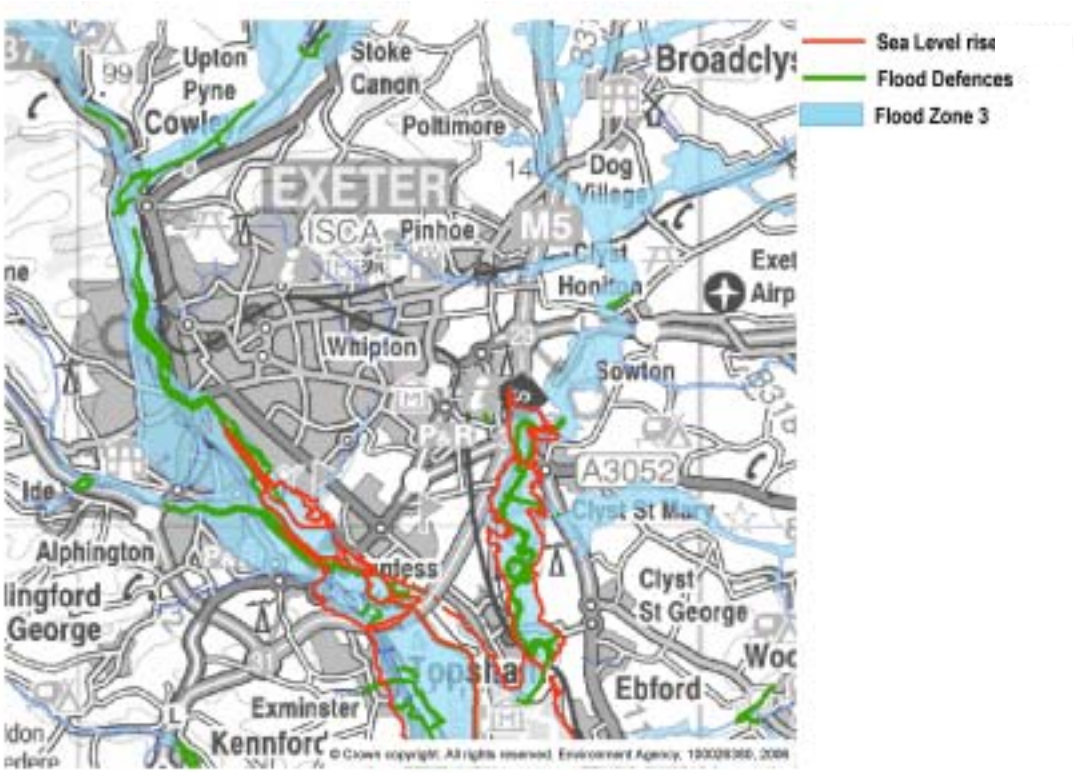

Figure 13 *Exe and Clyst existing floodplains (Flood Zone 3) and estimated line of sea level rise by 2060*

The effect of climate change and sea level rise is a concern for the River Exe and River Clyst floodplains. It is estimated that climate change and sea level rise will mean that severe tidal flooding events in the Exe estuary will be six times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 33 year event (3%)).[22]

8.4.1 Considering Flood Risk

When assessing the development options in the Exeter area, the strategic authority differentiated between absolute constraints and local constraints to future development. In this context areas subject to flood risk, as defined by Environment Agency data, were excluded from consideration for future development. Flood risk was thereby regarded as an absolute constraint to development.

The development options in the Exeter area were subject to a Sustainability Appraisal which included a further assessment of options against RSS Sustainability objectives[23]. In some cases such as the proposed new community development at Cranbrook, detailed flood risk assessment had been undertaken in respect of specific development proposals. The findings of such detailed assessments were also able to inform the conclusion of the Joint Study Area work. All of this evidence added to the context of the

[22] Appendix C has data for this Sub-Region
[23] RSS Sustainability Objective 5.6 – Reducing vulnerability of flooding and taking account of climate change.

emerging Local Development Framework Area Action Plan and Core Strategy.

8.5 Taunton and Bridgwater

Figure 14 *Taunton and Bridgwater Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

In Taunton and Bridgwater there are large areas of development in the fluvial and tidal floodplain and significant numbers of properties are at risk from flooding. In both towns flood peaks and tide locking furthermore affect surface water drainage.

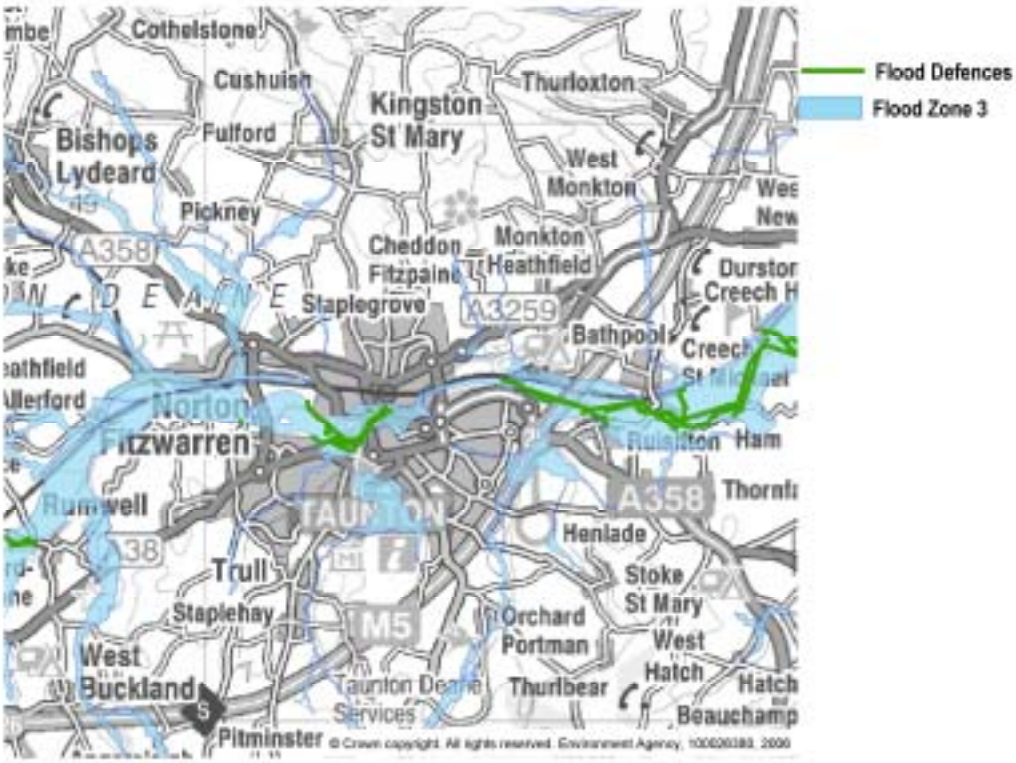

Figure 15 *Taunton existing floodplain (Flood Zone 3) and flood defences*

The River Tone potentially presents significant flood risk to the town of Taunton although flood protection schemes provide an acceptable standard of protection in most of the lower areas. The existing flood risk to Taunton is currently being addressed within the necessary infrastructure requirements for the Taunton regeneration scheme being delivered through the Taunton Vision (now Project Taunton). This is a partnership flood study for Taunton, which identifies existing flood risk and a necessary mitigation strategy that would form part of the development strategy. Redevelopment behind flood defences should be designed to reduce risk. Development in minor tributary catchments in Taunton needs to allow for conditions when the flood peak in the Tone prevents local drainage and attenuation is therefore needed. All new flood risk management would be provided by new development.

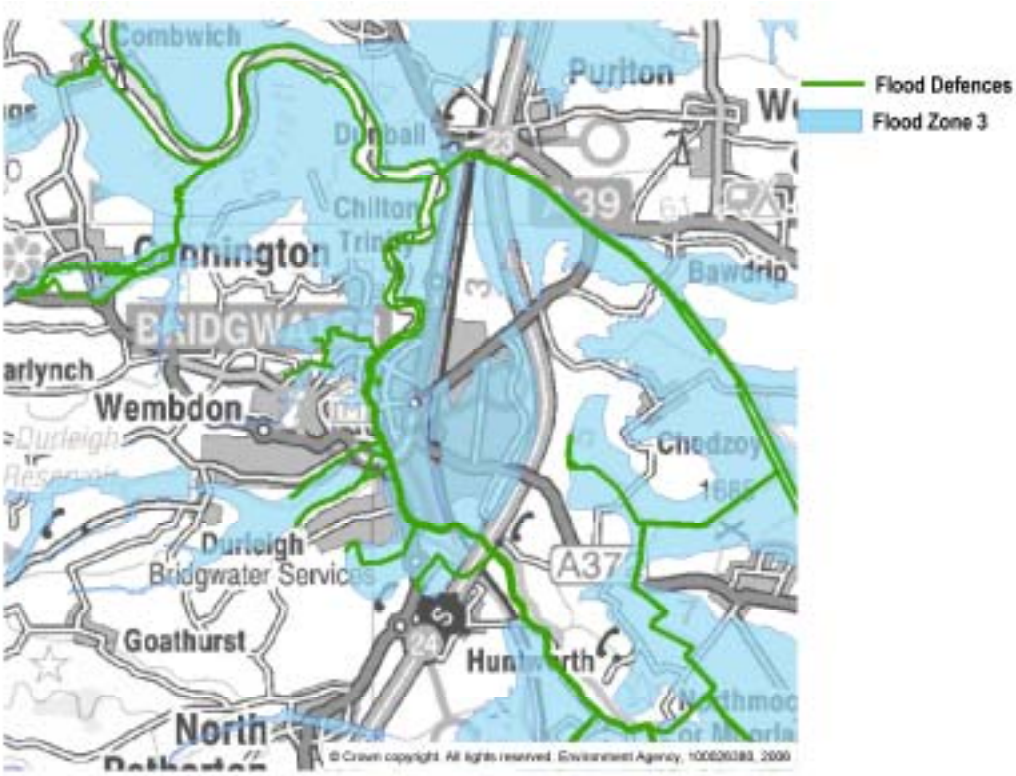

Figure 16 *Bridgwater existing floodplain (Flood Zone 3) and flood defences*

In Bridgwater both banks of the River Parrett have large areas with significant flood risks. There are existing fluvial and tidal defences in both these areas and fluvial and tidal schemes are also planned in coming years. Flood defence schemes are planned on the River Parrett and also in Taunton. It is however important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

Flood incident management is provided in the form of flood warnings to properties in the Taunton and Bridgwater areas on the Rivers Tone, Parrett, Halsewater Stream and other areas particularly susceptible to flooding. It is also worth noting that the Bristol Channel coast flood warning covers Bridgwater and that Taunton Deane Borough Council has initiated a SFRA[24].

The effect of climate change and sea level rise is a concern for significant areas of Bridgwater, particularly between the A38 and M5. It is estimated that climate change and sea level rise will mean that severe tidal flooding events on the River Parrett will be twenty times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 10 year event (10%)).[25]

[24] As per comment from Ralph Willoughby-Foster, Taunton Deane Borough Council, January 2007.
[25] Appendix C has data for this Sub-Region

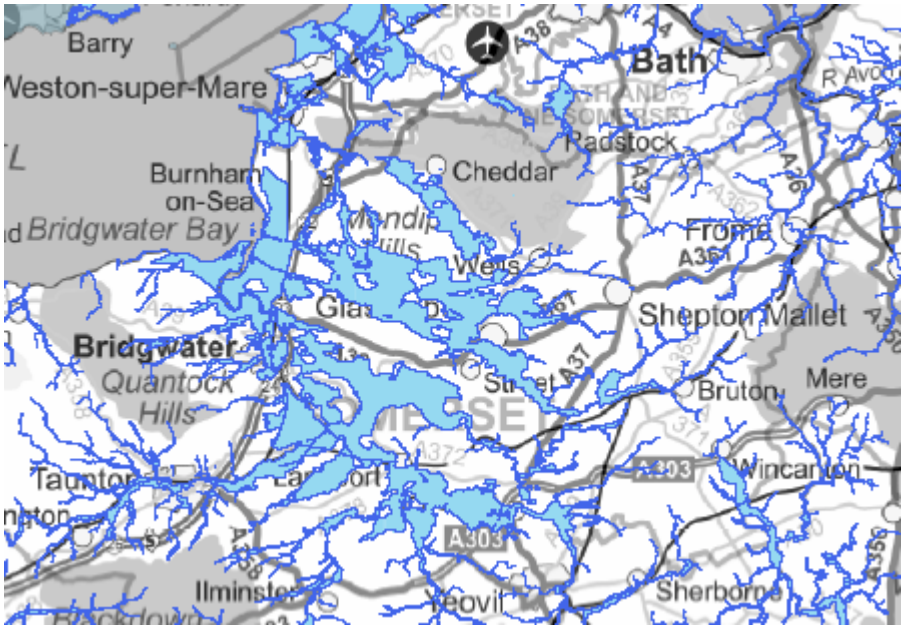

Figure 17 *Somerset Moors and Levels existing floodplain (Flood Zone 3)*

8.5.1 Considering Flood Risk

The designation of Taunton in RPG10 as a Principal Urban Area in 2001 triggered the need to undertake a strategic review of the future development of Taunton as a major growth centre. As a consequence a series of interrelated strategic studies were undertaken by a group of major key stakeholders[26] to identify the preferred strategy for future development in the town.

The Urban Design Framework Study in 2004 found that enhanced flood protection was necessary within the existing urban area to realise the full development potential of the town centre regeneration sites. It was recognised that there was a need for a comprehensive study to determine the mitigation measures required, and to assess the costs to development of providing solutions. This work has now been concluded by the Environment Agency[27]. The requirements necessary are additional upstream flood storage capacity an on-line attenuation. The need for such infrastructure is encompassed with the last sentence of Policy SR21 of the Draft RSS.

In assessing the potential of the urban fringe of Taunton for new development, in accordance with PPG25, two areas – land to the east and west of the town following the river Tone – were sieved out immediately because they were liable to flooding[28]. In accordance with the sequential test, advocated in PPG25, the French Weir green wedge including land to the west of Norton Fitzwarren, and land east of the M5 at Creech St Michael and Ruishton have also been discounted as there were other lower risk opportunities available.[29]

[26] Somerset County Council, Taunton Deane Borough Council, South West Regional Development Agency, Local Strategic Partners and the Environment Agency.
[27] *Taunton Vision Flood Risk Management Guidance*, October 2006, Black & Veatch.
[28] See figure 8.1 in *Urban Extension Study*, 2004, Baker Associates.
[29] As per comments from Paul Browning, Somerset County Council, January 2007.

8.6 South East Dorset

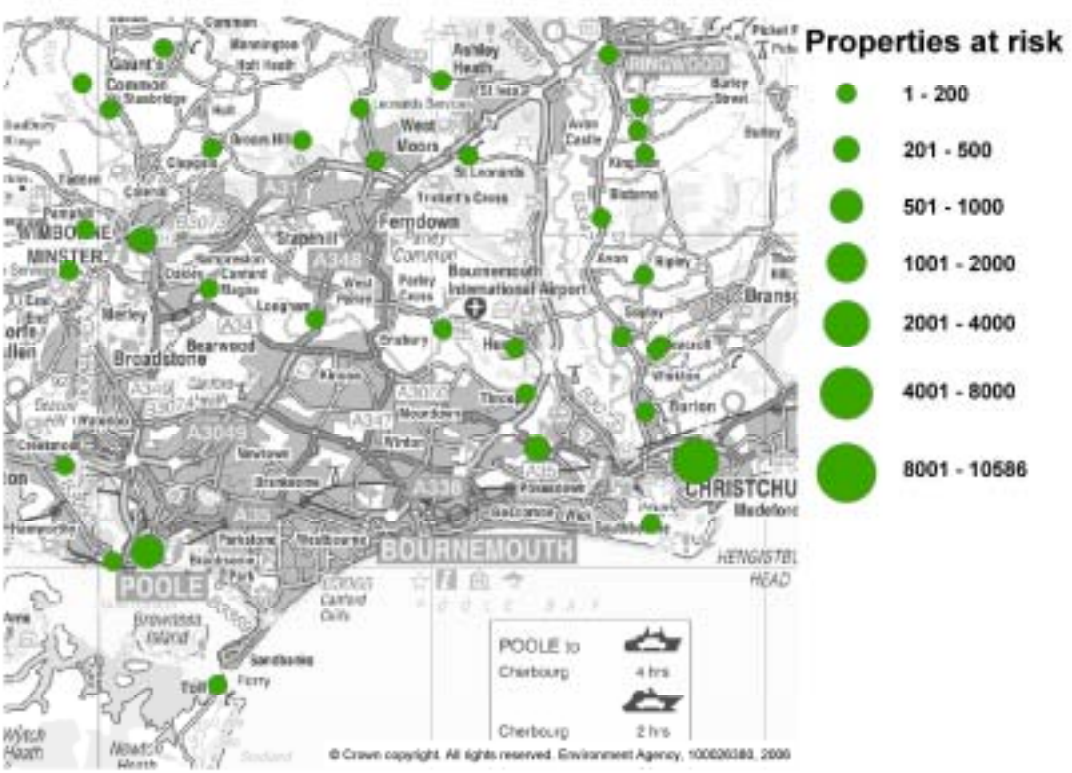

Figure 18 *South East Dorset Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

There are significant fluvial and tidal flood risks in Christchurch and Poole. Groundwater flooding affects Area of Search M, N, O and P and also areas of Poole, Bournemouth, Christchurch, Wimborne Minster, Lytchett Minster and much of the Lower Avon floodplain. The Flood Map (Flood Zone 3) does not show groundwater flooding.

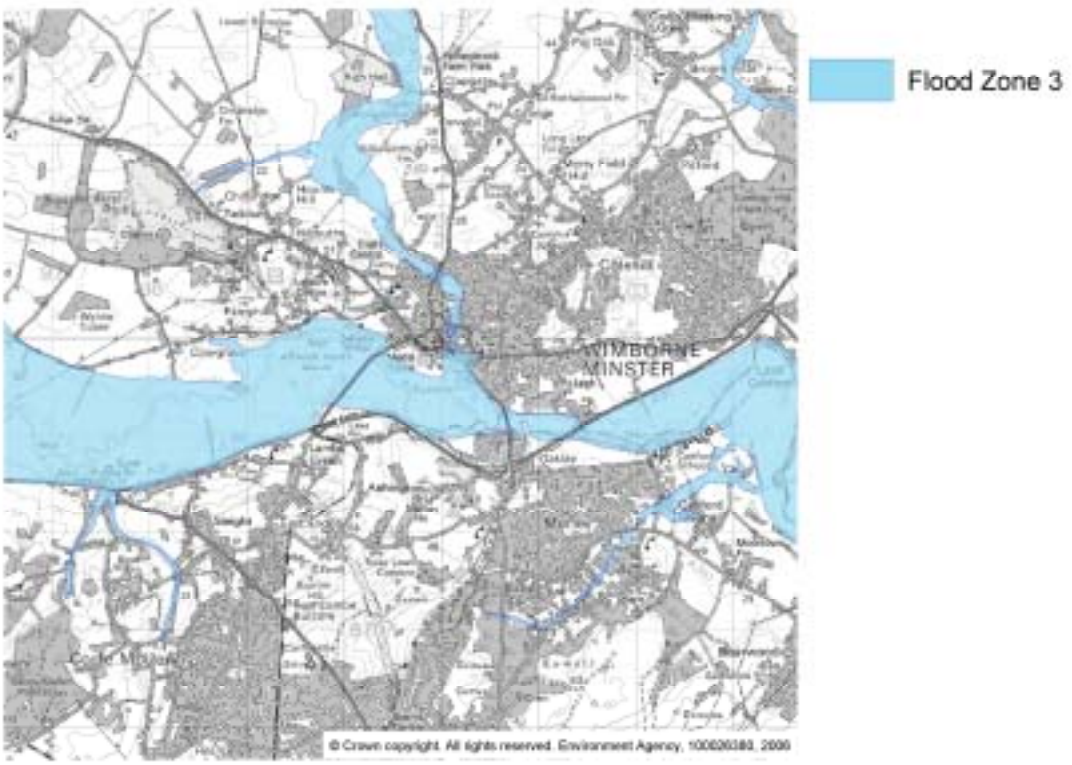

Figure 19 *Wimborne Minster existing floodplain (Flood Zone 3) (groundwater flooding not shown)*

Rivers in the lower reaches are slow to react to rainfall and this can also be exacerbated by tidal events. The effect of the chalk saturation in the upper catchment also affects fluvial flooding in the lower catchment.

There are fluvial and tidal flood defences in Christchurch, Poole and tidal defences in Bournemouth. There are tidal and fluvial schemes planned in these areas but it is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

Flood incident management is provided in the form of fluvial and tidal flood warnings to properties in Christchurch, tidal flood warnings to properties in Poole and also fluvial warnings in Areas of Search O and P. There are Major Incident Plans containing specific arrangements for warning the public in areas particularly susceptible to flooding in Bournemouth and Christchurch.

There are no SFRAs completed at present but a joint SFRA involving East Dorset District Council, Christchurch Borough Council, Bournemouth Borough Council, North Dorset District Council and Salisbury District Council is about to start. Any SFRAs will have to pay particular attention to the effect of sea level rise and also to groundwater flooding.

Figure 20 *Poole existing floodplain (Flood Zone 3), flood defences and estimated line of sea level rise by 2060 (groundwater flooding not shown)*

The effect of climate change and sea level rise is of particular concern in developed and undeveloped areas around Christchurch Harbour and Poole and also in Area of Search M. In addition concerns are being investigated over sea breakthrough at Hengistbury Head.

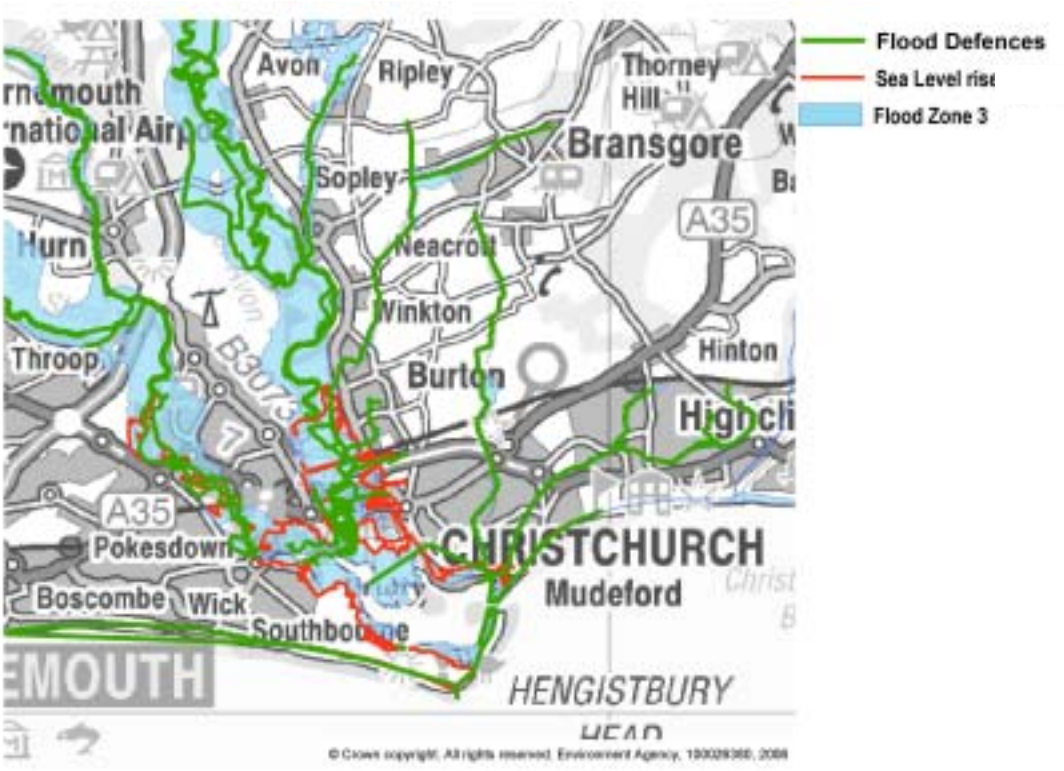

Figure 21 *Christchurch existing floodplain (Flood Zone 3), flood defences and estimated line of sea level rise by 2060 (groundwater flooding not shown)*

It is estimated that climate change and sea level rise will mean that severe tidal flooding events will be thirty two times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 6 year event (16%)).[30]

8.6.1 Considering Flood Risk

As part of the Joint Study Area work an assessment of potential flooding issues, including sea level rise, was considered and the results fed into the Sustainability Appraisal of the draft Regional Spatial Strategy. Water issues were also considered as part of the strategy options for South East Dorset.

The assessments identified that the sub-region is affected by potential impacts of flooding from both fluvial and tidal sources. Bournemouth, Poole and Christchurch are all at risk from coastal flooding and the potential affects of a rise in sea levels caused by climate change. It was considered that the most sustainable option for growth in South East Dorset would be to concentrate development in the PUA. It was however recognised that as appropriate mitigation development would need to avoid identified areas of flood risk.

At the local level, application of the sequential test was made in the provision of S4(4) advice to the South West Regional Assembly. Justification for development potential of planned extensions to the urban area involved referencing published Environment Agency flood risk maps. These cover the probability of fluvial and sea flooding in the conurbation. Reference was also

[30] Appendix C has data for this Sub-Region.

given to local advice from the Environment Agency on the risk from other forms of flooding, such as groundwater and flash floods, in relation to individual Areas of Search.[31]

[31] As per comment from Nigel Jacobs, Poole Borough Council, January 2007.

8.7 Plymouth, South East Cornwall and West Devon

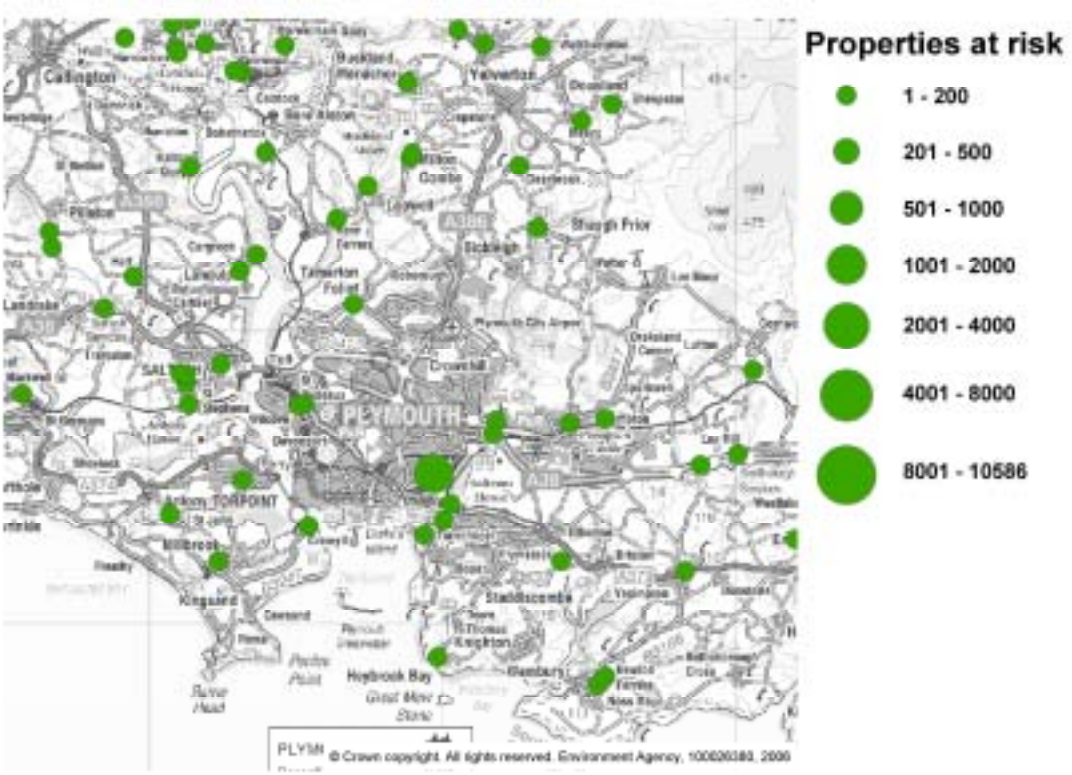

Figure 22 *Plymouth, South East Cornwall and West Devon Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

There are significant flood risks in Plymouth, which arise from a combination of tidal and fluvial flood risks and local surface water problems in highly urbanised catchments. Because of wave action at exposed shorelines, Plymouth's waterfront renaissance must be closely tied to a sound understanding of risks and street level design options that can be used to manage these risks.

There are fluvial and tidal flood defences in Plymouth, Saltash and Torpoint. There are tidal and fluvial schemes planned in Plympton, Sutton Harbour and Saltash, following the tidal flood event in 2004. It is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

Surface water flooding can become tide locked and particularly affect highways at Sutton Harbour and Embankment Road.

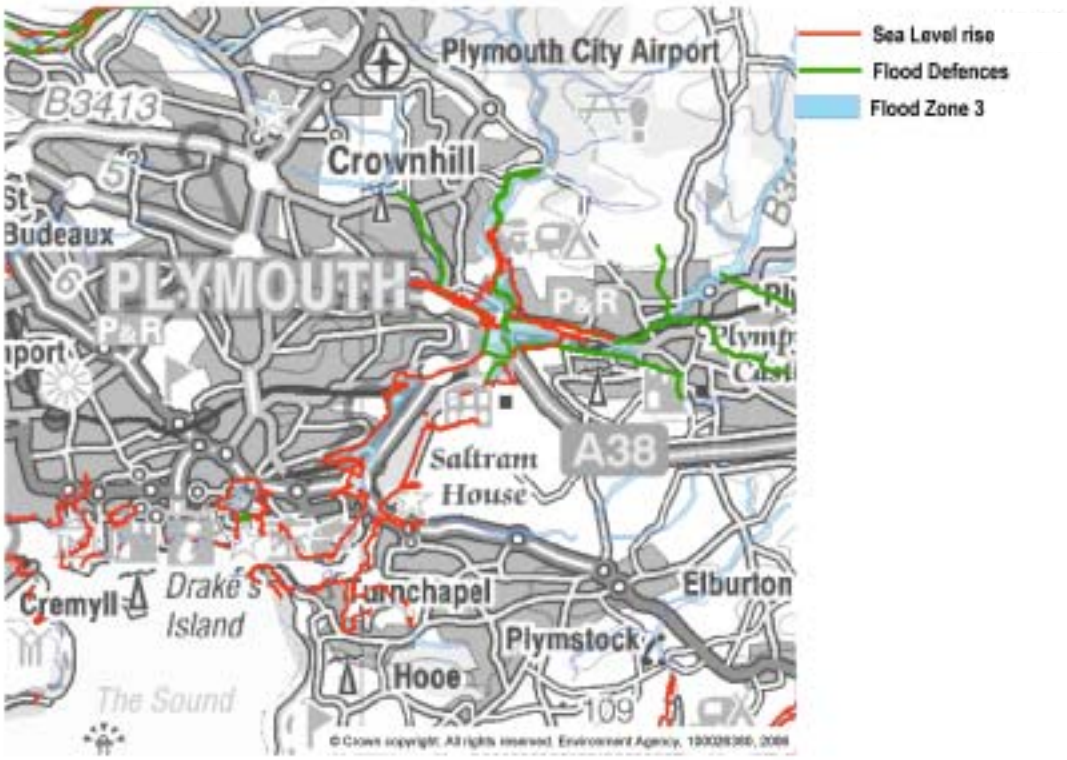

Figure 23 *River Plym in Plymouth existing floodplain (Flood Zone 3), flood defences and estimated line of sea level rise by 2060*

Flood incident management is provided in the form of fluvial and tidal flood warnings to properties on the coast and also properties along the River Plym, Tory Brook and Long Brook. There are Major Incident Plans containing specific arrangements for warning the public in areas particularly susceptible to flooding in Marsh Mills, Plympton and Plymouth Barbican.

A SFRA has been produced for Plymouth and is published on Plymouth City Council's website. The Environment Agency is also working with Plymouth City Council to develop the second level of the assessment for the east end area.

The effect of climate change and sea level rise is of particular concern in the Sutton Harbour area and also on the right bank of the River Plym at Mount Gould, Marsh Mills and Longbridge. It is estimated that climate change and sea level rise will mean that severe tidal flooding events will be fourteen times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 14 year event (7%)).[32]

8.7.1 Considering Flood Risk

Flood Risk was briefly highlighted as part of the Joint Study Area work submitted to the RPB prior to the publication of the draft RSS. Since then, and as required by PPS25, a Level 2 Strategic Flood Risk Assessment has been completed for the City of Plymouth.

[32] Appendix C has data for this Sub-Region.

In partnership with the Environment Agency, Plymouth City Council recognized that the Level 2 study most urgently needed to evaluate development proposed in low-lying areas of the city's East End as these are at risk from flooding by the Plym Estuary.

The SFRA identified relevant Flood Zones according to the Sequential Test, which will subsequently enable the City Council to apply the Exception Test in what is a highly strategic regeneration district. The SFRA did not otherwise highlight anything that would impede on the strategic growth in Plymouth in any major way.

The only other sub-regional issue identified through the SFRA was the potential flood risk in Saltash and Torpoint for which Caradon District Council has stated that they will ensure that development is identified in compliance with the PPS25.[33]

[33] As per comment from Ray Bryant, Plymouth City Council, January 2007.

8.8 Torbay

Figure 24 *Torbay Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

There are some flood risk issues in the Torbay area. Torbay has a very distinct flood risk 'signature' that is characterised by steep very flashy catchments that have been extensively urbanised and culverted through developed areas. Flood plains are limited in extent but risks are high from surface water and can be acute with high velocities of water causing particular hazards. This is of particular concern in Paignton Town Centre. Sewer flooding affects Torquay Town Centre and tidal flooding affects areas of the Torbay coast. Large areas of Newton Abbot are at risk from a 1 in 100 year's event (flood zone 3).

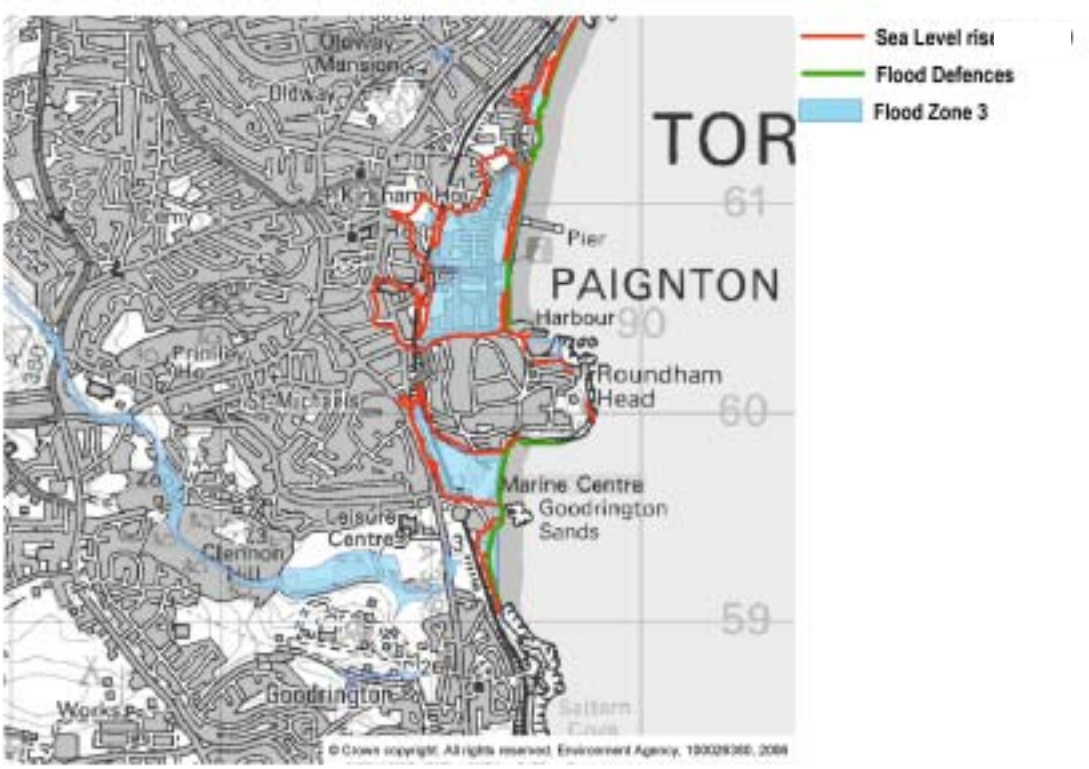

Figure 25 *Paignton existing floodplain (Flood Zone 3) and estimated line of sea level rise by 2060*

There are defences in the Torbay area and flood incident management is provided in the form of tidal flood warnings. It is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure. There are Major Incident Plans containing specific arrangements for warning the public in areas particularly susceptible to coastal flooding on the south Devon coast at Paignton, and from the River Lemon at Newton Abbot. There is a SFRA for Newton Abbot but no others planned in this sub region.

The effect of climate change and sea level rise is of particular concern in Newton Abbott on the River Teign floodplain. It is estimated that climate change and sea level rise will mean that severe tidal flooding events will be six times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 33 year event (3%)).[34]

8.8.1 Considering Flood Risk

The coastal setting and topography of the sub-region give rise to a wide range of flooding issues. The key flood risks faced by Torbay are flash flooding from run-off (affecting water courses, sewers and highway drainage), coastal flooding (inundation), tide-locking of watercourses and the broader ramifications of climate change. These factors are also relevant elsewhere in the sub-region, although flood plan issues are more prevalent in Teignbridge (Aller Brook, River Lemon and River Teign) and South Hams (River Dart).

[34] Appendix C has data for this Sub-Region.

The Torbay and South Devon JSA document dated June 2005 has addressed the broad flooding issues relating to the sub-region in the context of PPG25. These issues were furthermore highlighted during a JSA stakeholder Panel Hearing held in February 2005, attended by the Environment Agency.
Flood risk and attendant implications were considered in more detail during testing of options carried out in the JSA Strategic Sustainability Appraisal (November 2005) and further information was set out in Torbay's Section 4(4) Submission (September 2005) at Appendix A5.3 'Flood risk'.

More recently, additional detailed information has been produced in Torbay Council's Strategic Flood Risk Appraisal, due for publication in summer 2007. This SFRA is currently being revised to take on board the guidance and principles espoused in PPS25. Data from the published Teignbridge SFRA and the emerging South Devon Catchment Flood Management Plan (being prepared by the Environment Agency) will collectively contribute to the flood risk evidence base for the JSA. This broad evidence base in turn provides a basis for fine tuning of the Core Strategies of each Local Planning Authority.[35]

The development options in the Newton Abbot area were subject to a Sustainability Appraisal, which included a further assessment of options against RSS Sustainability objectives[36]. More detailed assessments of flood risk, and potential mitigation measures and management options, were produced. All of this evidence added to the context of the emerging Local Development Framework Area Action Plan and Core Strategy.

[35] As per comment from Steve Turner, Torbay Council, February 2007.
[36] RSS Sustainability Objective 5.6 – Reducing vulnerability of flooding and taking account of climate change.

8.9 Cornwall Towns

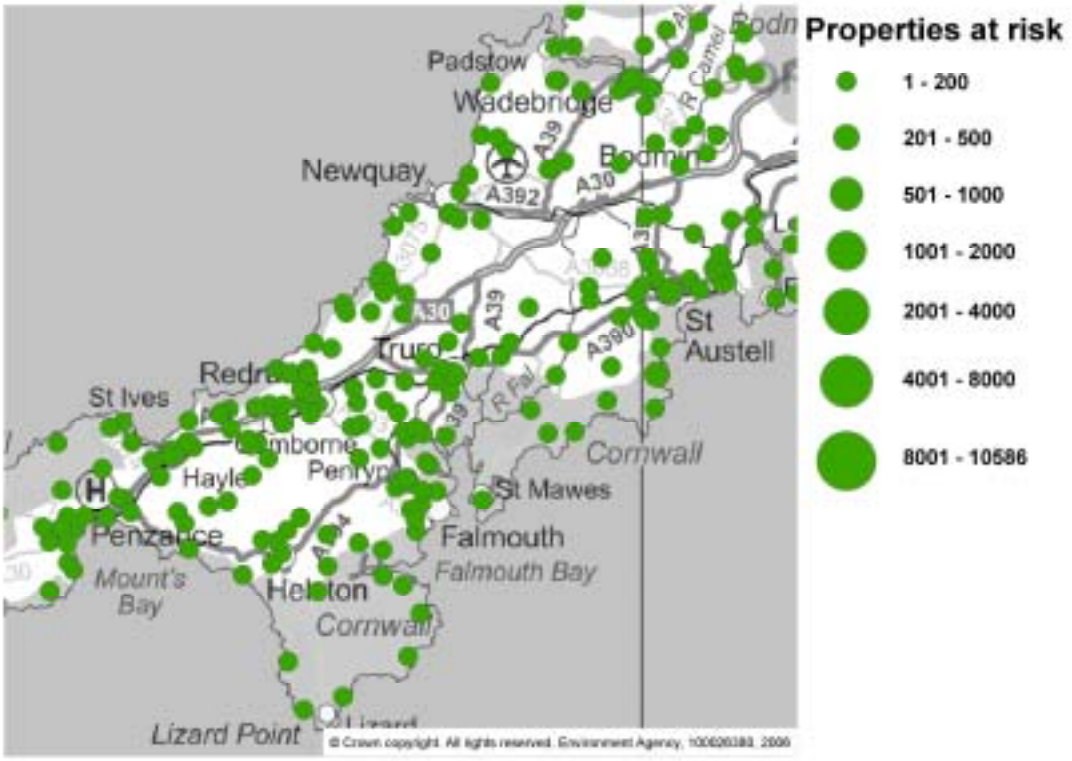

Figure 26 *Cornwall Towns Sub-Region existing properties at risk in the existing floodplain (Flood Zone 3)*

There are significant flood risks in Truro, arising from the Rivers Kenwyn, Allen and Tinney as well as from tidal flooding.

The proposed development area sits in the Tinney catchment to the south and west of Truro. The Tinney is a problem drainage catchment with flashy urbanised run-off leading to local flooding hotspots.

In Pool, Camborne and Redruth there is concern over land contamination, which requires particular approaches to drainage. There are also concerns about the existing sewer network and investigations are underway through the assessment 'Making Space for Water'. This will partly investigate retrofitting Sustainable Drainage Systems (SuDs) to address the combined sewer capacity issues in combination with future development proposals.

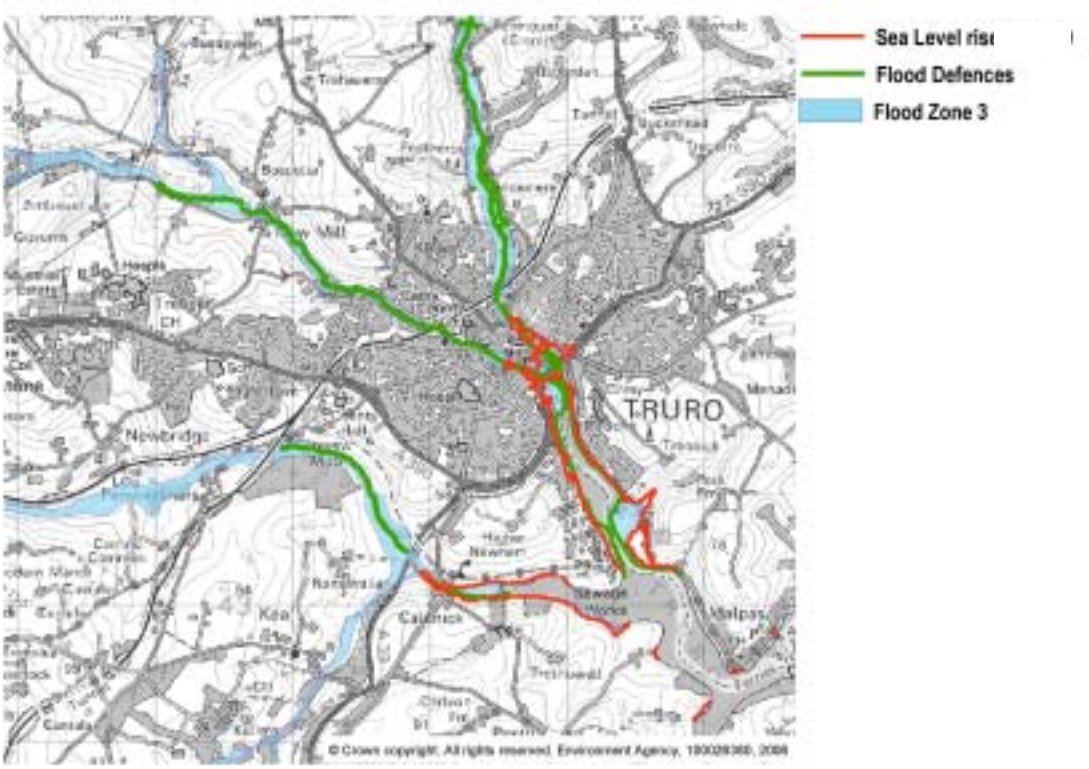

Figure 27 *Truro existing floodplain (Flood Zone 3), flood defences and estimated line of sea level rise by 2060*

There are flood defences in Truro, Penryn and Camborne and tidal schemes planned for Truro, Flushing and Falmouth. It is important to remember that even in areas with flood defences there remains a residual risk of flooding in extreme events or as a result of defence failure.

Flood incident management is provided in the form of tidal flood warnings for properties along the coast and also fluvial flood warnings in Truro. There are Major Incident Plans containing specific arrangements for warning the public in areas particularly susceptible to flooding in Truro and Penryn.

A SFRA has been produced by Carrick District Council as part of the preparation for their Core Strategy. There will be further study into the problems of flood risk for their Area Action Plans and notably for Truro and Falmouth/Penryn.

The affect of climate change and sea level rise is of particular concern in Truro and Penryn and climate change is also an issue for Looe, Mevagissey, Pentewan, Fowey and Flushing. It is estimated that climate change and sea level rise will mean that severe tidal flooding events will be fourteen times more likely to occur by 2060 (i.e. a 1 in 200 year event now (0.5%) will become a 1 in 14 year event (7%)).[37]

8.9.1 Considering Flood Risk

Cornwall County Council's advice to the South West Regional Assembly was largely based on The Cornwall Towns Study. This was a strategic assessment

[37] Appendix C has data for this Sub-Region.

of the function and role of Cornwall's Towns to inform strategy. It did not include a FRA. The strategic nature of the Council's advice made no site specific proposals. The Council took a broad view of the suitability of land not in Flood Zones 3 & 4 that could be available for the proposed level of development when forming its final advice.

Satisfied that there was no strategic flood risk to the Strategy it is anticipated that more detailed local planning would undertake the appropriate FRA and make policies and proposals in the light of these. This is being properly carried out at the local level for the Carrick Area Action Plans and other emerging Area Action Plans in Cornwall notably for the Camborne Pool Redruth area.[38]

[38] As per comment from Steve Havers, Cornwall County Council, January 2007.

9. Conclusion

Although it is unlikely that a flood event will have a regional impact as flooding very rarely affects the entire region at one particular time, it is evident through the sub-regional appraisals that there are several areas within the South West that are in significant risk of flooding.

Through the sub-regional appraisals it can be concluded that areas which suffers from regionally significant flood risk include **Somerset Levels and Moors, Avonmouth, Weston-super-Mare, Exeter, Bridgwater, Taunton, Christchurch, Poole, Weymouth** and **Truro**.

Furthermore the main concerns highlighted in each sub-region are:

1. **Weston-Super-Mare**, **Bristol** and **Avonmouth** are at risk from tidal and fluvial flooding. Surface water drainage is furthermore affected by tide locking.
2. In **Swindon** properties are at risk from fluvial flooding.
3. Climate change will have an impact on tidal flooding in **Gloucester**.
4. The Rivers Exe and Clyst have large floodplains but the new Cranbrook community lies outside the floodplain.
5. Severe tidal flooding events affecting **Bridgwater** will become significantly more likely with sea level rise.
6. There are fluvial and tidal flood risks in **Christchurch** and **Poole** as well as well as part of Area of Search M and O. Groundwater flooding is also of concern in this Sub-Region.
7. The effect of sea level rise on areas of **Plymouth** is of concern, as is the existing tidal and fluvial flood risk.
8. Surface water flooding in the flashy catchments of the **Torbay** area, plus tidal flooding along the Torbay coast.
9. **Truro** is at risk from fluvial and tidal flooding. Sea level rise is of concern, with the frequency of severe tidal flooding events increasing significantly.

According to government guidance (PPS25), Local Planning Authorities (LPAs) have to follow a sequential approach to guide development away from flood risk areas. LPAs should seek to reduce the causes of flooding by requiring that no developments and land uses may add to the risk of flooding elsewhere. They must also prepare Strategic Flood Risk Assessments, which will help to guide development away from floodplains and current or future areas at risk. In order to identify which areas are of particular risk they must consult the Environment Agency and follow the Government Practice Guide on the application of PPS25.

By taking account of climate change and the increasing risk of coastal and river flooding, as well as using an adaptive management approach, Local Planning Authorities (LPAs) should seek to defend existing properties and locate new development in places with little or no risk of flooding. Where development is exceptionally necessary, LPAs should ensure that it is safe, without increasing flood risk elsewhere and, where possible, reduce flood risk overall.

SFRAs in the South West should specifically address:

- The effect of climate change on fluvial flow increases and waves, using latest government guidance (Defra)
- Groundwater flooding
- Sewer flooding
- Surface water flooding and its management, identifying the scale of management required (SuDs)
- Sea level rise
- The effect of climate change on increased frequency of severe flooding events[39]

The RFRA will be updated to inform future revisions of the RSS and will use the latest data and guidance available at that time. In the meantime, there should be a 2-way feedback process between SFRAs, FRAs and this RFRA. As technical data becomes available through the detailed study of a FRA this will be fed into SFRAs and the RFRA. In turn, policy changes from the RFRA and SFRA will be fed into FRAs.

[39] Appendix D contains guidance on the production of a SFRA. Further advice is available from Development Control teams at the Environment Agency.