



# Severn River Basin District Flood Risk Management Plan 2015-2021

## PART B - Sub Areas in the Severn River Basin District

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# Contents

Contents .....	iii
Glossary and Abbreviations .....	iv
1. The layout of this document .....	1
2. Sub-areas in the Severn River Basin District.....	2
2.1. England only section .....	4
2.2. Wales only section.....	10
3. Conclusions, objectives and measures to manage risk for the Flood Risk Area in the Severn River Basin District.....	17
3.1. Conclusions, objectives and measures to manage risk for the Bristol Flood Risk Area and surrounding LLFA areas .....	18
4. Conclusions, objectives and measures to manage flood risk in the Severn RBD catchments .....	28
4.1a. The Welsh Severn Uplands Catchment .....	33
4.1b. The English Severn Uplands Catchment.....	40
4.2. The Shropshire Middle Severn Catchment.....	53
4.3. The Worcestershire Middle Severn Catchment.....	63
4.4. The Teme Catchment.....	74
4.5. The Warwickshire Avon catchment .....	84
4.6. The Severn Vale catchment .....	96
4.7a. The Welsh Wye catchment .....	109
4.7b. The English Wye catchment.....	116
4.8. The Usk catchment .....	128
4.9. South East Valleys catchment.....	136
4.10. The Bristol Avon and North Somerset Streams catchment .....	147

# Glossary and Abbreviations

AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
Catchment	The watershed of a surface water river system
CaBA	Catchment based approach: an approach to environmental planning that focuses on local engagement and partnerships
CFMP	Catchment Flood Management Plan
Coastal Groups	Voluntary coastal defence groups made up of maritime district authorities and other bodies with coastal defence responsibilities.
Cross Border Advisory Group (CBAG)	Set up under The Flood Risk (Cross Border Areas) Regulations 2012 (SI No. 1102). A statutory group made up of representatives from SEPA, Environment Agency and local authorities within the cross border areas.
Cross Border Areas	Those areas designated as 'cross border' under The Flood Risk (Cross Border Areas) Regulations 2012 (SI No. 1102).
CWS	County Wildlife Site
DCLG	Department for Communities and Local Government
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EIA	Environmental Impact Assessment
EPR	Environmental Protection Regulations
EU	European Union
FCERM	Flood and coastal erosion risk management
Floods Directive	The European Floods Directive (2007/60/EC) on the assessment and management of flood risks.
Flood Risk Area (FRA)	Areas where the risk of flooding from local flood risks is significant as designated under the Flood Risk Regulations.
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan – plan produced to deliver the requirements of the Flood Risk Regulations.
Government	The term government is used within this report to refer to Defra (the Department for Environment, Food and Rural Affairs) and Welsh Government.
Groundwater flooding	Occurs when water levels in the ground rise above the natural surface. Low-lying areas underlain by permeable strata are particularly susceptible.
Ha	Hectares
HLS	Higher Level (Environmental) Stewardship
HRA	Habitats Regulations Assessment: an assessment undertaken in relation to a site designated under the Habitats and Birds Directives
Km	Kilometres
LDF	Local Development Framework
LLFA	Lead Local Flood Authority
Local FRM Strategy	Local flood risk management strategy produced by LLFAs under the Flood and Water Management Act 2010.
Main river	A watercourse shown as such on the main river map, and for which the Environment Agency and Natural Resources Wales has responsibilities and powers
MSFW	Making Space for Water
National FCERM Strategy	National flood and coastal erosion risk management strategy: these are strategies prepared under the Flood and Water Management Act 2010, by the Environment Agency for England and by Welsh Government for Wales.
Natural Resource Management	The taking care of (or management of) natural resources such as land, water, air, soil, plants and animals with a particular focus on how their management affects the quality of life for both present and future generations.
NNR	National Nature Reserve

NRW	Natural Resources Wales. The NRW took over the functions of the Environment Agency in Wales on 1 <sup>st</sup> April 2013.
Ordinary watercourses (OW)	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards.
PFRA	Preliminary Flood Risk Assessment – these were required to be published by December 2011 and were the first stage in delivering the Regulations.
PU	Policy Unit
Ramsar	Wetlands of international importance designated under the Ramsar Convention
Reservoir	A natural or artificial lake where water is collected and stored until needed. Reservoirs can be used for irrigation, recreation, providing water supply for municipal needs, hydroelectric power or controlling water flow.
Risk management authorities (RMAs)	Organisations that have a key role in flood and coastal erosion risk management as defined by the Act. These are the Environment Agency, Natural Resources Wales, lead local flood authorities, district councils where there is no unitary authority, internal drainage boards, water companies, and highways authorities.
RFCCs	Regional Flood and Coastal Committees
River Basin District (RBD)	These are the reporting units to the European Commission for the Water Framework Directive and the Floods Directive.
RBMP	River Basin Management Plan – plan required by the European Water Framework Directive.
River flooding	Occurs when water levels in a channel overwhelms the capacity of the channel.
SAC	Special Area of Conservation
SAM	Scheduled Ancient Monument
SAMP	System Asset Management Plan
SEA	Strategic Environmental Assessment
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
SPA	Special Protection Area
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage Systems
Sewer flooding	Flooding caused by overloaded sewers or blockages or defects within the sewerage network
Surface water flooding	Flooding from rainwater (including snow and other precipitation) which has not entered a watercourse, drainage system or public sewer.
SWMP	Surface Water Management Plan
UKCIP	United Kingdom Climate Impact Projections
Working with natural processes:	Taking action to manage flood and coastal erosion risk by protecting, restoring and emulating the natural regulating function of catchments, rivers, floodplains and coasts. An example of this is using land to temporarily store flood water away from high risk areas.

# 1. The layout of this document

Flood Risk Management Plans have been divided into four sections to help readers identify and access information relevant to them. This is Part B. The plan has been divided into four parts.

Name	Audience
Summary Document	For those who want a high level overview of the plan
Part A: Background and river basin district wide information	For those who need some legislative background and river basin district wide, high level information
<b>Part B: Catchment Summaries</b>	For those who want the detail of the sub-areas and flooding statistics. This section includes the catchments based on Water Framework Directive (WFD) management catchments, Flood Risk Areas (identified through the Preliminary Flood Risk Assessment) and other strategic areas across the RBD.
Part C: Appendices	For those who want to see the detailed measures set out for individual communities in England

The measures that relate to Wales only are found in the Welsh Severn section. The measures tables for all Welsh catchments are reported in Part B and not in the Part C: Appendices, as the Welsh measures relate to the highest risk communities by catchment. The Welsh measures are continually updated and the measures in this plan are indicative although correct at the time of publication. The RBD-wide measures that affect Welsh Catchments are found in the Appendices.

The measures that relate to the River Basin District, the English Severn and English catchments are contained in the appendices.

Part B introduces each of the sub-areas in turn. This section outlines the catchments based on Water Framework Directive (WFD) management catchments, which make up the RBD, then the Flood Risk Areas (identified through the Preliminary Flood Risk Assessment) and other strategic areas across the RBD.

**The other parts of the flood risk management plan are located on [gov.uk](https://www.gov.uk/government/publications/severn-river-basin-district-flood-risk-management-plan) (<https://www.gov.uk/government/publications/severn-river-basin-district-flood-risk-management-plan>)**

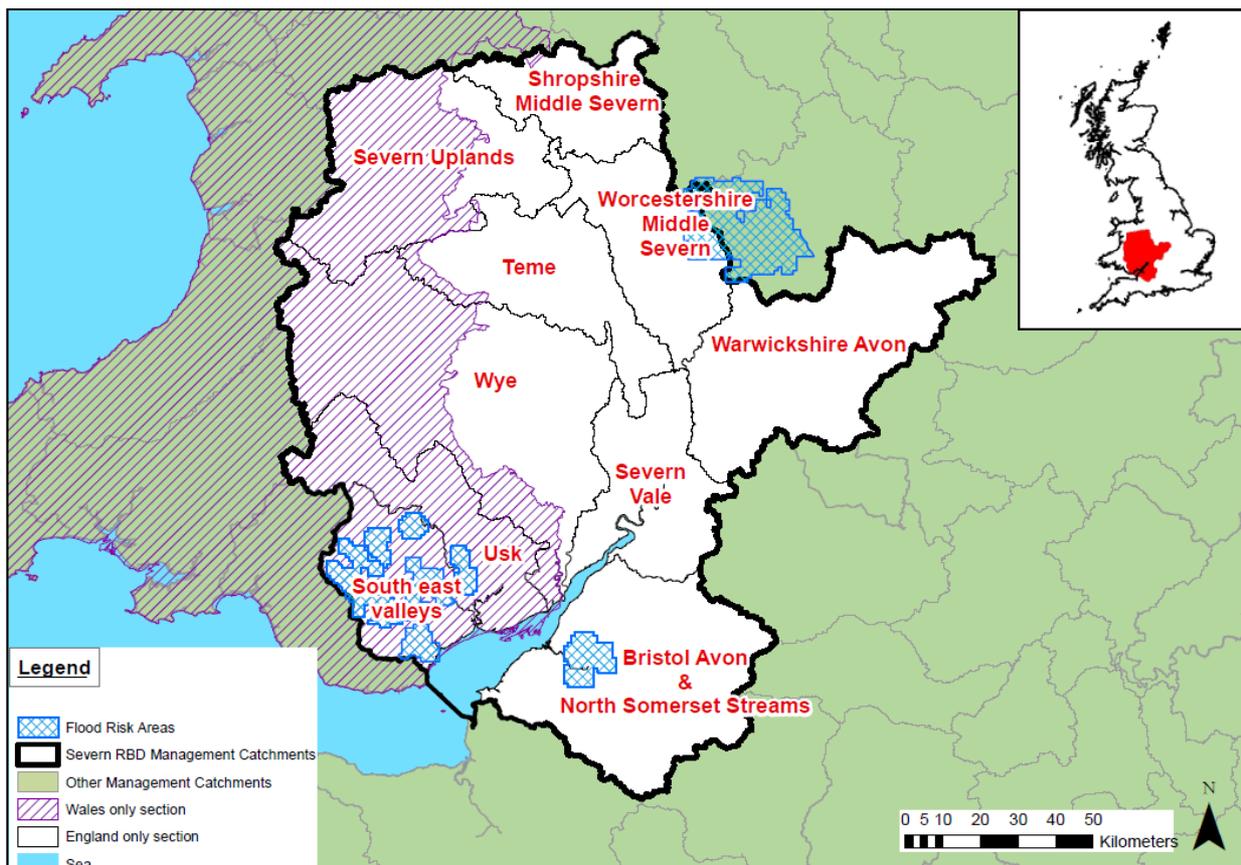
## 2. Sub-areas in the Severn River Basin District

### Introduction

There are a number of sub-areas within the Severn River Basin District (RBD), as shown in Figure 2.1 and outlined below. These are:

- English part of RBD
- Welsh part of RBD
- Catchments (which are set out according to WFD Management Catchments)
- Flood Risk Areas identified in the Preliminary Flood Risk Assessment: areas that require flood risk management plans for local sources of flooding.

**Figure 2.1: Catchments, FRAs and Wales and England only areas in the Severn river basin district**



**English / Welsh part of RBD:** Where possible, this plan has been co-ordinated at RBD scale covering the whole of the Severn RBD. As the Severn RBD covers parts of both England and Wales, there may be elements of flood risk management work that are not applicable to the whole RBD and may just cover the Welsh section or the English section due to different administrations. This plan includes two sections to consider these in turn:

- English Severn
- Welsh Severn

This will enable risk conclusions, objectives and measures to be developed for the English Severn as a distinct area and the Welsh Severn as a distinct area. The Teme, Severn Uplands and Wye catchments have areas in both the English and Welsh Severn.

**Catchments:** These are areas where National Resources Wales and the Environment Agency focus engagement to enable a catchment based approach to water management. There are 10 catchments in the Severn RBD, as listed below:

- Severn Uplands (cross border)
- Shropshire Middle Severn (English Severn)
- Worcestershire Middle Severn (English Severn)
- Teme (cross border)
- Warwickshire Avon (English Severn)
- Severn Vale (English Severn)
- Wye (cross border)
- Usk (Welsh Severn)
- South East Valleys (Welsh Severn)
- Bristol Avon & North Somerset Streams (English Severn)

**Flood Risk Areas:** These are areas identified through Preliminary Flood Risk Assessments as areas of potentially significant local flood risk (for instance surface water runoff, groundwater and ordinary watercourses), for which FRMPs need to be prepared.

The Bristol Flood Risk Area is included within this FRMP and is entirely within the Bristol Avon & North Somerset Streams catchment.

The West Midlands Flood Risk Area is included within the Humber FRMP.

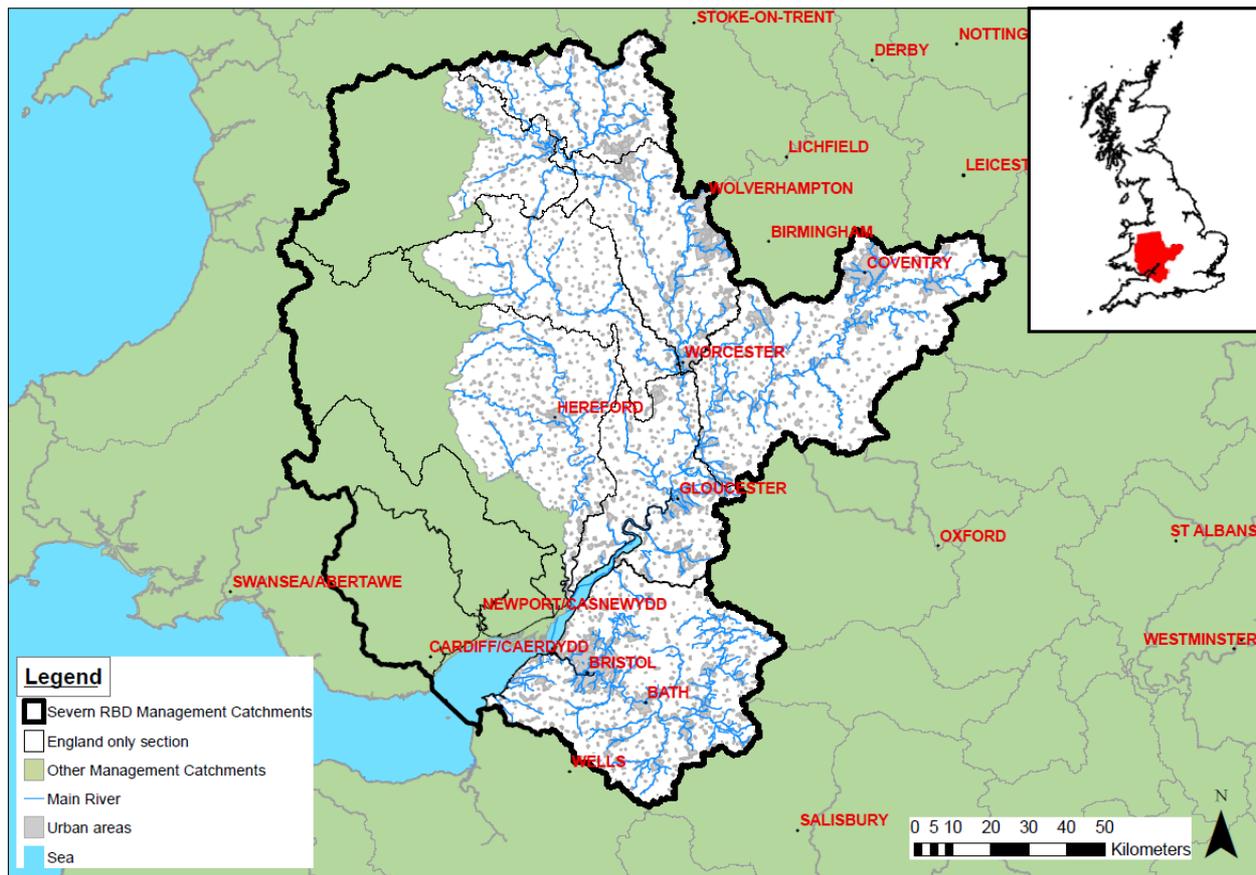
The Flood Risk Areas in Wales form separate individual FRMPs.

## 2.1. England only section

The following section considers the objectives and measures that are only applicable to the English side of the Severn River Basin District (RBD) (these are applicable at a scale larger than a single catchment but not applicable across the border in the RBD).

This section also includes information that is specific to England about the investment programme, long-term investment scenarios and contribution to broader benefits.

**Figure 2.2: Map showing England only section**



### Six year investment programme in England

In December 2014 the government set out a 6 year plan for investment in flood and coastal erosion risk management (2015/16 to 2020/21). The latest published [figures](#) show the current funding profile of each year. Each year Risk Management Authorities (local councils, Internal Drainage Boards, highway authorities, and water and sewage companies) are invited to submit details of proposed FCERM capital works to the Environment Agency. These proposals are combined with Environment Agency proposed schemes to form a programme of work. Investment in FCERM is prioritised according to government policy, and in line with the government's National FCERM Strategy and HM Treasury Green Book on economic appraisal. Government policy gives the highest priority to lives and homes and all FCERM projects should at least have a benefit cost ratio greater than 1:1. All FCERM schemes are prioritised against a consistent set of criteria applied to all risk management authorities (RMAs). This ensures a fair distribution of funding based on agreed priorities, principles and needs. Measures in FRMPs do not all have secured funding and are not guaranteed to be implemented. Money is allocated to all RMA measures in the same way and is based on current Government policy that gives the highest priority to lives and homes. The published programme can be found [here](#). Measures from the 6 year investment programme

are included in the FRMP. In subsequent years the FRMP will inform which proposed FCERM capital works are submitted to the investment programme.

## The Environment Agency’s long-term investment scenarios in England

The Environment Agency’s long-term investment scenarios (LTIS) study published in December 2014, presents a new analysis of the costs and risks of flood and coastal erosion risk management in England. The study sets out the link between national investment in flood and coastal erosion risk management, and the outcomes in terms of economic risk and numbers of properties at risk. The study found that the annual economic ‘optimum’ investment need over the next 10 years is broadly in line with current expenditure (about £750 million, including public and third party contributions). The study shows that over the next 50 years optimal investment in FCERM is expected to rise by 10-20% (in present day terms). A key finding of the study is that even if average annual investment is sustained at an optimal level there will still be significant numbers of properties at high and medium flood risk in 50 years time meaning new and innovative approaches will be needed. LTIS estimates that, by 2021, the six year programme could reduce overall flood risk by up to 5% on the assumption that planned capital, maintenance and incident management activities are maintained.

## Flood Risk Management Plan contribution to broader benefits and links with the Severn River Basin Management Plan (England)

Part A, Section 8, outlines how the FRMP can contribute to delivering broader benefits to the environment. As part of this the following table summarises the WFD outcomes expected to be delivered through flood risk management programmes by the end of cycle 2 of the RBMP by 2021:

**Table 2.1: RBMP outcomes related to flood risk management programmes by 2021**

Type of FCERM programme actions	No of actions	Hectares of water dependent habitat created or improved to help meet the objectives of WFD	Hectares of intertidal habitat created to help meet the objectives of WFD for protected areas	Kilometres of rivers protected under EU Habitats/Birds Directive improved to help meet the objectives of WFD
FCERM actions in Site Improvement Plans of water dependent sites designated under the EU Habitats and Birds Directives that will deliver a WFD outcome.	3	4	0	187
FCERM actions addressing remedies and threats to water dependent sites designated under the Wildlife & Countryside Act 1981 (SSSIs) that will deliver a WFD outcome.	1	18	0	0
FCERM actions addressing requirements for consent of flood works such as planning, EIA, HRA etc.	2	21	0	0
FCERM actions that deliver WFD outcomes from works that contribute to the Eel Regulations.	4	No of eel barrier easements or removal = 4		
<b>Total</b>	<b>10</b>	<b>43</b>	<b>0</b>	<b>187</b>

## Severn opportunities for linked work

The measures tables in the appendices show measures which support the environmental objectives of the FRMP and contribute to Water Framework Directive outcomes. These include measures that promote working with natural processes to protect and restore the natural function of catchments, floodplains and rivers. Together with supporting flood risk management, such measures can provide valuable additional benefits including water quality improvements through reductions in run-off and diffuse pollution, water resource provision through aquifer recharge and helping to mitigate and adapt to climate change through measures such as wetland creation. At the local level, measures such as sustainable drainage systems, can also contribute to urban green space provision, enhance biodiversity and contribute to local amenity and recreation.

## Links to Severn RBD Designated Site Plans

The FRMP aims to contribute to the specific plans of designated conservation sites and these are set out as proposed actions in specific plans and related to FCERM and the relevant Risk Management Authorities. These include actions in the Severn RBD Site Improvement Plans for the following European designated sites:

**Table 2.2: Severn RBD Natura 2000 sites with Site Improvement Plans**

Severn RBD Natura 2000 sites with Site Improvement Plans
<a href="#">Brown Moss</a>
<a href="#">Chew Valley Lake</a>
<a href="#">Fens Pool</a>
<a href="#">Lyppard Grange Ponds</a>
<a href="#">River Clun</a>
<a href="#">River Wye</a>
<a href="#">Severn Estuary Mor Hafren</a>
<a href="#">Walmore Common</a>
<a href="#">West Midlands Mosses</a>
<a href="#">Wye Valley Woodlands/Coetiroedd Dyffryn Gwy</a>

These plans have been developed by Natural England, in conjunction with National Resources Wales for sites that cross the border such as the River Wye (SAC) and Severn Estuary SAC/SPA/Ramsar site. For every European site in Wales (apart from cross-border sites) National Resources Wales are leading on the development of Prioritised Improvement Plans (PIPs). These are currently subject to consultation and include the River Usk.

## Conclusions and objectives for the Severn River Basin District in England

### Conclusions:

Flood risk in the English area of the Severn RBD is widespread and originates from a range of sources or a combination of these sources. These sources include:

Fluvial flooding, which is the most commonly occurring in what is predominantly a rural catchment. The speed and duration of this type of flooding can vary greatly from the rapidly responding catchments in the upland areas and in some urban locations within the district to the more prolonged events within the lowland floodplains of the larger watercourses. Predicting the extent and impact of these floods can in some circumstances be difficult, being heavily influenced by antecedent conditions.

Tidal flooding is rarer in occurrence as the majority of the areas potentially affected are provided with a level of protection by flood defences. Many of the areas are covered by the flood warning

system. The main areas affected are in North Somerset, the lower reaches of the River Wye and up the Severn Estuary as far as Gloucester. Tributaries entering into the Severn Estuary/Bristol Channel can be indirectly impacted upon by tides due to tidal locking.

There is a risk of surface water and sewer flooding in some urban locations. However surface water flooding also occurs in rural areas as a result of local influences such as topography, soil type and land use. Surface runoff also exacerbates the flooding that may occur in catchments that respond rapidly to river flooding.

The English area of the RBD has some key reservoirs such as Stanford, Draycote, Chew Valley lake and Blagdon Lake. Under the Reservoirs Act 1975 the Environment Agency regulates all reservoirs with a capacity of 25,000 cubic metres or more above ground level, which could escape in the event of a dam failure. The Environment Agency is currently going through a process of identifying which of these reservoirs is 'high-risk'. 'High-risk' reservoirs will be those reservoirs that they think, in the event of an uncontrolled release of water, could endanger human life. In the future the Environment Agency will continue to maintain a register of all reservoirs with a capacity of over 25,000 cubic metres above ground level, but will only fully regulate the 'high-risk' reservoirs.

Flooding from any of these sources individually or in combination can impact on residential and commercial properties as well as some regionally important infrastructure including roads, railways, water treatment works and electricity sub stations throughout the RBD.

### Objectives:

The objectives in tables 2.3 to 2.5 below have been sourced from the CFMPs that cover the Severn RBD in England. They set out the key factors that the measures should aim to tackle in this area. They cover social, economic and environment factors. The links to the RBD level objectives are indicated in the right hand column.

**Table. 2.3: Social objectives for the Severn River Basin District in England**

Ref	Social Objective	Links to RBD level objectives
Soc A	Promote understanding of flood risk and working in partnership	RBD 6, 10, 11
Soc B	Reduce or prevent an increase in harm to life, as a result of flooding	RBD 2
Soc C	Reduce the likelihood of death or serious injury resulting from rapid inundation or deep and fast flowing water	RBD 2
Soc D	Improve community awareness and resilience to flooding	RBD 7, 10
Soc E	Reduce or prevent an increase in the number of properties affected by flooding	RBD 2
Soc F	Reduce disruption resulting from flooding to key services and critical infrastructure	RBD 1, 6, 8, 10
Soc G	Improve flood warning procedures to reduce potential risk to communities by improving the quality of the flood warning service	RBD 9

**Table 2.4: Economic objectives for the Severn River Basin District in England**

Ref	Economic Objective	Links to RBD level objectives
Ec A	Reduce the cost of flood damage for residential and commercial properties	RBD 1
Ec B	Reduce or prevent an increase in the economic damages from flooding to cities, towns and commercial property in the catchment (including trade and tourism)	RBD 1
Ec C	Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5
Ec D	Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11
Ec E	Reduce or prevent an increase in the economic losses from flooding to agricultural land in the catchment	RBD 1

**Table 2.5: Environmental objectives for the Severn River Basin District in England**

Ref	Environmental Objective	Links to RBD level objectives
En A	Promote integrated catchment based water management	RBD 11
En B	Help maintain and enhance priority habitats and species in line with BAP targets	RBD 1, 4
En C	Protect and where possible enhance internationally and nationally designated sites through appropriate flood risk management procedures	RBD 1, 4
En D	Protect and enhance, where possible, naturally functioning rivers and floodplains	RBD 1, 4
En E	Encourage a more natural management of the river and its floodplain to help deliver WFD target of good ecological status	RBD 1, 4
En F	Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4
En G	Protect and enhance catchment landscape character, including designated landscapes	RBD 1, 4

## Measures specific to the Severn River Basin District in England

Across the Severn RBD in England measures to manage flood risk include:

**Preventing risk:** There is 1 measure in this category (Measure codes M21/M23/M24, in Annex 1):

- RMA's including water companies, deliver joined up advice on flooding.

**Preparing for risk:** There are no specific measures in this category over and above the flood risk activities described in section 6.

**Protecting from risk:** There are 2 measures in this category. (Measure codes M32/M34/M35 in Annex 1):

- undertake a programme to replace/refurbish flood risk management assets;
- investigate the benefits of planting wet woodlands to hold water back.

**Recovery and review of risk:** There are no specific measures in this category over and above existing flood risk work.

**Other measures:** There is 1 other measure (Measure code M61 in Annex 1):

- partnership working across RMA's including water companies.

More detail on specific measures is included in Annex 1

## 2.2. Wales only section

### Conclusions and objectives for the Wales only area of the Severn River Basin District

This section will outline the ways in which Wales works that are different to those set out in Part A, Section 8. It will address the conclusions and objectives that Wales have and the methodology used to ensure all the objectives set by Welsh Government are met.

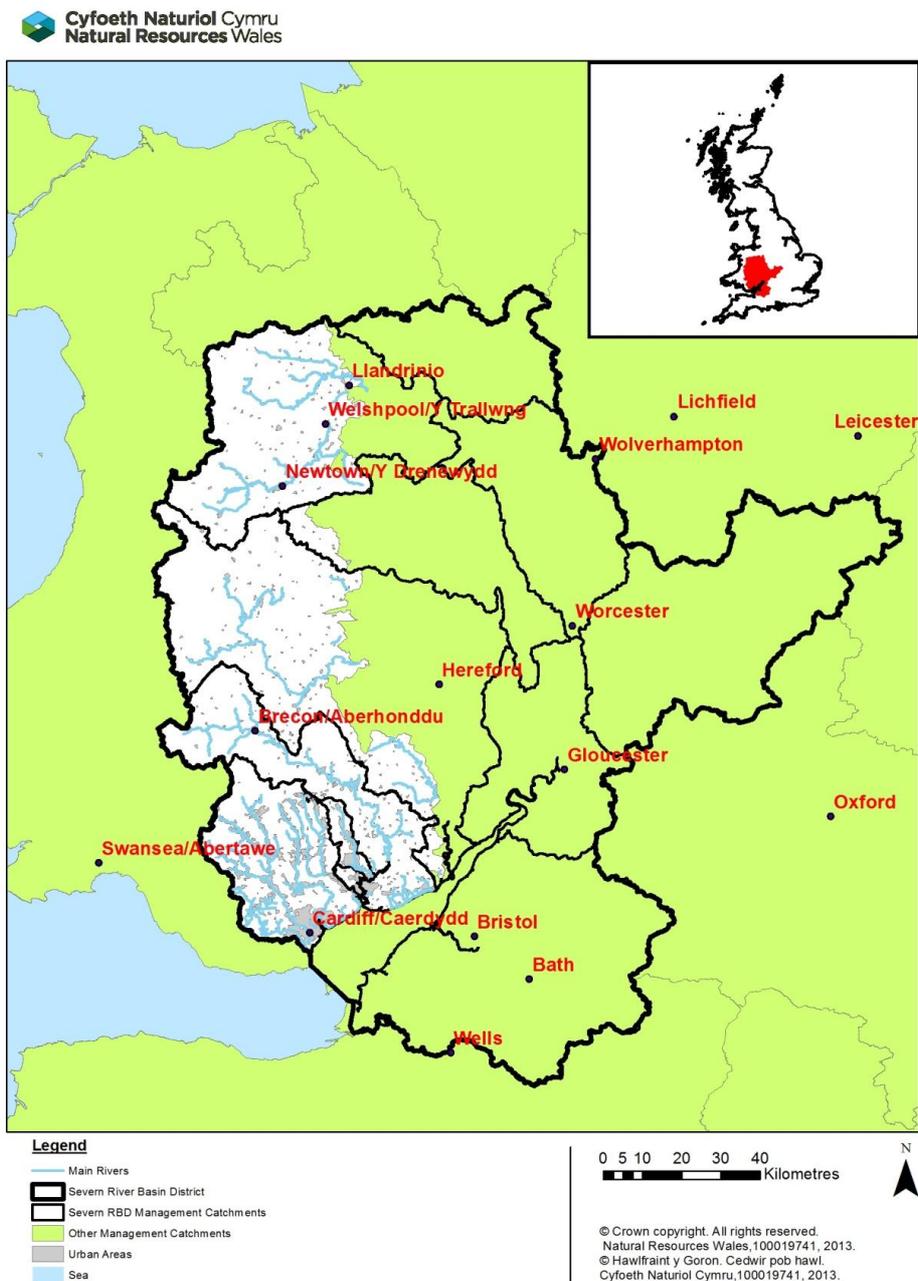


Figure 2.3: Area covered by Wales only section.

## Conclusions:

Flood risk in the Welsh area of the Severn River Basin District (RBD) is predominantly in the tidal areas and South East Valleys catchments with over half of the top 50 at risk communities in Wales being in this basin district. The flood risk can be split into two discreet types, with the tidal risk being predictable and relatively well catered for by flood warnings, and the less predictable and difficult to warn for fluvial flooding. The South Wales valleys are highly urbanised, with numerous important infrastructure and economically important areas, while the upper catchments of the Wye and Severn are more rural with typically sheep farming and forestry the dominant activities.

The key communities in the Wales areas are found in the South Wales valleys along the rivers Taff, Rhondda, Cynon and lower Usk, with both Newport and Cardiff being within this area. The risk is managed predominantly by well established flood alleviation schemes that were built in the last 30 to 40 years and maintained by Natural Resources Wales and its predecessor organisations.

The Welsh areas of the river basin also have some key reservoirs in the headwaters such as Pontsticil, Beacons, Cantref and Llwyn-on on the Taff, Clywedog on the Severn, Lake Vyrnwy and the Elan cascade on the Wye.

Under the Reservoirs Act 1975 Natural Resources Wales regulates all reservoirs in Wales with a capacity of 25,000 cubic metres or more above ground level, which could escape in the event of a dam failure. Once new legislation is commenced, Natural Resources Wales will go through a process of identifying which of these reservoirs is 'high-risk'. 'High-risk' reservoirs will be those reservoirs that it is believed, in the event of an uncontrolled release of water, could endanger human life.

In the future Natural Resources Wales will continue to maintain a register of all reservoirs with a capacity of over 10,000 cubic metres above ground level, but will only fully regulate the 'high-risk' reservoirs; lower risk reservoirs will require a lesser level of regulation.

## Objectives:

The Welsh Government National Flood and Coastal Erosion Risk Management Strategy objectives set the framework for flood and coastal erosion risk management work within Wales.

- Reducing the consequences for individuals, communities, businesses and the environment from flooding and coastal erosion
- Raising awareness of and engaging people in the response to flood and coastal erosion risk
- Providing an effective and sustained response to flood and coastal erosion events;
- Prioritising investment in the most at risk communities.

Every flood risk management action undertaken in Wales aims to deliver the National Flood and Coastal Erosion Risk Management strategy objectives.

Sitting beneath the National Strategy objectives, Natural Resources Wales has developed a set of seven objectives for this plan. The majority of these objectives were developed and agreed by the CFMP Steering Groups based upon understanding of flood risk and issues that are important now and/or in the future. Their suitability has been reviewed against the Welsh Government National Strategy and FRMP requirements and are deemed to still sufficiently reflect the key objectives of flood risk management work in Wales. The sub-objectives were developed by considering the three main aspects of sustainable flood risk management:

- Social: people and communities
- Economic: potential cost and economic benefit
- Environment: cultural heritage, landscape and habitat diversity.

The principles of sustainable flood risk management remain the key deliverables for the flood risk management work of Natural Resources Wales.

Sustainable flood risk practice in Wales is increasingly focused on working with natural processes to create more flexible and adaptive solutions that provide increased resilience to the changing and uncertain climate. Natural Resources Wales actively seek opportunities to undertake natural flood management by using all appropriate tools available to us, such as the Woodland Creation maps. By working with natural processes to deliver flood risk management other benefits are provided such as restoring/maintaining soil drainage capacity, creating/restoring habitats, enhancing biodiversity, capturing carbon, reducing sedimentation and improving water quality. This approach has the potential to achieve greater value for money because it enables the development of multi-functional projects which provide a wide range of ecosystem services and benefits to society.

Through the flood risk management planning and river basin management planning process Natural Resources Wales have determined where priority water bodies coincide with communities at risk to identify opportunities to deliver more holistic natural resource management through flood risk management projects and operations.

Where a flooding problem is identified in Wales, the first step is to fully understand the cause to determine what management response might be appropriate. Natural Resources Wales aim to consider non-structural solutions first and implement these where it is possible to do so, such as flood warning and awareness raising so people and communities are able to plan and prepare for flooding. If the flood risk is at a level that without intervention will pose a serious threat to people and property, Natural Resources Wales, in consultation with the community and environmental experts, will consider solutions to reduce and manage the threat of flooding.

It is through this process of assessing different risk management options that Natural Resources Wales will consider all the options that could reduce the risk of flooding, including how the river interacts with the natural flood plain and options to retain water, amongst all other solutions. Potential options are considered for their technical feasibility and cost amongst many other factors in order to select the preferred option. If an option is identified as having the potential to retain water close to the point where it has fallen, Natural Resources Wales will aim to work closely with land owners and managers, and communities to develop the solution that will not only slow the flow of water into the watercourse but also can create improved landscape and environment.

Integrated natural resource management is a key element of the Welsh Government's legislative programme. The Well Being and Future Generations Act, the Planning Act and the Environment Bill, together with the Wales National Marine Plan, set out a new statutory framework and process for the integrated management and sustainable use of natural resources in Wales.

This new framework for managing natural resources, will build on the UN ecosystem approach, defined as 'an integrated strategy for the management of natural resources'. The Environment Bill, expected to receive Royal Assent by spring 2016 will legislate for a more joined-up management process, focused on delivering a healthier, more resilient Wales through economic, social and environmental benefits.

This starts by introducing a new prioritisation process - to identify and characterise the key pressures on natural resources and to explore the opportunities for the sustainable management of these resources within a defined geographical area. By recognising and better understanding the challenges faced, the tools used to safeguard and deliver environmental benefits (of which flood risk management plans are one) can be applied in a more integrated and joined-up way— better reflecting the needs of that place. An integrated approach to natural resource management is currently being trialled across Wales in three catchment areas, the Dyfi, Tawe and Rhondda.

The natural resource management framework is still being developed in Wales but the flood risk management plans reflect the essential elements of the new approach in the following ways:

**Be area based.**

The flood risk management plans are set at a variety of spatial scales. This enables the focus for managing flood risk to be delivered at the spatial scale most relevant for communities, stakeholders and level of flood risk.

**Involve stakeholder engagement throughout.**

It is essential that stakeholders are involved, including local authorities, communities, developers and industry, throughout the process of drawing up and implementing the flood risk management plans. This will ensure efforts are targeted in the right places.

**Plan and present at the most appropriate scale.**

The Floods Directive requires that management plans are produced and reviewed at the river basin scale. For some management actions, this scale is appropriate. For others, management actions are best considered at the catchment or community scale. Flood risk management work is planned at the scale which is most appropriate to deliver most for communities and stakeholders.

**Plan for the long term.**

To create a sustainable Wales there is a need to consider the opportunities and constraints Wales will face in the long term. Flood risk management plans consider both short term and long term objectives and measures for the management of flood risk are reviewed every six years.

**Plan to deliver multiple benefits.**

There is a need to ensure future activities deliver multiple, long term benefits for the environment and for the economy and society in Wales. All decision making must therefore reflect the long-term well-being goals for Wales and be underpinned by the principles of sustainable management.

Sustainable flood risk practice in Wales is increasingly focused on how working with natural processes can be used to create more flexible and adaptive solutions that provide increased resilience to a changing and uncertain climate.

**Be evidence based.**

To develop this flood risk management plan the best available evidence has been used from a range of sources, building on both Natural Resources Wales knowledge and that of stakeholders and local communities. Natural Resources Wales will continue to build and improve this evidence base.

**People focussed.**

The natural resource planning process will need to reflect the principles of co-production and stakeholder engagement. The overarching aim should deliver outcomes that are equitably distributed and focussed on delivering long term benefits for the people of Wales.

By working with others the aim is to:

- Understand all the issues (not just flood risk) and how they interact;
- Understand how the issues are affecting the current local benefits and future sustainability;
- Involve local people, communities, organisations and businesses in making decisions that affect their area by sharing evidence, knowledge and experience;
- Identify which issues to tackle as a priority

The table below provides details on the Seven FRMP sub-objectives and how they link to the Welsh Government National Flood and Coastal Erosion Risk Management Strategy and the aspects of sustainable flood risk management.

**Table 2.6: Wales FRMP Objectives**

FRMP Objective Number	Wales FRMP Objective	Link to Welsh Government National Flood and Coastal Erosion Risk Management Strategy Objectives	Principles of Sustainability		
			People	Environment	Economy
Objective 1	Reduce the risk of harm to life from flooding to people and communities from main rivers, reservoirs and the sea	1, 3	Y		Y
Objective 2	Increase resilience of services, assets and infrastructure to the risk of flooding	1, 3	Y		Y
Objective 3	Improve understanding of flood risk so that decisions are based upon the best available information	1, 3	Y	Y	Y
Objective 4	Improve community awareness and resilience to flooding	2	Y		Y
Objective 5	Provide an effective and sustained response to flood events.	3	Y		Y
Objective 6	Allocate funding and resources for all sources of flooding on a risk basis	4	Y	Y	Y
Objective 7	Incorporate the ecosystem approach into the delivery of flood risk management	1, 4	Y	Y	Y
Objective 8	Seek opportunities to deliver RBMP measures through Flood Risk Management	1	Y	Y	Y

## Selecting measures to achieve objectives

Any measure that Natural Resources Wales undertakes as part of this FRMP will be for the purpose of meeting the sub-objectives set out above, and ultimately, those set out in the Welsh Government National Flood and Coastal Erosion Risk Management Strategy. The measures within this plan have been selected after considering:

- the source and severity of the risk;
- what risk management processes are already in place;
- how the risk might change in the future; and
- the options to address the risk.

The most appropriate measure is selected after considering all of these factors along with the technical feasibility and the cost. The appropriate measure is then assessed against the plan objectives to ensure the proposed measure is in keeping with the preferred Welsh approach.

The measures within the latter sections of this plan are linked to the relevant plan objectives so it is possible to see which measures will deliver which objectives.

Within the Wales area of the Severn RBD, a combination of measures is used to manage and reduce flood risk. This section outlines the RBD scale measures that are already ongoing in the Wales part of the Severn RBD and will continue to be delivered by Natural Resources Wales.

## Priority scoring the measures

In Wales priorities for each measure are set using the table below:

<b>1</b>	Critical - Needs attention - immediately
<b>2</b>	Very High - Needs attention - short term ( year 1)
<b>3</b>	High - Needs attention - medium term ( year 2 - 3)
<b>4</b>	Medium - Needs attention - medium term ( year 4 - 6)
<b>5</b>	Low - Good status - no intervention required for > 6 years

## Implementation Status

**Table 2.7: This gives an indication of what stage the measure has reached**

Implementation status	Description
Not started	<p>Could mean that:</p> <ul style="list-style-type: none"> <li>The technical and/or administrative procedures necessary for starting the construction or building works of a project have not started.</li> <li>The advisory services are not yet operational and have not provided any advisory session yet.</li> <li>The research, investigation or study has not started, i.e. contract has not been signed or there has not been any progress.</li> <li>The administrative file has not been opened and there has not been any administrative action as regards the measure.</li> </ul>
On-going	<p>Could mean that:</p> <ul style="list-style-type: none"> <li>The administrative procedures necessary for starting the construction or building works have started but are not finalised.</li> <li>The advisory services are operational and are being used.</li> <li>The research, investigation or study has been contracted or started and is being developed.</li> <li>An administrative file has been opened and at least a first administrative action has been taken.</li> </ul>
Complete	<p>Could mean that:</p> <ul style="list-style-type: none"> <li>The works have been finalised and the facilities are operational.</li> <li>An advisory service that has been implemented and has been finalised,</li> <li>The research, investigation or study has been finalised and has been delivered.</li> <li>The administrative act has been concluded (e.g. the regulation has been adopted, etc.).</li> </ul>

## Welsh National FRMP measures for RBMP and FRMP

**Identify opportunities to improve the water environment through existing programmes of work and scheme designs for Flood Risk Management.** Potential synergies and conflicts between RBMP measures and FRMP measures in specific communities at risk have been identified and will be incorporated into the Communities at Risk Register to identify where multiple benefits can be delivered through projects. Those actions that can be delivered within the next 6 year planning window are documented in the delivery plans in Section 8.

**Natural Resources Wales will seek opportunities and influence others to utilise natural flood risk management measures where appropriate.** FRM will work with the Area Natural Resource Management teams in the development of the Area Based Statements to ensure flood risk is integral in the consideration of Natural Resource Management, including identifying opportunities to deliver Natural Flood Risk Management. FRM will support the work of others to identify opportunities and implement measures to secure flood risk benefits as part of planned programmes of work/projects.

**Implement managed realignment and intertidal habitat creation through the National Habitat Creation Programme (NHCP).** Natural Resources Wales will continue with this programme of work, delivering coastal compensation habitat to offset predicted losses brought about through coastal squeeze, as identified in the SMP2's.

**In waterbodies designated as heavily modified due to flood and coastal protection, mitigation for National Resources Wales owned assets and activities will be reviewed and delivered on a prioritised basis.**

**Contribute to the achievement of the WFD objective and favourable conservation status at priority Water Level Management sites.** Natural Resources Wales will continue working with protected sites colleagues and land owners in the delivery of Water Level Management Plans.

**Contribute to research and development to identify best practice for managing hydromorphological pressures in the water environment. Preventing risk:**

**Seek opportunities to undertake Natural Flood Risk Management by using all appropriate tools available, such as the Woodland Creation maps.**

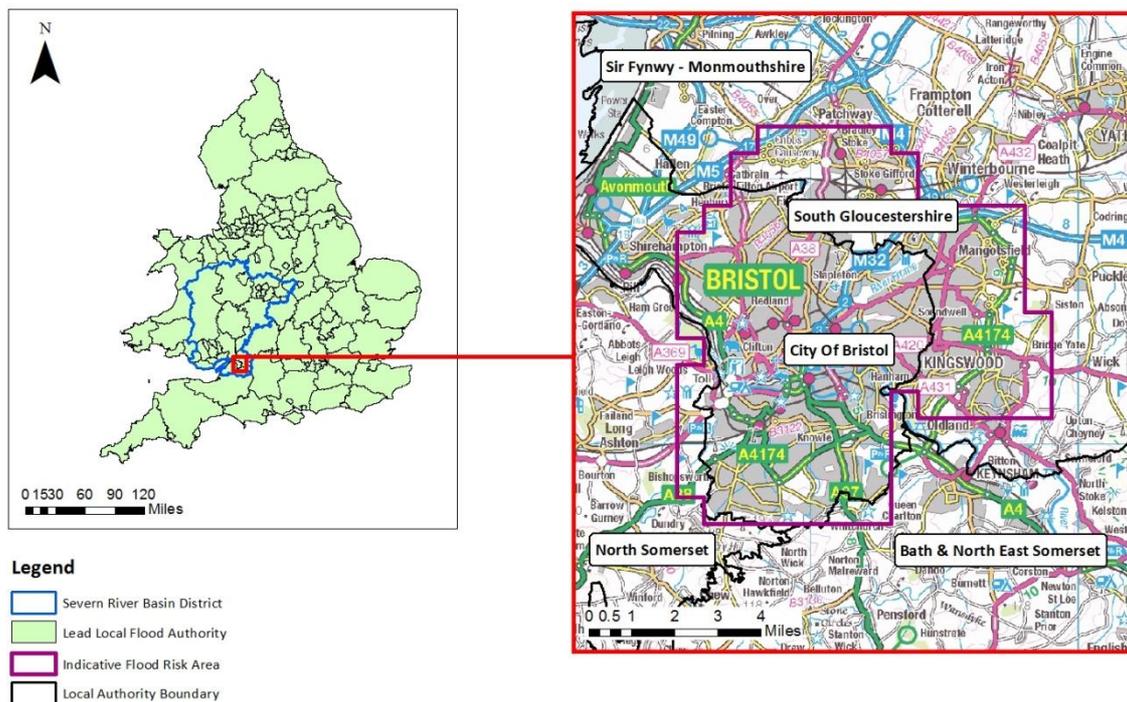
### 3. Conclusions, objectives and measures to manage risk for the Flood Risk Area in the Severn River Basin District

The following section considers the conclusions, objectives and measures for the Bristol Flood Risk Area and surrounding LLFA areas.

# 3.1. Conclusions, objectives and measures to manage risk for the Bristol Flood Risk Area and surrounding LLFA areas

## Introduction to the Bristol Flood Risk Area

The Bristol Flood Risk Area (BFRA) extends beyond the Bristol City Council boundary and into 3 neighbouring Lead Local Flood Authority (LLFA) areas. This is shown in Figure 3.1, which identifies the position of other Flood Risk Areas across England and Wales, as well as the setting of the study area with regards to the relevant Severn River Basin District boundary.



**Figure 3.1: Location Plan showing indicative Flood Risk Area and Severn River Basin District boundary.**

Unemployment is below the national average and some areas are among the least deprived in the country, although these lie adjacent to some of the most deprived in the country.

Bristol City is characterised by a great richness in its historic environment encompassing both areas such as the medieval centre, historic dockland and individual structures such as the Clifton Suspension Bridge. Its urban areas contain nearly 4,500 listed buildings and over 30 conservation areas. This, along with Bristol's heritage in the arts, culture and education has been credited with being a major factor in the attraction of inward investment. There has been a growing consensus around the need to protect Bristol's open spaces, and to balance the value of wildlife and nature conservation against the need for development.

## Key statistics

**Table 3.1: Summary flood risk from surface water to people, economic activity and the natural and historic environment across the Bristol Flood Risk Area (BFRA)\***

Surface Water	Total in BFRA	High risk	Medium risk	Low risk
<b>Risk to people:</b>				
Number of people in area:	570,600	38,400	14,900	15,200
Number of services:	611	35	11	13
<b>Risk to economic activity:</b>				
Number of non-residential properties:	32,400	2,600	2,200	300
Number of airports:	0	0	0	0
Length of roads (km):	110	<10	<10	10
Length of railway (km):	50	<10	<10	<10
Agricultural land (ha):	3,550	100	50	250
<b>Risk to the natural and historic environment:</b>				
Number of EU designated bathing waters within 50m:	0	0	0	0
Number of EPR installations within 50m:	7	3	0	1
Area of SAC within area (ha):	100	0	<50	<50
Area of SPA within area (ha):	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0
Area of World Heritage Site within area (ha):	2,900	0	0	0
Area of SSSI within area (ha):	250	<50	<50	<50
Area of Parks and Gardens within area (ha):	100	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	<50	0	0	0
Number of Listed Buildings within area:	2,300	40	10	10
Number of Licensed water abstractions within the area:	20	<10	0	0

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

\*For the Bristol Flood Risk Area (BFRA), the property counting method uses Bristol City Council (BCC) parameter settings for the portion of the area within the BCC boundary (4m buffer, 0.25 proportion wetted perimeter) and national settings for the portion of the BFRA outside the BCC boundary (2m buffer, 0.5 proportion wetted perimeter). The different parameter settings ensure that the property counting method accords with the different flood modelling methodology used in each portion of the area.

## Conclusions and objectives for the Bristol Flood Risk Area

### Conclusions:

The Bristol Preliminary Flood Risk Assessment (which was based on evidence provided by the Bristol Surface Water Management Plan) quantified the risk posed to the Bristol FRA from surface water flooding. The Surface Water Management Plan (SWMP) utilised an Integrated Urban Drainage hydraulic modelling approach to simulate surface water flooding in the Bristol FRA. The SWMP indicated that approximately 29,200 residential properties, 5,100 non-residential and 59 critical infrastructure sites are at risk from surface water flooding in the Bristol FRA. The SWMP also used a multi-criteria analysis to identify a number of High Risk Areas within the Bristol FRA that are at particular high risk of surface water flooding, notably Ashton, Henbury, Southmead, St George and Dundry Hills.

The outputs from the PFRA and SWMP have been used by this FRMP and the local Flood Risk Management Strategies to promote a risk-based and data-led approach to managing flood risk within the catchment, work with communities and utilise resources in the most efficient manner.

South Gloucestershire Council is presently preparing its Local Flood Risk Management Strategy. It is anticipated that this will be completed and approved by the end of 2014.

The Strategy objectives will be important to provide a formalised approach to flood risk management across South Gloucestershire. The proposed measures and accompanying Action Plan will build on and enhance South Gloucestershire Council's present policies/strategies, procedures (work streams) and programmed activities to further manage the likelihood and impact of flooding to deliver improved social, economic and environmental benefits within and beyond the district.

### Objectives:

**Table 3.2: Social objectives in the Flood Risk Area**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce risk to life	RBD 2	Soc B
Improved flood warning service	RBD 9	Soc G
Minimise community disruption by reducing impact of flooding - improve resilience of infrastructure and services and community preparedness through improved flood warning service and increased public awareness	RBD 7, 9, 10	Soc D, F, G
Take a sequential approach to locating development	RBD1, 11	Soc E
Reduce flood risk to historic environment	RBD 4	En F
Increased understanding and management of flood risk impacts	RBD 6, 11	Soc A

**Table 3.3: Economic objectives in the Flood Risk Area**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1, 2	Ec A
Reduce flood risk to private properties	RBD 1, 2	Ec A
Reduce flood risk to agricultural and horticultural land	RBD 1	Ec D, E
Support tourism by reducing flood risk and enhancing river and 'green' corridors	RBD 1, 4	Ec B En D, G
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B Soc F
Encourage sustainable development that manages flood risk appropriately	RBD4	Ec B

**Table 3.4: Environmental objectives in the Flood Risk Area**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	En E
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydromorphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Create habitat through flood risk management activities	RBD 4	En B
Take climate change projections into account for all objectives	RBD 11	En A
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management &/or sustainable drainage approach	RBD 11	En A

Proposed measures to manage flood risk in South Gloucestershire, including within the BFRA, are based on 6 LFRMS objectives as follows:

### **LFRMS Objectives:**

- improve understanding of flood risk and how climate change will influence future flood risk
- prioritise and implement improvements to local flood infrastructure to reduce the likelihood of flooding causing harm to communities, businesses and the environment of South Gloucestershire
- increase public awareness of the level of flood risk affecting communities and businesses and how they can better protect themselves and their property
- ensure future development considers all known flood risks and climate change projections for South Gloucestershire
- actively work with other Lead Local Flood Authorities and Risk Management Authorities to coordinate management and reduce flood risk across South Gloucestershire
- contribute to wider social, economic and environmental benefits by encouraging sustainable multi-benefit solutions and maximising use of resources.

These are consistent and align with the National Flood and Coastal Erosion Risk Management Strategy objectives for flood risk management.

More specific objectives and measures are included in the tables in Annex 1.

## **Measures across the Bristol Flood Risk Area**

Across the Bristol Flood Risk Area measures to manage flood risk include

**Preventing risk:** 61 measures. (Measure code M21,M23,M24, in Annex 1)

- progress ongoing flood alleviation projects to reduce the risk to existing land and infrastructure and promote sustainable development, taking account of climate change
- manage existing infrastructure and watercourses to help manage flood risk
- continue to implement minor schemes to reduce the risk of flooding to people and property
- promote sustainable drainage and flood alleviation to reduce the risk of flooding
- progress ongoing flood alleviation projects to reduce the risk to existing land and infrastructure and promote sustainable development, taking account of climate change
- manage existing infrastructure and watercourses to help manage flood risk
- continue to implement minor schemes to reduce the risk of flooding to people and property
- promote sustainable drainage and flood alleviation to reduce the risk of flooding
- assessing climate change effect on catchment river flooding and possible mitigation measures;
- developing systems and procedures to record flooding incidents and associated action plan to address specific local issues;
- ensure a programme is followed to update South Gloucestershire's flood risk documents in conjunction with RMA Partner's catchment documentation;
- map and register flood risk assets and prioritise maintenance of vulnerable infrastructure based on available resources and funding;
- through Flood Risk Partnership Operational Working Group agree potential FRM schemes and funding sources;

- review asset maintenance planning with RMA Partners and adjacent LLFAs and work collaboratively;
- liaise with RMAs regarding potential flood risk management measures, priorities and shared funding;
- ensure funding sources are investigated for flood relief and water management gains;
- advertise ordinary watercourse riparian responsibility on website and the Council's RMA role to landowners;
- upskill new staff for SuDS duties using e-learning modules;
- collaborative working with Highways Agency and Network Rail to ensure active flood risk management of critical transport links;
- liaise with RMAs to deliver flood risk works combined with other schemes to provide wider environmental and economic benefits.

**Preparing for risk:** 18 measures Measure code M41,M42,M43,M44 in Annex 1)

- utilise existing data and information to improve processes and preparations
- improve catchment understanding through improved monitoring and flood warning
- work with communities at risk to improve resilience and preparedness
- utilise existing data and information to improve processes and preparations
- improve catchment understanding through improved monitoring and flood warning
- work with communities at risk to improve resilience and preparedness
- Further contact with Parish Councils and businesses to obtain recent locally held flood data plus engagement regarding flood protection measures;
- use mobile apps to record flooding incidents;
- review both the Multi Agency Flood Plan and SGC's Severe Weather Plan;
- signpost information on council's website relating to flood risk sources, high flood risk areas and self help;
- provide schools with educational presentations regarding flood resilience training linked to other environmental issues;
- support Parishes with Flood Plans or groups.

**Protecting from risk:** 9 measures (Measure code M32,M34,M35 in Annex 1)

- investigate and manage existing infrastructure
- review council policies regarding drainage infrastructure for new development;
- work with Environment Agency and adjacent LLFAs to agree strategic options for improving flood storage capacity in River Frome and River Avon catchments to safeguard against climate change projected impact;
- promote SuDS through the planning system including policy and process training to accord with national guidance and local criteria;
- support planning department regarding pre-application discussion to ensure development is 'SuDS fit' and drainage design satisfies extreme rainfall and climate change criteria;
- brief council officers and members on SuDS benefits as well as assess and advise cost comparison with traditional development surface water drainage.

**Recovery and review of risk:** 4 measure (Measure code M51,M53 in Annex 1)

- develop procedures for recording flood events to aid rapid recovery
- review flood investigation criteria for significant flooding incidents at agreed intervals;
- review emergency response strategy and procedures for present flooding incident process;
- input to South West Flood Managers Group flood event lessons learnt and management initiatives.

## Introduction to the remaining LLFA areas outside of the Bristol Flood Risk Area (FRA)

The 4 LLFAs that are located inside the Bristol FRA have also chosen to contribute towards a joint FRMP for their entire council boundary area. The majority of Bristol City Council lies inside the FRA, except for Avonmouth and its surrounding areas. A large proportion of South Gloucestershire urban area also lies inside the boundary of the FRA. However, only small sections of North Somerset and Bath and North East Somerset lie inside the FRA. More information on these LLFAs is set out below:

### **Bath and North East Somerset**

Bath and North East Somerset covers an area of approximately 35,000 hectares. Two thirds of the area is designated as a green belt. The largest urbanised areas within Bath and North East Somerset are Bath, Keynsham, Midsomer Norton and Radstock. The population of the area has been growing in recent decades and at the 2011 census the population was 176,000 with approximately half the population living in the City of Bath. There are numerous villages and hamlets spread across 49 rural parishes which accommodate a substantial rural population.

Approximately 1,800 residential and non-residential properties across the Bath & North East Somerset area are predicted to be at risk of surface water flooding during a rainfall event with an annual probability of occurrence of 1 in 30. Approximately 10,000 residential and non-residential properties are predicted to be at risk of surface water flooding during a rainfall event with an annual probability of occurrence of 1 in 200.

Historically, significant flooding has occurred in the Chew Valley area, specifically in the towns of Chew Magna and Chew Stoke. Chew Magna lies within a rapid response catchment with a number of properties located within the flood plain. Flooding events in Chew Magna in 2012 led to the evacuation of many residents from their homes, with significant damage to possessions, property, services and infrastructure. Flood preparedness and protection work is ongoing in the Chew Valley. This work includes community flood planning and a large-scale Property Level Protection scheme.

The River Avon runs through the centre of the City of Bath. A major flood protection scheme was completed in Bath in the early 1970s. The scheme involved deepening and widening the main channel, and introduced a series of sluice gates to protect the city. Enabling the city of Bath to modernise and develop while ensuring flood protection has been a historical challenge for the city over the centuries and something that will continue for the foreseeable future.

## North Somerset

North Somerset is located in the southwest of England and borders the local authority areas of Bristol, Sedgemoor, Mendip and Bath & North East Somerset. North Somerset Council (NSC) is a unitary authority which is approximately 375km<sup>2</sup> in size, and more than two thirds of the district is rural. The majority of residents live in the main urban centres of Weston-super-Mare, Portishead, Clevedon and Nailsea. There are many villages and hamlets spread across 40 rural parishes which accommodate a substantial rural population. The population within the entire district is just over 200,000.

The Rivers Land Yeo, Kenn and Yeo all flow through the valleys between the limestone ridges then over the level moors areas to the Severn. As they progress through the valleys they generally have a natural river form sometimes with adjacent wetlands. As they reach the moors the channels are often more engineered and sometimes embanked, forming part of the system of numerous drainage ditches used to control the water levels on the wetlands of the Moors.

Flooding can threaten lives and cause substantial negative social and economic effects to people, property, infrastructure and agricultural land. Historical flooding within North Somerset has demonstrated these devastating effects. In addition to the Great Flood of 1607 which killed 2,000 people there have been a number of significant flooding incidents in North Somerset in 1968, 1981, 1989-90, 2007, 2008, and more recently in 2012 which was the second wettest year on record in the UK. Indeed, during 2012 it is estimated that approximately 340 properties flooded internally across North Somerset. Flooding in North Somerset arises from rivers, the sea, surface water runoff, exceedance from urban drainage networks, reservoirs, and groundwater. Flooding from the sea presents the most significant source of flood risk in North Somerset, although this is well managed by the presence of raised and natural sea defences along the majority of the coastline. A future increase in precipitation and sea level due to climate change is likely to cause further increases in flood risk for North Somerset, although the nature and extent of this increase remains uncertain.

## Measures across the surrounding LLFA areas

The following section outlines measures across the Lead Local Flood Authority areas, but outside of the Bristol Flood Risk Area:

**Preventing risk:** 24 measures. (Measure code M21,M23,M24, in Annex 1). These include:

- operation and maintenance of flood defences.
- developing an implementation plan which sets out progress against the objectives of the LFRMS and the works programmed over the next two year period.
- creating the Strategic Flood Board and Flood Risk Asset Register.
- North Somerset will develop a risk-based approach to the maintenance of assets in the highest risk locations, using the 'asset register plus' as the platform to accomplish this.
- improving links with development management services will allow earlier engagement to be sought with developers.

- this will maximise the opportunities to influence the location and design of drainage in new development.
- preparation of the Surface Water Management Plan,
- promoting SuDS and the Local Flood Risk Management Strategy

**Preparing for risk:** 5 measures (Measure code ,M43 in Annex 1) including:

- improving linkages with development management services to inform decisions on planning applications.
- North Somerset will work with Community Resilience groups across North Somerset to build communities which can be more resilient to flooding. Recognising that resources are limited North Somerset will prioritise community resilience to flooding in those communities which are identified in this Strategy as being most vulnerable to flood risk.

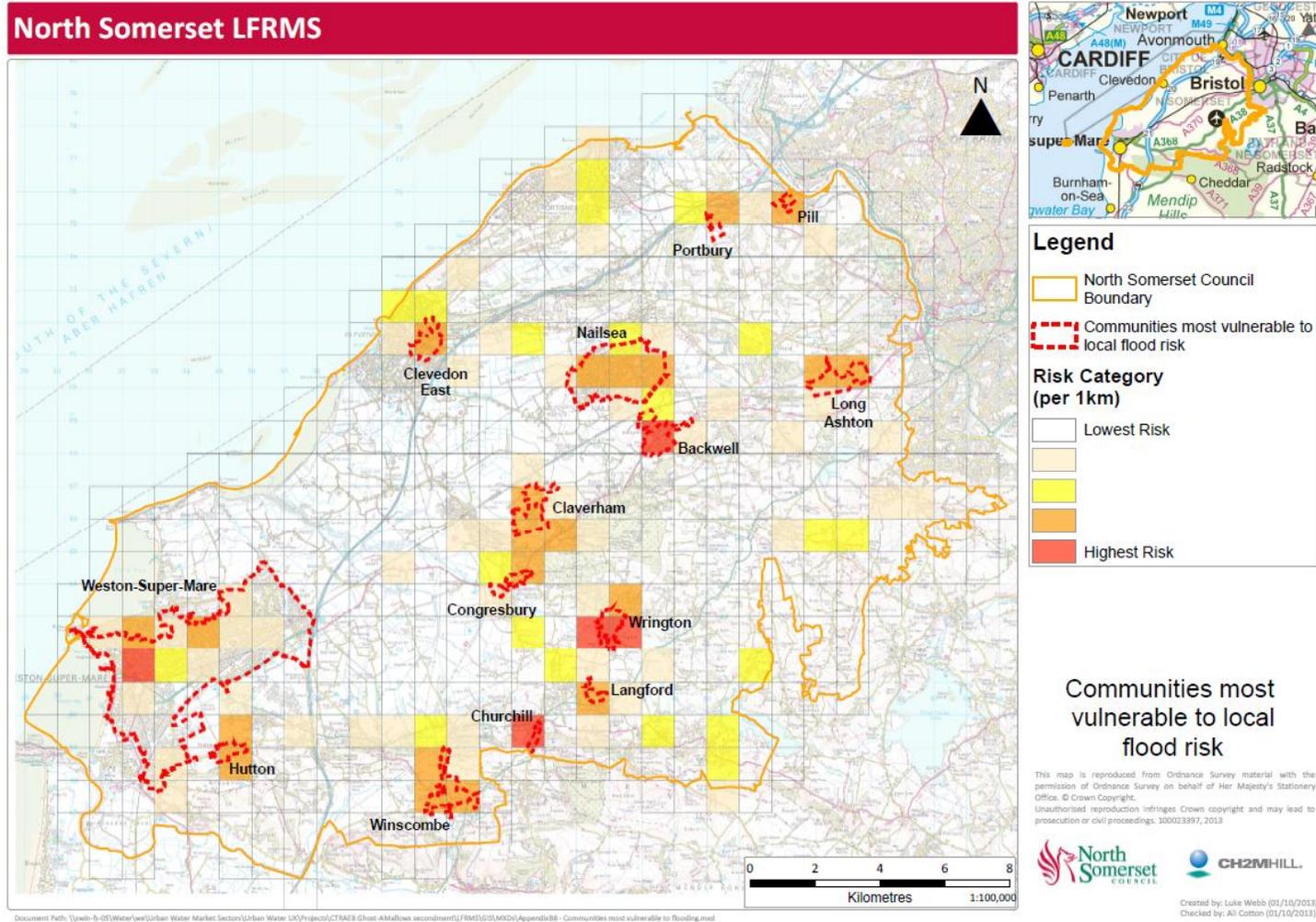
**Protecting from risk:** 32 measures (Measure code M31,M33, M34 in Annex 1) including:

- developing action plans, property level protection schemes, highway schemes and land drainage engineering projects.
- promoting SuDS protocols in line with government policy. This will encourage and promote flood risk management activities which have multiple benefits for amenity, biodiversity or water quality.
- North Somerset will encourage and promote investment in drainage and flood risk management infrastructure which achieves multiple benefits (e.g. green infrastructure).
- the Action Plans within the LFRMS outline types of measures and their timescales for the 15 most vulnerable communities in North Somerset. In many locations the Action Plan recommends investigation or survey in the first instance. This is necessary to fully understand flooding mechanisms impacts prior to the development of flood mitigation measures.
- working with Partners to work towards improving understanding of climate change by assessing the future implications of precipitation changes on flood risk from surface water, ordinary watercourses and groundwater.
- we have developed a funding strategy and funding guidance that identifies the primary sources of local flood risk management funding. The strategy also identifies how to maximise other non-flood related outputs to secure contributions from other secondary sources of funding.
- property level protection scheme
- land drainage engineering projects

**Recovery and review of risk:** 3 measures (Measure code M53 in Annex 1) including:

- developing protocols for the reporting and investigation of flooding incidents and a historic flood record database.
- North Somerset have been working closely with internal partners to share information, establish common investment needs and manage flood risk more effectively.

Figure 3.2: Communities most vulnerable to local flood risk



## 4. Conclusions, objectives and measures to manage flood risk in the Severn RBD catchments

The following sections consider the measures for each of the following catchments in the Severn River Basin District (RBD). Catchments are set out according to Water Framework Directive management catchments:

- Welsh Severn Uplands (Welsh Severn)
- English Severn Uplands (English Severn)
- Shropshire Middle Severn (English Severn)
- Worcestershire Middle Severn (English Severn)
- Teme (cross border)
- Warwickshire Avon (English Severn)
- Severn Vale (English Severn)
- Welsh Wye (Welsh Severn)
- English Wye (English Severn)
- Usk (Welsh Severn)
- South East Valleys (Welsh Severn)
- Bristol Avon & North Somerset Streams (English Severn)

**Table 4.1: Links to local flood risk management strategies or flooding pages of lead local flood authorities in the Severn river basin district**

LLFA	Relevant management catchment(s)	Link to further information
	<ul style="list-style-type: none"> <li>• Severn Uplands</li> <li>• Teme</li> <li>• Wye</li> <li>• Usk</li> <li>• South East Valleys</li> </ul>	<a href="http://pstatic.powys.gov.uk/fileadmin/Docs/Roads/Powys_local_flood_risk_management_strategy_en.pdf">http://pstatic.powys.gov.uk/fileadmin/Docs/Roads/Powys_local_flood_risk_management_strategy_en.pdf</a>
	<ul style="list-style-type: none"> <li>• Severn Uplands</li> <li>• Shropshire Middle Severn</li> <li>• Worcestershire Middle Severn</li> <li>• Teme</li> </ul>	<a href="http://new.shropshire.gov.uk/get-involved/local-flood-risk-management-strategy/">http://new.shropshire.gov.uk/get-involved/local-flood-risk-management-strategy/</a>
	<ul style="list-style-type: none"> <li>• Worcestershire Middle Severn</li> <li>• Shropshire Middle Severn</li> </ul>	
	<ul style="list-style-type: none"> <li>• Shropshire Middle Severn</li> <li>• Worcestershire Middle Severn</li> </ul>	<a href="http://www.telford.gov.uk/downloads/file/3090/telford_and_wrekin_council_flood_risk_management_strategy">http://www.telford.gov.uk/downloads/file/3090/telford_and_wrekin_council_flood_risk_management_strategy</a>
	<ul style="list-style-type: none"> <li>• Worcestershire Middle Severn</li> <li>• Warwickshire Avon</li> <li>• Teme</li> <li>• Severn Vale</li> </ul>	<a href="http://www.worcestershire.gov.uk/flooding">www.worcestershire.gov.uk/flooding</a>
	<ul style="list-style-type: none"> <li>• Usk</li> </ul>	
	<ul style="list-style-type: none"> <li>• Wye</li> <li>• Teme</li> <li>• Severn Vale</li> </ul>	<a href="https://www.herefordshire.gov.uk/floods">https://www.herefordshire.gov.uk/floods</a>
	<ul style="list-style-type: none"> <li>• Warwickshire Avon</li> </ul>	<a href="http://www.floodtoolkit.com/pdf-library/">http://www.floodtoolkit.com/pdf-library/</a>
	<ul style="list-style-type: none"> <li>• Worcestershire Middle Severn</li> </ul>	<a href="http://www.wolverhampton.gov.uk/article/3336/Flooding-of-the-Highway">http://www.wolverhampton.gov.uk/article/3336/Flooding-of-the-Highway</a>

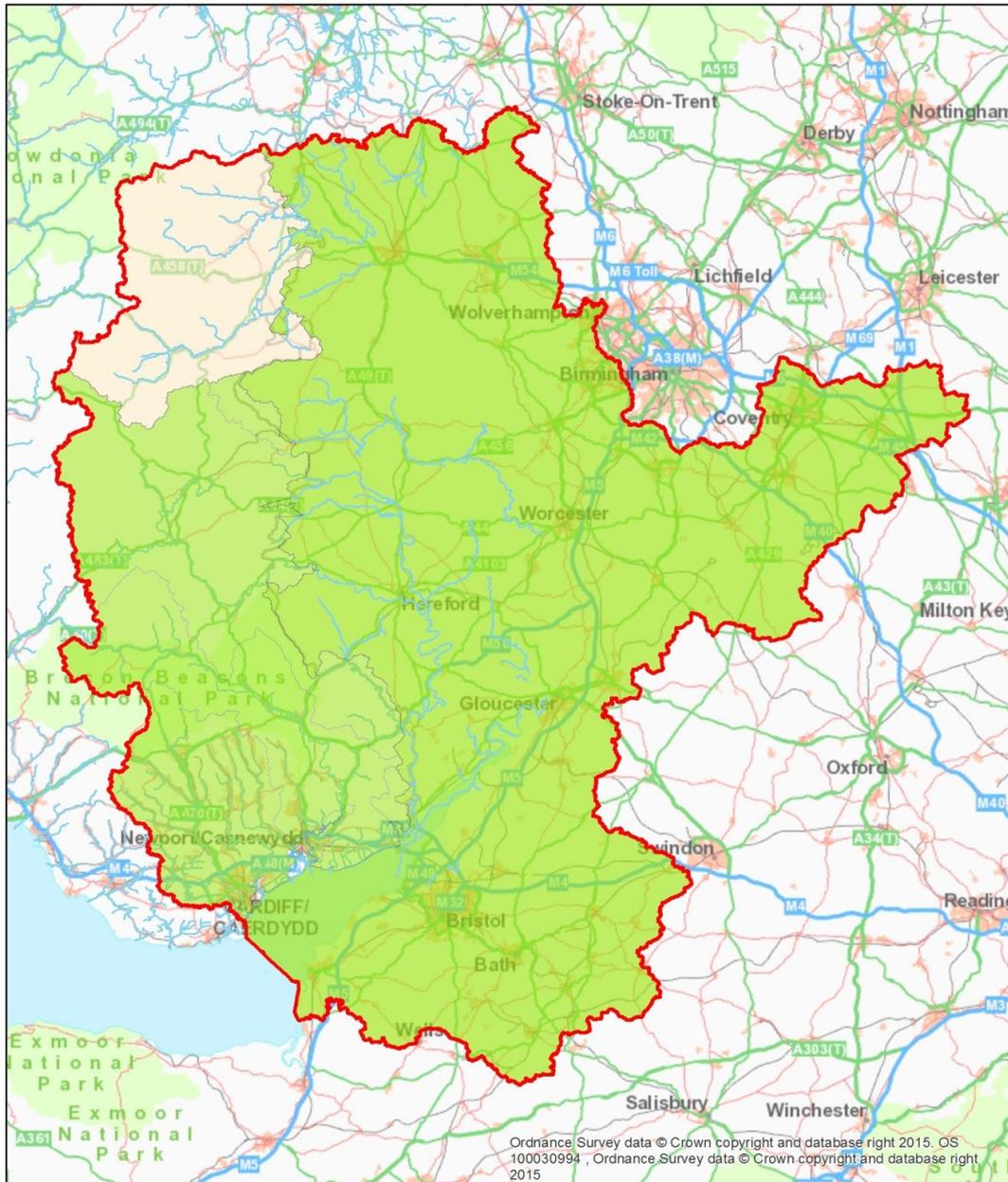
LLFA	Relevant management catchment(s)	Link to further information
 Coventry City Council	<ul style="list-style-type: none"> <li>Warwickshire Avon</li> </ul>	<a href="http://www.coventry.gov.uk/info/70/water_management_and_flooding">http://www.coventry.gov.uk/info/70/water_management_and_flooding</a>
 Leicestershire County Council	<ul style="list-style-type: none"> <li>Warwickshire Avon</li> </ul>	<a href="http://www.leics.gov.uk/index/environment/energy_and_climate_change/flood_management/floods_strategy.htm">http://www.leics.gov.uk/index/environment/energy_and_climate_change/flood_management/floods_strategy.htm</a>
 Sandwell <small>Metropolitan Borough Council</small>	<ul style="list-style-type: none"> <li>Warwickshire Avon</li> </ul>	<a href="http://www.sandwell.gov.uk/info/200284/roads_travel_and_parking/985/drains">http://www.sandwell.gov.uk/info/200284/roads_travel_and_parking/985/drains</a>
 Dudley <small>Metropolitan Borough Council</small>	<ul style="list-style-type: none"> <li>Worcestershire Middle Severn</li> </ul>	<a href="http://www.dudley.gov.uk/resident/environment/drainage-and-sewerage-/flood-risk-management-and-sustainable-drainage/">http://www.dudley.gov.uk/resident/environment/drainage-and-sewerage-/flood-risk-management-and-sustainable-drainage/</a>
 Warwickshire County Council	<ul style="list-style-type: none"> <li>Warwickshire Avon</li> </ul>	<a href="https://askwarks.wordpress.com/2015/06/23/local-flood-risk-management-strategy-consultation-phase-1-consultation-results/">https://askwarks.wordpress.com/2015/06/23/local-flood-risk-management-strategy-consultation-phase-1-consultation-results/</a>
Gloucestershire County Council	<ul style="list-style-type: none"> <li>Warwickshire Avon</li> <li>Severn Vale</li> <li>Bristol Avon and North Somerset Streams</li> </ul>	<a href="http://www.gloucestershire.gov.uk/flooding">http://www.gloucestershire.gov.uk/flooding</a>
 South Gloucestershire Council	<ul style="list-style-type: none"> <li>Bristol Avon and North Somerset Streams</li> </ul>	<a href="https://www.southglos.gov.uk/environment-and-planning/drainage-advice/local-flood-risk-management/">https://www.southglos.gov.uk/environment-and-planning/drainage-advice/local-flood-risk-management/</a>
	<ul style="list-style-type: none"> <li>Bristol Avon and North Somerset Streams</li> </ul>	<a href="http://www.bristol.gov.uk/page/environment/flooding-and-drainage">http://www.bristol.gov.uk/page/environment/flooding-and-drainage</a>
 Bath & North East Somerset Council	<ul style="list-style-type: none"> <li>Bristol Avon and North Somerset Streams</li> </ul>	
 North Somerset Council	<ul style="list-style-type: none"> <li>Bristol Avon and North Somerset Streams</li> </ul>	

LLFA	Relevant management catchment(s)	Link to further information
	<ul style="list-style-type: none"> <li>Bristol Avon and North Somerset Streams</li> </ul>	<a href="http://www.wiltshire.gov.uk/communityandliving/civilemergencies/floodinganddrainage.htm">http://www.wiltshire.gov.uk/communityandliving/civilemergencies/floodinganddrainage.htm</a>
	<ul style="list-style-type: none"> <li>Bristol Avon and North Somerset Streams</li> </ul>	<a href="http://www.somerset.gov.uk/environment-and-planning/flooding/">http://www.somerset.gov.uk/environment-and-planning/flooding/</a>
	<ul style="list-style-type: none"> <li>South East Valleys</li> </ul>	
	<ul style="list-style-type: none"> <li>South East Valleys</li> </ul>	
	<ul style="list-style-type: none"> <li>South East Valleys</li> </ul>	<a href="http://www.merthyr.gov.uk/resident/parking-roads-and-travel/flooding-and-drainage/flood-risk-management/">http://www.merthyr.gov.uk/resident/parking-roads-and-travel/flooding-and-drainage/flood-risk-management/</a>
	<ul style="list-style-type: none"> <li>South East Valleys</li> </ul>	
	<ul style="list-style-type: none"> <li>South East Valleys</li> </ul>	<a href="http://www.caerphilly.gov.uk/My-Council/Strategies,-plans-and-policies/Road-and-pavements/Local-Flood-Risk-Management-Strategy?lang=cy-gb">http://www.caerphilly.gov.uk/My-Council/Strategies,-plans-and-policies/Road-and-pavements/Local-Flood-Risk-Management-Strategy?lang=cy-gb</a>
	<ul style="list-style-type: none"> <li>South East Valleys</li> </ul>	<a href="http://www.valeofglamorgan.gov.uk/Documents/Living/Environment/Flood-and-coastal-erosion-risk/Local-Flood-Risk-Management-strategy-Draft.pdf">http://www.valeofglamorgan.gov.uk/Documents/Living/Environment/Flood-and-coastal-erosion-risk/Local-Flood-Risk-Management-strategy-Draft.pdf</a>

LLFA	Relevant management catchment(s)	Link to further information
 <b>cardiff.gov.uk</b>	<ul style="list-style-type: none"> <li>• South East Valleys</li> </ul>	<a href="https://www.cardiff.gov.uk/ENG/Your-Council/Strategies-plans-and-policies/Documents/Flood/Local%20Flood%20Risk%20Management%20Strategy.pdf">https://www.cardiff.gov.uk/ENG/Your-Council/Strategies-plans-and-policies/Documents/Flood/Local%20Flood%20Risk%20Management%20Strategy.pdf</a>
 <b>NEWPORT</b> <small>CITY COUNCIL</small> <small>CYNGOR DINAS</small> <b>CASNEWYDD</b>	<ul style="list-style-type: none"> <li>• South East Valleys</li> </ul>	

# 4.1a. The Welsh Severn Uplands Catchment

**Cyfoeth Naturiol Cymru**  
**Natural Resources Wales**



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**Legend**

- Main Rivers
- Severn Uplands Management Catchment
- Severn RBD Other Management Catchments



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 Cyfoeth Naturiol Cymru, 100019741, 2013.

Figure 4.1: The Welsh Severn Uplands catchment

## Catchment description/overview

The Severn Uplands catchment extends from Plynlimon in the west to Shrewsbury in the east and from Oswestry in the north to Newtown in the south. It covers an area of approximately 2,500 km<sup>2</sup>. The boundary between Wales and England is the Rivers Severn and Vyrnwy, which highlights the need for joint working between National Resources Wales and the Environment Agency to effectively manage the risk and benefits the rivers have to the local communities.

The catchment is predominantly hilly, dominated on the western edge by the Cambrian Mountains, and is drained by the Rivers Severn and Vyrnwy. Both rivers rise within the area of Plynlimon before dropping quickly through steep sided, incised river valleys. Further downstream, around the Severn-Vyrnwy confluence the topography becomes flatter and this is an important area for flood storage, before the Severn flows into England.

The catchment is predominantly rural in character. The land use is dominated by agriculture with pasture and sheep farming covering approximately a third of the hillsides (Grade 4 to 5 low to poor quality), while dairy farming dominates the valleys and confluence area where soils are of a better quality. Agriculture also supports the local economy through the associated businesses that are underpinned by servicing it.

There is a concentration of managed forested areas at the western edge of the Severn uplands around Dyfnant Forest, south of Lake Vyrnwy, and the Hafren Forest around Llyn Clywedog.

Tourism and small business are also key to the financial well being of the area. This includes a number of urban centres including Newtown and Welshpool.

The area is popular with anglers and walkers and has a high conservation value, including the Montgomery Canal, which is internationally recognised for its plant species.

Watercourses are also used for public water supply purposes with a number of large reservoirs situated within the headwaters at Lake Vyrnwy and Llyn Clywedog. These provide an element of attenuation within the upper catchment and can influence the flows in the Rivers Severn and Vyrnwy.

There are a number of designated areas of nature conservation importance within the catchment. There are several internationally designated Special Areas of Conservation (SACs) that include the Berwyn/South Clwyd Mountains, and Montgomery Canal and two Special Protection Areas (SPA's) at Berwyn and Elenydd/Mallaen.

There are also numerous Sites of Special Scientific Interest (SSSI's) and three National Nature Reserves including Y Berwyn.

A small part of the Severn Uplands catchment is situated within the Snowdonia National Park.

Within the Severn Uplands Catchment the Environment Agency and Natural Resources Wales have developed good working relationship with partners. These include, but are not limited to local authorities and water companies. The Welsh catchment is covered by Powys unitary authority.

We also work closely with the Regional Flood and Coastal Committees, Local Flood Fora, Severn Trent Water plc, Dwr Cymru/Welsh Water, Canals & Rivers Trust, National Farmers

Union, National Resources Wales administers the Powysland Internal Drainage District which, until April 2015, was the Powysland Internal Drainage Board. National Resources Wales also works closely with local landowners, councillors and politicians through a local liaison group which focuses on flood issues and the use of the reservoirs in mitigation.

## Historical flooding in the catchment

Flooding in the Severn Uplands catchment is characteristically rapid due to the steep topography of the area, impacting on many rural communities and a number of towns within the bottom of the steep incised valleys through which many of the rivers run. These towns include Newtown, Caersws and Welshpool. Downstream the Vyrnwy/Severn confluence area has been affected on a regular basis, often remaining flooded for prolonged periods of time.

The largest flood recorded occurred in 1947 which caused widespread damage and disruption. This event was triggered by a 'rain on snow event' where relatively warm rain fell onto snow resulting in rapid melting of the snowpack. For many communities, the 1947 event is the highest recorded event in living memory.

Since then large catchment-wide flood events have been relatively rare until those experienced in October 1998 and the autumn of 2000 which impacted on many communities.

In February 2011 significant flooding occurred along the River Vyrnwy resulting in the highest levels recorded since records began in many locations.

## Current flood risk in the catchment

Although the fluvial flood risk within the catchment is predominantly to agricultural land, a number of communities and individual properties within the catchment remain at risk.

The nature of flooding in the catchment is that of frequent, low impact events which tend to last for prolonged periods of time. The Severn/Vyrnwy confluence area is complex and there are many local issues relating to the speed at which flood waters are returned to the rivers, once levels have dissipated. The confluence area plays a key role in reducing flood risk downstream as it provides storage of flood water. The Hayes Basin storage area along the English and Welsh border provides around 5 million cubic metres of storage.

There are no locations currently in the top 50 flood risk communities in Wales but two are in the top 100 and as a result they do not feature highly on the list of residual risk. Some of the urban centres within the Welsh part of the catchment already have flood alleviation schemes associated with them.

A significant amount of infrastructure is at risk of flooding, particularly a number of trunk and minor roads which can cause significant disruption as well as isolating some communities. Flooding from surface water/sewer sources also occurs in some of the larger urban areas.

## Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. In future scenarios the defended areas of this catchment will be more prone to overtopping and urban areas such as Newtown and Welshpool may experience more surface water flooding.

## Recent flood risk management activity in the Catchment

There are many flood alleviation schemes along the Severn and its tributaries including at Newtown, Welshpool, Llandrinio and the system of earth embankments, known locally as Argaes. The Argaes stretch from the Caersws area to the confluence, and are designed to overtop and control the flow of flood water back into the rivers as the level falls.

A number of isolated and smaller communities at risk of flooding have installed individual property level protection to reduce the risk of flooding.

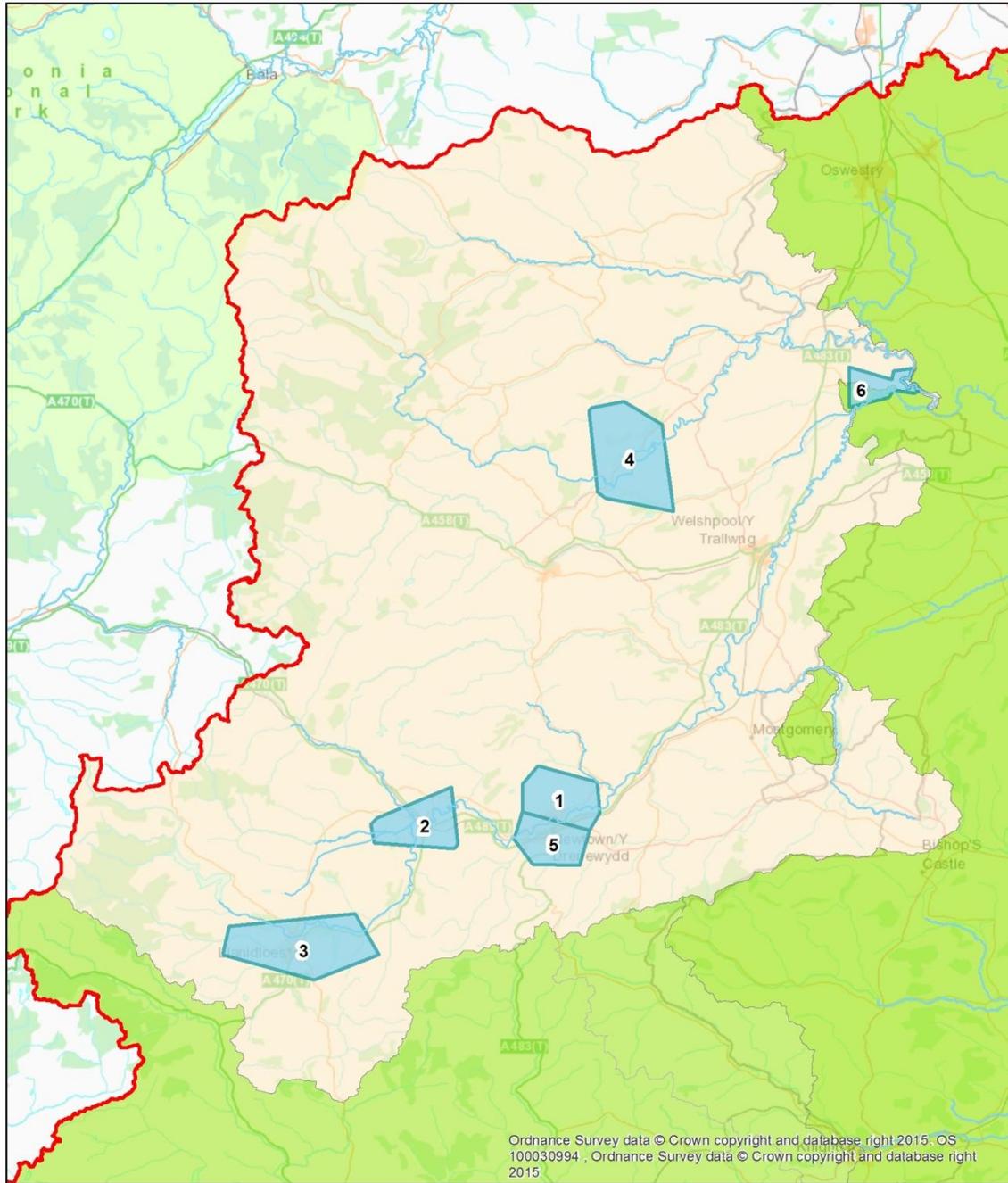
Natural Resources Wales has commissioned a study to investigate the current operating instructions for the Vyrnwy and Clywedog reservoirs. The study will look at the potential to use both reservoirs as flood risk assets by increasing the available storage without risking their primary purpose of water resource control and drinking water provision. This study will also look at the effects of the reservoirs on flooding within the catchment and the combined effects at the confluence. The study is being developed with local communities and stakeholders to ensure it addresses local concerns. The study has been undertaken with the consent and input from all the parties involved in the management of the reservoirs to ensure that a catchment-wide view is taken and that all recommendations are realistic.

## Key communities where Natural Resources Wales are planning actions (Bold Communities are in Top 50 Wales)

There are a number of communities within the catchment where Natural Resources Wales feel there is still more to be done to manage and reduce the risk of flooding. Section 2.2 of this report sets out how Natural Resources Wales prioritise work on a risk basis so that those communities that are most at risk are addressed first.

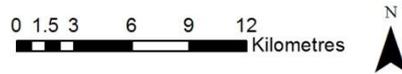
**Table 4.2: Key communities**

Label	Community	Label	Community
1	Llanllwchaiarn	4	Meifod
2	Caersws	5	Newtown / Y Drenewydd
3	Llanidloes	6	Llandrinio



**Legend**

-  Main Rivers
-  Severn Uplands Key Communities
-  Severn Uplands Management Catchment
-  Severn RBD Other Management Catchments



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**Figure 4.2: The Welsh Severn Uplands Catchment**

**Table 4.3: The Welsh Severn Upland Catchment – Measures**

The following catchment delivery plan sets out on a community basis, the measures that Natural Resources Wales have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures Natural Resources Wales intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Caersws	Main River	Implement alternative risk reduction measures.	M2 - Prevention	1 2 8	Current	High	Not Started	Natural resources Wales
		Improve existing flood forecasting model	M4 - Preparedness	1 2 3 4	Current	low	On-going	Natural resources Wales
		Carry out assessment on existing structures to ensure they are fit for purpose.	M2 - Prevention	1 2 3	Current	High	Not Started	Natural resources Wales
Meifod	Main River	Carry out assessment on existing structures to ensure they are fit for purpose.	M2 - Prevention	1 2 3	Current	High	Not Started	Natural resources Wales
Llanidloes	Main River	Assess conveyance requirements and implement maintenance.	M2 - Prevention	1 2 3	Current	High	Not Started	Natural resources Wales

Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
		Improve existing flood forecasting model	M4 - Preparedness	1 2 3 4	Current	low	On-going	Natural resources Wales
Llanllwchaiarn	Main River	Carry out assessment on existing structures to ensure they are fit for purpose.	M2 - Prevention	1 2 3	Current	Low	Not Started	Natural resources Wales
		Review and Update model	M2 - Prevention	3	Current	Low	Not Started	Natural resources Wales
Llandrinio	Main River	Carry out assessment on existing structures to ensure they are fit for purpose.	M2 - Prevention	1 2 3	Current	Low	Not Started	Natural resources Wales
Newtown	Main River	Review and Update model	M2 - Prevention	3	Current	Low	Not Started	Natural resources Wales

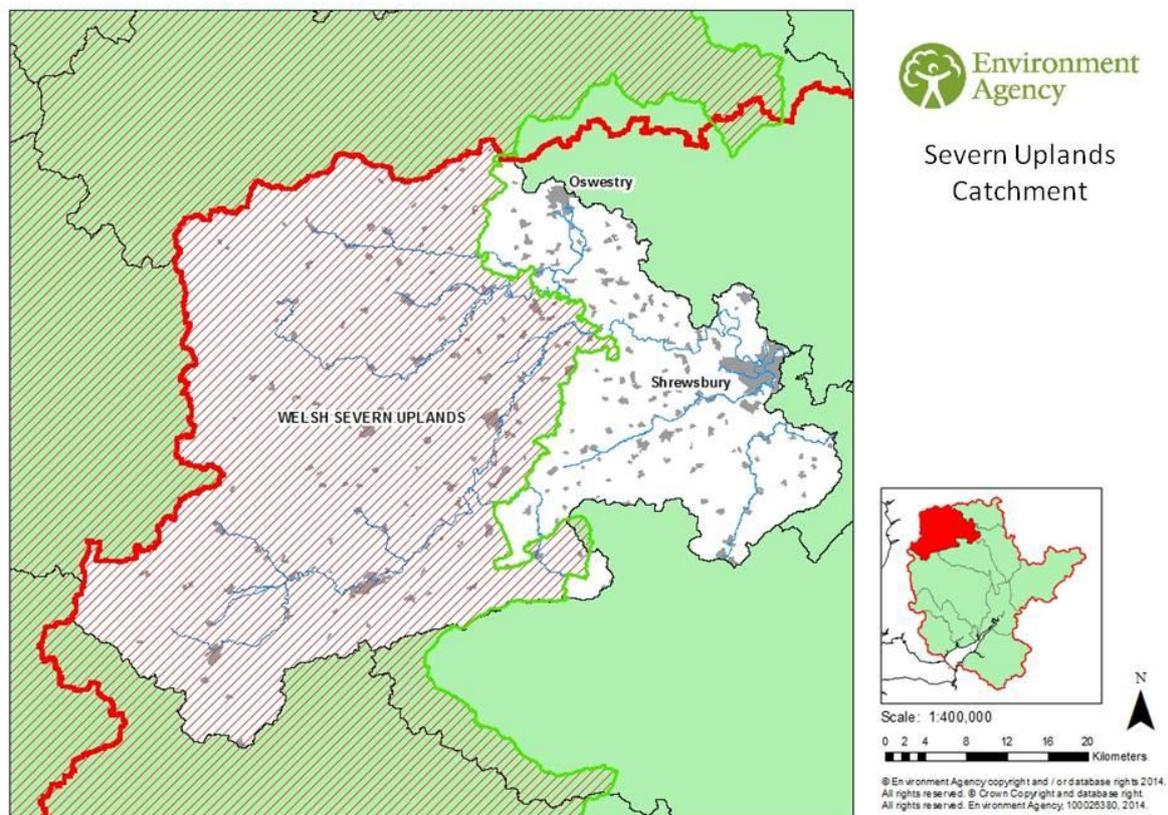
# 4.1b. The English Severn Uplands Catchment

## Introduction to the Severn Uplands catchment

The Severn Uplands catchment extends from the area of Plynlimon in the west to Shrewsbury in the east and from Oswestry in the north to Newtown in the south. It covers an area of approximately 2,500 km<sup>2</sup>. Straddling the boundary between Wales and England are the Rivers Severn and Vyrnwy, which highlights the need for joint working between Natural Resources Wales and the Environment Agency to effectively manage the risk and benefits the rivers have to the local communities.

The catchment is predominantly hilly, dominated on the western edge by the Cambrian Mountains, and is drained by the Rivers Severn and Vyrnwy. Both rivers rise within the area of Plynlimon before dropping quickly through steep sided, incised river valleys. Further downstream, around the Severn-Vyrnwy confluence the topography becomes flatter, and this is an important area for flood storage, before the Severn reaches Shrewsbury.

**Figure 4.3: Total number of measures specific to the Severn Uplands catchment**



## Land use and management

The catchment comprises upland areas, with steep incised valleys, before opening out into a wider flatter area around the Severn-Vyrnwy confluence. The catchment is predominantly rural in character. The land use is dominated by agriculture, with pasture and sheep farming covering approximately a third of the hillsides (Grade 4 to 5 low to poor quality). Agriculture also supports the local economy through the associated businesses that are underpinned by servicing it.

There is a history of metal mining within the headwaters of some streams within the catchment, such as at Stiperstones and Van Lead mine, which has had impacts on water quality downstream. In addition small scale gravel extraction along the river valleys continues to occur.

Tourism and small business are also key to the financial well being of the area. Urban centres include Oswestry and Shrewsbury.

The area is popular with anglers and walkers and has a high conservation value, including the Montgomery Canal, which is internationally recognised for its plant species.

Watercourses are also used for public water supply purposes with a number of large reservoirs situated within the headwaters at Lake Vyrnwy and Llyn Clywedog. These provide an element of attenuation within the upper catchment and can influence the flows in the Rivers Severn and Vyrnwy, particularly in the upper catchment.

## Geology

The headwaters of the River Severn rise on Silurian mudstones, siltstones and grits and the Severn flows eastwards over the same rock formations. These rock formations do not allow water to flow easily through them and are classified as non-aquifers with only limited potential for groundwater abstraction. Drift deposits of river sands and gravel exist along the floor of the River Severn valley.

## National and international designations

The Severn Uplands management catchment crosses the England-Wales border and contains a number of internationally designated areas of nature conservation importance. These include the Midland Meres & Mosses – Phase 1 and Phase 2 Ramsar sites and the Stiperstones and the Hollies Special Area of Conservation (SAC).

The Severn Uplands management catchment also contains nationally and locally designated sites of conservation importance such as River Severn at Montford Site of Special Scientific Interest (SSSI). To the south of the management catchment there is the Shropshire Hills Area of Outstanding Natural Beauty (AONB).

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic

Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. Shrewsbury is an example of a historic riverside town within the catchment.

## Partnership working

Within the Severn Uplands Catchment the Environment Agency and Natural Resources Wales have developed good working relationship with partners, including local councils. The catchment is covered by two unitary authorities, Shropshire and Powys.

The Environment Agency works with the Regional Flood and Coastal Committee, Local Flood Fora, Severn Trent Water Ltd, Canals & Rivers Trust, National Farmers Union, Forestry Commission, Natural England, Historic England and local authority archaeologists and conservation officers.

The Environment Agency will also continue to work, and strengthen links, with the Severn Uplands Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the catchment to meet England Biodiversity Strategy (2020) targets.

## Historic flooding

Flooding in the Severn Uplands catchment is characteristically rapid due to the steep topography of the area, impacting on many rural communities and a number of towns within the bottom of the steep incised valleys through which many of the rivers flow.

Downstream of the Vyrnwy/Severn confluence Shrewsbury is the main conurbation at risk, with parts of the town having historically been affected on a regular basis.

The largest recorded flood occurred in 1946 which caused widespread damage and disruption. This event was triggered by a 'rain on snow event' where relatively warm rain fell onto snow resulting in rapid melting of the snowpack. For many communities, including Shrewsbury the 1946 event is the highest recorded event in living memory.

Since then large flood events had been relatively rare until those experienced in October 1998 and the autumn of 2000. These had an impact on many communities, with Shrewsbury being particularly badly affected.

In February 2011 significant flooding occurred along the River Vyrnwy resulting in the highest levels recorded since records began in many locations.

## Current flood risk

Although the fluvial flood risk within the catchment is predominantly to agricultural land, a number of communities and individual properties within the catchment remain at risk.

The nature of flooding in the catchment is that of frequent, low impact events which tend to last for prolonged periods of time. The Severn/Vyrnwy confluence area is complex and there are many local issues relating to the speed at which flood waters are returned to the rivers, once levels have dissipated. The confluence area plays a key role in reducing flood risk downstream as it provides storage of flood water. The Hayes Basin storage area along the English and Welsh border provides around 5 million cubic metres of storage.

Within the English part of the catchment Shrewsbury is the largest urban area at flood risk. Although risk has been reduced through the construction of flood defences, there are areas that remain unprotected. There are also smaller rural communities in the River Severn catchment that are at risk of surface water flooding such as Oswestry and Church Stretton.

A number of communities are affected by watercourses that respond quickly to rainfall. These include at Llanyblodwel where flooding from the River Tanat can occur rapidly with limited warning.

A significant amount of infrastructure is at risk of flooding, particularly a number of trunk and minor roads which can cause significant disruption as well as isolating some communities. Access around the centre of Shrewsbury can be a particular problem during periods of significant flooding.

Flooding from surface water/sewer sources also occurs in some of the larger urban areas.

## Recent flood risk management activity in the catchment

There are many flood alleviation schemes along the Severn and its tributaries including at Shrewsbury (Coleham Head and Frankwell), and the system of earth embankments, known locally as Argaes, in and around the confluence area, that are designed to overtop and control the flow of flood water back into the rivers as the level falls.

A number of isolated and smaller communities at risk of flooding have installed individual property level protection to reduce the risk of flooding.

Natural Resources Wales has commissioned a study to investigate the current operating instructions for the Vyrnwy and Clywedog reservoirs. The study will look at the potential to use both reservoirs as flood risk assets by increasing the available storage without risking their primary purpose of water resource control and drinking water provision. This study will also look at the effects of the reservoirs on flooding within the catchment and the combined effects at the confluence.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Upper Severn management catchment. The significant issues within this catchment are diffuse pollution from rural areas, pollution from waste water and physical modifications.

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency and Natural Resources Wales have made an assessment of the measures needed to achieve positive

benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

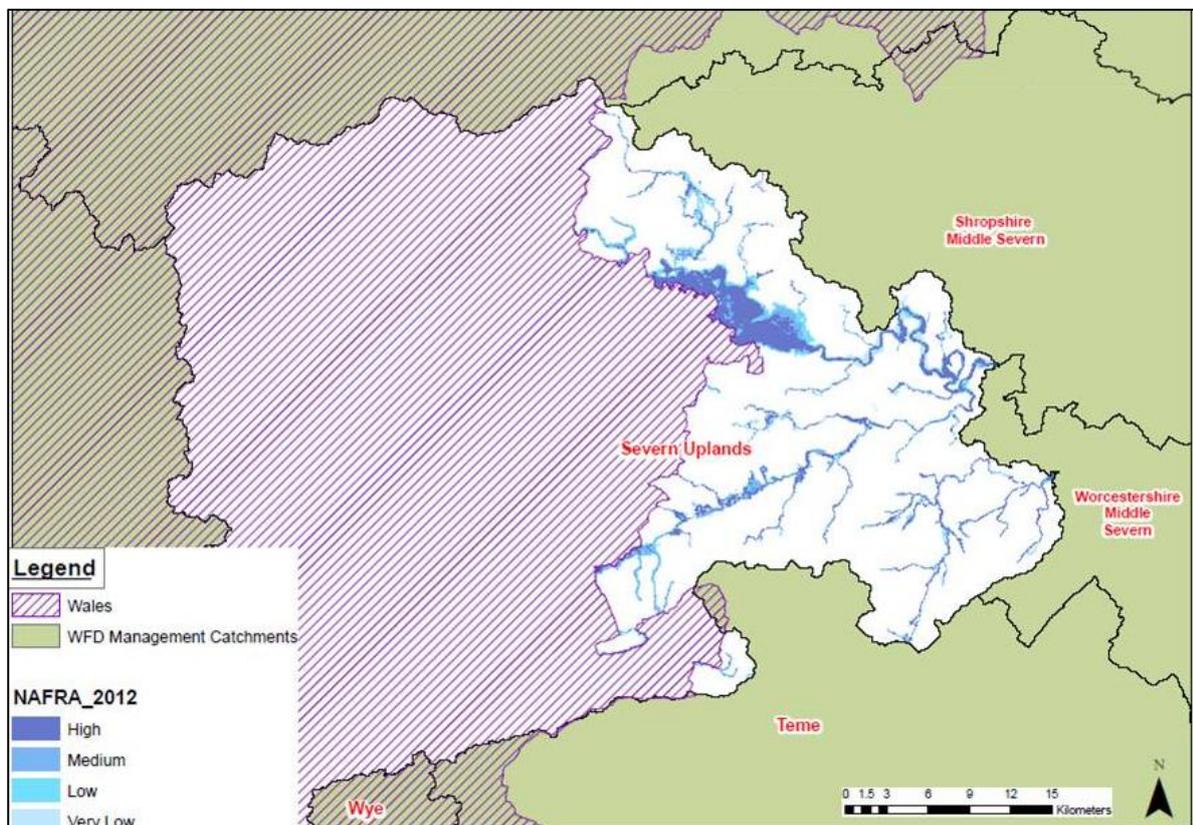
## Key statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 12,950 people at risk from river flooding, representing 7.3% of the total population. Nearly 5,150 non-residential properties are at risk of flooding from rivers of which 1,450 are considered to be at high risk. Approximately 12% of agricultural land within the catchment is at risk of flooding with around 3,850 hectares being at high risk.

**Figure 4.4: National Flood Risk Assessment (NAFRA) in the English Severn Uplands catchment**



The [rivers and sea flood map](#) has been developed and published by the Environment Agency

**Table 4.4: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Severn Uplands Catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	177,900	2,600	3,950	4,800	1,600
Number of services:	950	40	30	20	10
<b>Risk to economic activity:</b>					
Number of non-residential properties:	55,800	1,450	1,850	1,450	400
Number of airports:	0	0	0	0	0
Length of roads (km):	230	10	10	<10	<10
Length of railway (km):	110	<10	<10	<10	<10
Agricultural land (ha):	58,800	3,850	1,550	1,050	700
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	34	1	2	0	1
Area of SAC within area (ha):	10,850	<50	<50	<50	<50
Area of SPA within area (ha):	11,900	<50	<50	<50	<50
Area of RAMSAR site within area (ha):	100	<50	<50	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	15,150	100	50	<50	<50
Area of Parks and Gardens within area (ha):	1,650	<50	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	850	<50	<50	<50	<50
Number of Listed Buildings within area:	4,330	200	160	210	30
Number of Licensed water abstractions within the area:	240	80	<10	<10	<10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

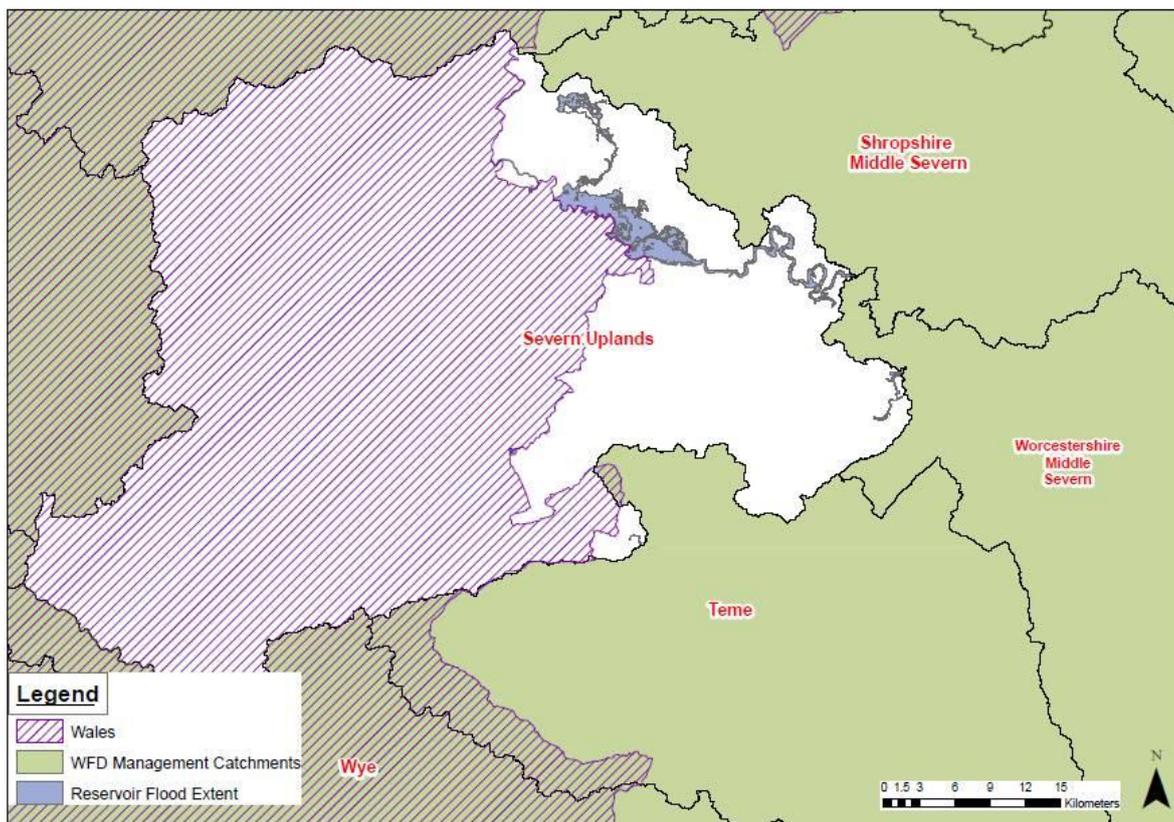
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 19,000 people are at risk of flooding from reservoirs in the Severn Uplands Catchment, representing approximately 11 % of the total population within the catchment. Approximately 5,450 non-residential properties are at risk of flooding from reservoirs in the Severn Uplands Catchment. Approximately 8% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 0.5% of SSSI sites and there are no Ramsar sites at risk of flooding in the area.

**Figure 4.5: Reservoir flood risk extents in the Severn Uplands catchment**



The [reservoirs flood map](#) has been developed and published by the Environment Agency

**Table 4.5: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Severn Uplands Catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	177,900	19,450
Number of services:	950	100
<b>Risk to economic activity:</b>		
Number of non-residential properties:	55,800	5,450
Number of airports:	0	0
Length of roads (km):	230	40
Length of railway (km):	110	20
Agricultural land (ha):	58,800	4,650
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	34	3
Area of SAC within area (ha):	10,850	<50
Area of SPA within area (ha):	11,900	<50
Area of RAMSAR site within area (ha):	100	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	15,160	70
Area of Parks and Gardens within area (ha):	1,640	40
Area of Scheduled Ancient Monument within area (ha):	860	70
Number of Listed Buildings within area:	4,330	730
Number of Licensed water abstractions within the area:	240	60

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the English Severn Uplands Catchment

### Conclusions

The Severn Uplands is a reactive catchment in terms of fluvial flooding, that can result in the rapid onset of 'out of bank' events within the steep incised valleys that characterise it upstream of the River Severn/Vyrnwy confluence. This is exacerbated by the above average rainfall totals experienced in this part of the country (three times greater than in other parts of the Severn RBD).

However, as a result of the presence of a number of reservoirs, used for water supplies and managing water resources downstream, some of this risk is reduced in the upper reaches.

As the confluence area attenuates river flow, it slows the onset of flooding within the main urban area of Shrewsbury. Flood events still occur though, on a regular basis, and this impacts upon the centre of the town, requiring the erection of demountable flood defences to protect some areas.

Due to the rural nature of the Severn Uplands the overall risk of property flooding is relatively low in comparison to other parts of the Severn RBD, as many of the larger urban centres already have some means of flood alleviation.

Flooding from surface water/sewer sources also occurs in some urban areas.

In the future, the increased frequency and intensity of rainfall events associated with climate change in combination with the fast responding nature of catchments will be the greatest threat to the upper areas, where a relatively large number of small to medium sized communities are distributed over a wide area. The increased intensity of rainfall events will mean that the current level of protection provided by some existing flood alleviation schemes may reduce over time, thus increasing the risk of damage to properties and infrastructure. The system of Argaes in and around the confluence of the rivers Severn and Vyrnwy will be at particular risk, thus reducing the control this area provides on flood peaks downstream.

There is a continued need to work in partnership with others, where possible, to achieve flood risk management measures which will alleviate flooding from multiple sources, as well as providing wider environmental and other benefits to improve the natural, rural and built environment, consistent with the principles of sustainable development.

## Objectives for English Severn Uplands catchment

The following Objectives apply to this management catchment, where possible and viable to do so. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.6: Social objectives for the English Severn Uplands catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce or prevent an increase in harm to life as a result of flooding	RBD 2	Soc B
Minimise community disruption by reducing impact of flooding by increasing preparedness through improved flood warning service and public awareness	RBD 7, 9, 10	Soc D, G
Steer development towards areas of little or no risk of flooding, where development must occur in medium or high flood risk areas it must be sustainable, not increase flood risk and take account of the impacts of climate change	RBD 1, 11	Soc E
Improve awareness in catchments which react rapidly to rainfall	RBD 2, 9	Soc C
Increase understanding and management of flood risk impacts	RBD 6, 11	Soc A
Reduce the likelihood of death or serious injury resulting from rapid inundation or deep and fast flowing water	RBD 2	Soc C
Continue to work with utility providers to improve resilience of infrastructure and services	RBD 1, 8, 10, 11	Soc A, F
Continue to work with other bodies to improve resilience to the communication network and transport links	RBD 1, 8, 10, 11	Soc A, F
maintain existing assets that protect people where economically viable or find suitable alternatives by working in partnership with communities	RBD 6, 11, 12	Soc A

**Table 4.7: Economic objectives for the English Severn Uplands catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1	Ec A
Reduce flood risk to residential properties	RBD 1	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec E
Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5	Ec C
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B, Soc F
Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11	Ec D
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	Ec B, En D, G

**Table 4.8: Environmental objectives for the English Severn Uplands catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Take opportunities to restore sustainable natural storage of floodwater on tributaries in their upstream areas, in order to offset increasing flood risk from trends including climate change	RBD 11	En A
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydro-morphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Maintain and enhance habitat through flood risk management activities	RBD 4	En B
Help achieve WFD Objectives through Flood Risk Management	RBD 1, 4	En E
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	Env E
Protect and enhance designated landscapes and local landscape character	RBD 1, 4	En C, G
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures in the Severn Uplands Catchment

Measures that are relevant to this catchment are included in the Severn RBD, Severn England and Severn Wales measures shown in Annex 1. In addition, there are measures specific to this catchment as follows:

Across the English Severn Uplands catchment there are 12 measures to manage flood risk specific to this catchment. These include;

**Preventing risk:** There are 5 measures in place to prevent flood risk that are specific to this catchment. (Measure codes M21/M23/M24, in Annex 1)

- prevent risk by working with the community in Shrewsbury to raise awareness of flooding and promote property level protection measures;
- Severn Trent Water will continue to invest in reduction of flood risk to properties at known risk of flooding;
- Severn Trent Water invest partnership funding opportunities;
- Severn Trent Water will continue to carry out risk based maintenance;
- Severn Trent Water will continue to raise awareness to help reduce preventable sewer flooding incidents.

**Preparing for risk:** There are 3 measures in place to prepare for flood risk that are specific to this catchment. (Measure codes M41/M42/M43/M44 in Annex 1)

- Severn Trent Water will continue to contribute to development of surface water management plans and sewerage management plans (2 measures);
- encouraging the community to prepare for flooding in Llanyblodwel.

**Protecting from risk:** There are 4 measures in place that protect from flood risk that are specific to this catchment. (Measure codes M32/M34/M35 in Annex 1)

- assess the role of raised defences at the Vyrnwy confluence;
- continuing with defence and channel maintenance and flood warning at Molverley;
- continuing with channel maintenance and flood warning at Hayes, Red Abbey, Shrawardine and Montford in the Severn Uplands;
- review maintenance operations.

**Recovery and review of risk:** There are no specific measures in this category, over and above those included in Annex 1 of this document and the flood risk activities described in section 6 of Part A.

More detail on the measures is included in Annex 1

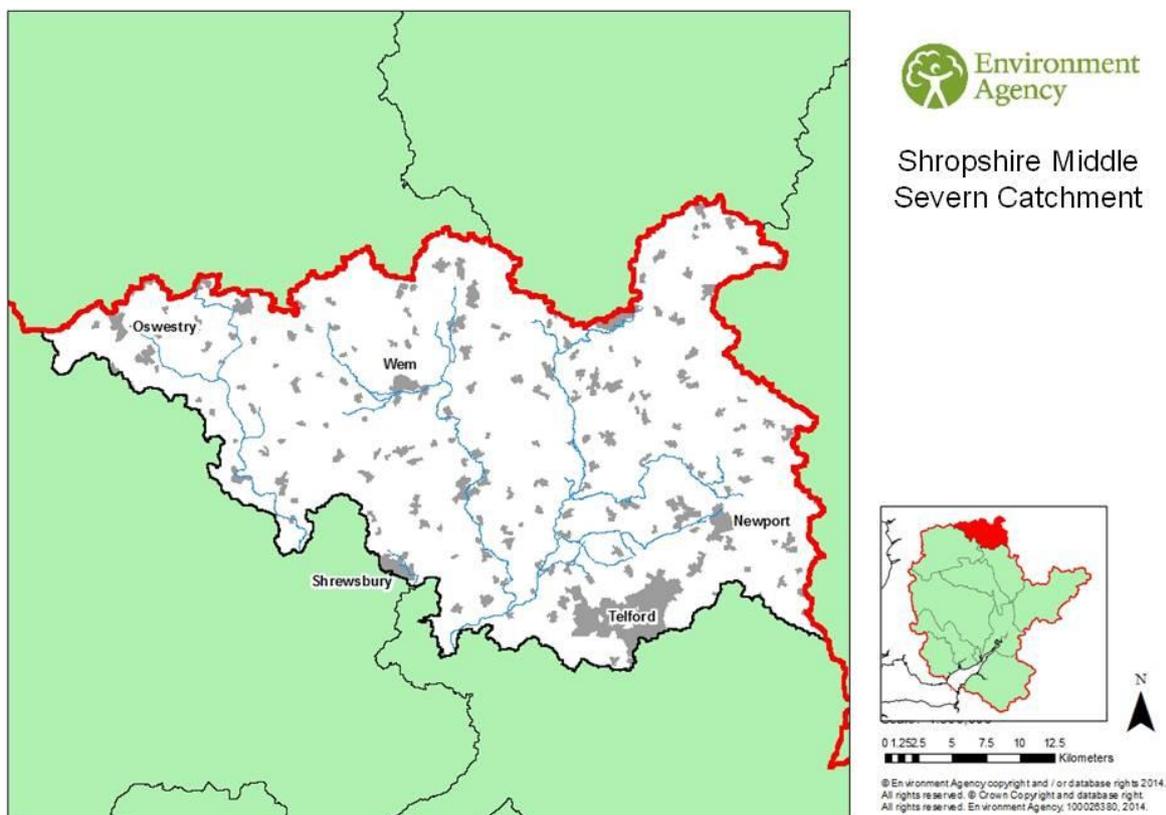
## 4.2. The Shropshire Middle Severn Catchment

### Introduction to the catchment

The Shropshire Middle Severn catchment extends from Telford in the South to Whitchurch in the north and from Staffordshire in the east to Oswestry in the west covering an area of 1,107 km<sup>2</sup>.

The landscape comprises mostly relatively flat Shropshire plain, which is crossed by a number of tributaries of the River Severn including the Rivers Roden, Tern and Perry.

**Figure 4.6: The Shropshire Middle Severn catchment**



### Land use and management

The land use within the catchment is mainly agricultural (Grade 3 or better land quality), with an even mix of arable and managed grassland farming.

Small business is also key to the financial well-being of the area. This includes businesses based in a number of small urban centres across the Shropshire Plain including Shawbury, Ellesmere, Wem, Newport and other rural communities.

The northern part of Telford, which is the largest urban area, is located on the southern edge of the catchment.

## Geology

Geology in the Shropshire Middle Severn is dominated by the Permo-Triassic sandstones underlying the Shropshire Plain, which are classified as a major aquifer and are highly permeable, highly productive and able to support large groundwater abstractions.

Glacial and postglacial sands, alluvium and river terrace gravels from palaeo-channels overlie much of the bedrock and provide mobile sediment re-worked by the present-day rivers.

For this reason the catchment is very important in relation to the abstraction of groundwater for water supply purposes.

## National and international designations

There are a number of designated areas of nature conservation importance located within the catchment including Ramsar sites (under the Ramsar Convention) such as the Midland Meres and Mosses – Phase 1 and Phase 2 Ramsar sites.

There are also three internationally designated Special Areas of Conservation (SAC) within the Shropshire Middle Severn catchment, including Brown Moss SAC, Fenn's, Whixall, Bettisfield, Wem and Cadney Mosses SAC, and West Midlands Mosses SAC.

There also a number of Sites of Special Scientific Interest (SSSIs) and one National Nature Reserve (NNR) at Fenn's, Whixall and Bettisfield mosses on the northern boundary of the catchment that are known for their species, habitats or geology.

The Shropshire Hills Area of Outstanding Natural Beauty (AONB) extends just to the west of Telford.

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets also have historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape.

## Partnership working

Within the Shropshire Middle Severn Catchment the Environment Agency has developed good working relationships with partners, including local councils. The catchment is covered by two unitary and three local councils. These are the councils of Shropshire, Telford & Wrekin, Stafford District, Newcastle under Lyme District and South Staffordshire District respectively.

We also work closely with the Regional Flood and Coastal Committee, Severn Trent Water Limited, National Farmers Union, Natural England, Historic England and local authority archaeologists and conservation officers.

The Environment Agency will continue to work, and strengthen links, with the Shropshire Middle Severn Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the catchment to meet England Biodiversity Strategy (2020) targets.

## Historic flooding

The catchment is relatively flat and hence watercourses are not particularly reactive in this area.

Due to the mostly rural nature of the area, there is no significant flooding to large numbers of properties within the catchment and any flooding is limited to relatively isolated locations.

There is no history of wide-scale flooding in the catchment, the last significant events occurring in 2000 and 2007.

## Current flood risk

Flooding from fluvial sources within the catchment is relatively low and this is not expected to change significantly even when accounting for climate change.

Agricultural farm land is affected which could impact on food production.

Flooding in the catchment from fluvial sources is infrequent and when it does occur is not rapid.

Changes in land use within the catchment may contribute in incidents of flooding in certain locations. A large area of Telford and Newport drains into the Strine catchment.

There is a greater risk of surface water flooding in some areas, particularly in locations such as Oswestry and the towns in the south that have expanded rapidly in recent years, including Newport and Telford.

Climate change is most likely to have a greater impact on urban areas where there are existing surface water drainage problems or where further urban expansion occurs without appropriate mitigation measures being put in place.

## Recent flood risk management work

As there has been relatively few fluvial flood incidents in recent years, flood alleviation works have been concentrated mainly in the urban locations of the catchment and any surface water/sewerage issues.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Shropshire Middle Severn management catchment. The significant issues within this catchment are diffuse pollution, sedimentation and phosphate loss from agricultural sources throughout the catchment. Pollution from waste water, urban areas, physical modifications, barriers to fish (weirs) and over abstraction are also significant issues in some rivers.

Where failures have been identified, a range of measures has been assessed with the aim of improving the status of water bodies. The Environment Agency has made an assessment of the measures needed to achieve positive benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

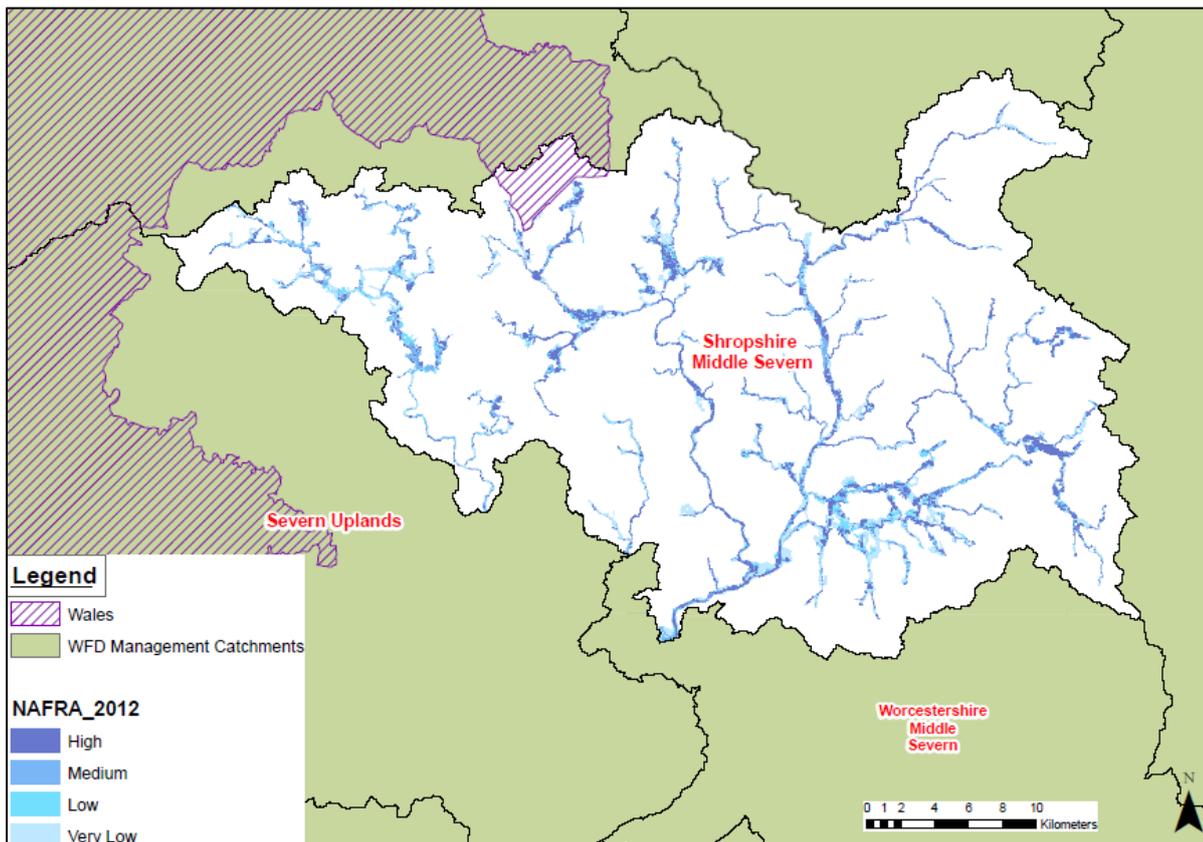
## Key statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 5,850 people at risk from river flooding, representing 3% of the total population. Nearly 1,050 non-residential properties are at risk of flooding from river of which 200 are considered to be at high risk. Approximately 5% of agricultural land within the catchment is at risk of flooding with around 1,700 hectares being at high risk.

**Figure 4.7: National Flood Risk Assessment (NAFRA) in the Shropshire Middle Severn catchment**



The ivers and sea flood map has been developed and published by the Environment Agency.

**Table 4.9: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Shropshire Middle Severn Catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	174,000	1,150	350	400	3,950
Number of services:	780	30	10	<10	30
<b>Risk to economic activity:</b>					
Number of non-residential properties:	37,000	200	100	100	650
Number of airports:	0	0	0	0	0
Length of roads (km):	180	<10	<10	<10	<10
Length of railway (km):	70	<10	<10	<10	<10
Agricultural land (ha):	91,200	1,700	700	400	1,650
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	40	1	1	0	0
Area of SAC within area (ha):	850	50	<50	<50	<50
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	1,250	150	<50	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	1,750	200	50	<50	100
Area of parks and gardens within area (ha):	1,500	<50	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	200	<50	<50	<50	<50
Number of listed buildings within area:	1,890	50	<10	<10	50
Number of licensed water abstractions within the area:	630	210	10	<10	10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

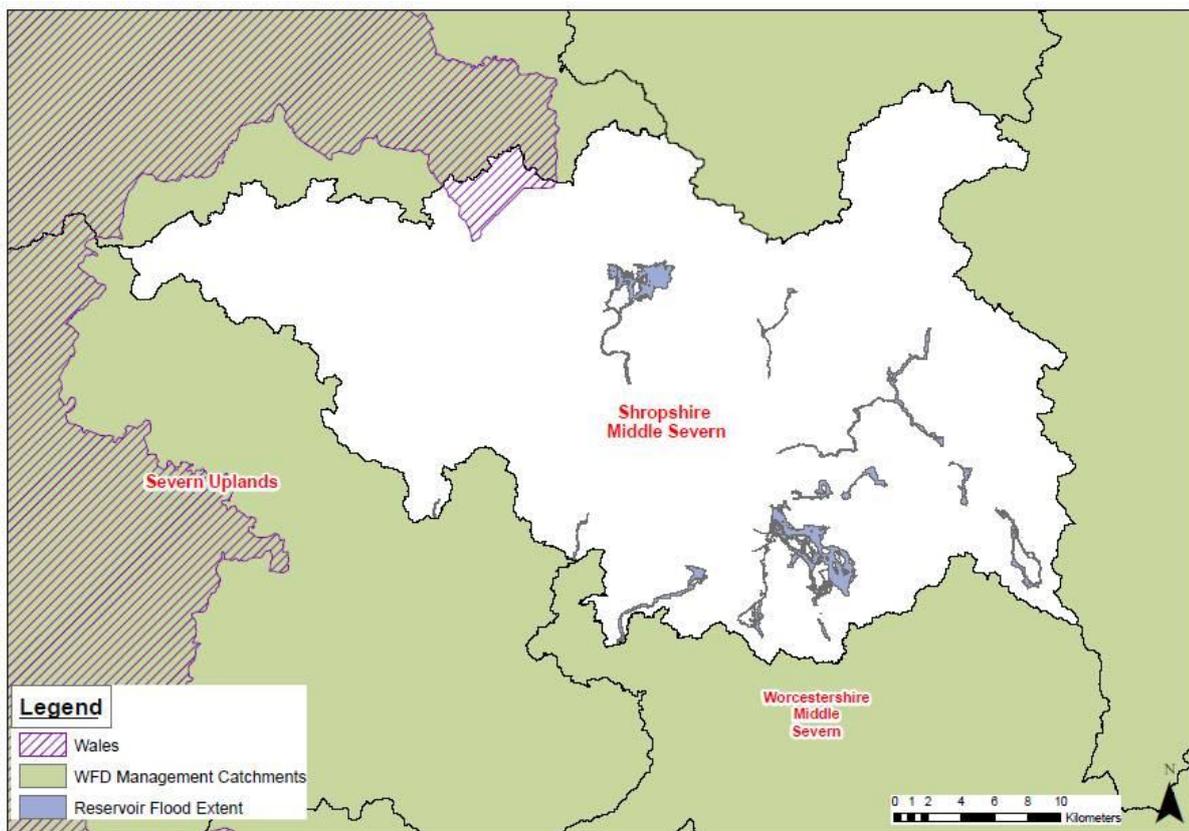
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 2,900 people are at risk of flooding from reservoirs in the Shropshire Middle Severn Catchment, representing approximately 2% of the total population within the catchment. Approximately 850 non-residential properties are at risk of flooding from reservoirs in the Shropshire Middle Severn Catchment. Approximately 2% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 2% of SSSI sites and there are no Ramsar sites at risk of flooding in the area.

**Figure 4.8: Reservoir flood risk extents in the Shropshire Middle Severn catchment**



The reservoirs flood map has been developed and published by the Environment Agency.

**Table 4.10: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Shropshire Middle Severn Catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	174,000	2,900
Number of services:	780	30
<b>Risk to economic activity:</b>		
Number of non-residential properties:	37,000	850
Number of airports:	0	0
Length of roads (km):	180	<10
Length of railway (km):	70	<10
Agricultural land (ha):	91,200	1,700
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	40	2
Area of SAC within area (ha):	850	0
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	1,250	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	1,750	<50
Area of parks and gardens within area (ha):	1,500	<50
Area of Scheduled Ancient Monument within area (ha):	200	<50
Number of listed buildings within area:	1,890	40
Number of licensed water abstractions within the area:	630	90

**Note:**

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the Shropshire Middle Severn Catchment

The Environment Agency has set out the following for this catchment:

### Conclusions

Flood risk within the Shropshire Middle Severn is relatively low due to its rural nature. As the catchment is within the upper part of the river basin district, it is important to ensure there is no increase in runoff as a result of changes in land use management and where possible that opportunities are sought to help reduce downstream peaks. Future impacts may also be minimised through managing surface water from any future urban expansion around the existing towns/villages.

There is a continued need to work in partnership with others, where possible, to achieve flood risk management measures which will alleviate flooding from multiple sources, as well as providing wider environmental and other benefits to improve the natural, rural and built environment consistent with the principles of sustainable development.

### Objectives

The following objectives apply to this management catchment, where possible and viable to do so. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.11: Social objectives for the Shropshire Middle Severn catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce or prevent an increase in harm to life as a result of flooding	RBD 2	Soc B
Minimise community disruption by reducing impact of flooding by increasing preparedness through improved flood warning service and public awareness	RBD 7, 9, 10	Soc D, G
Steer development towards areas of little or no risk of flooding, where development must occur in medium or high flood risk areas it must be sustainable, not increase flood risk and take account of the impacts of climate change	RBD 1, 11	Soc E
Increase understanding and management of flood risk impacts	RBD 6, 11	Soc A
Continue to work with utility providers to improve resilience of infrastructure and services	RBD 1, 8, 10, 11	Soc A, F
Continue to work with other bodies to improve resilience to the communication network and transport links	RBD 1, 8, 10, 11	Soc A, F
maintain existing assets that protect people where economically viable or find suitable alternatives by working in partnership with communities	RBD 6, 11, 12	Soc A

**Table 4.12: Economic objectives for the Shropshire Middle Severn catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1	Ec A
Reduce flood risk to residential properties	RBD 1	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec E
Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5	Ec C
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B, Soc F
Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11	Ec D
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	Ec B, En D, G

**Table 4.13: Environmental objectives for the Shropshire Middle Severn catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Take opportunities to restore sustainable natural storage of floodwater on tributaries in their upstream areas, in order to offset increasing flood risk from trends including climate change	RBD 11	En A
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydro-morphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Maintain and enhance habitat through flood risk management activities	RBD 4	En B
Help achieve WFD Objectives through Flood Risk Management	RBD 1, 4	En E
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	Env E
Protect and enhance designated landscapes and local landscape character	RBD 1, 4	En C, G
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures in the Shropshire Middle Severn Catchment

Measures that are relevant to this catchment are included in the RBD and Severn England level measures shown in Annex 1. In addition, there are measures specific to this catchment as follows:

Across the Shropshire Middle Severn Catchment there are 8 measures to manage flood risk over and above those included in Annex 1 and the flood risk activities described in section 6 in Part A.

**Preventing risk:** There are 4 measures in place to prevent flood risk that are specific to this catchment (Measure codes M21/M23/M24, in Annex 1):

- Severn Trent Water invest in reduction of flood risk to properties;
- Severn Trent Water invest in partnership funding opportunities;
- Severn Trent Water will continue to carry out risk based maintenance;
- Severn Trent Water will continue to raise awareness to help reduce preventable sewer flooding incidents.

**Preparing for risk:** There are 2 measures in place to prepare for flood risk that are specific to this catchment (Measure codes M41/M42/M43/M44 in Annex 1):

- Severn Trent Water will continue to contribute to development of surface water management plans;
- Severn Trent Water will continue to develop sewerage management plans.

**Protecting from risk:** There are 2 measures in place that protect from flood risk that is specific to this catchment (Measure codes M32/M34/M35 in Annex 1):

- review the effectiveness of raised defences.
- Staffordshire Local Flood Risk Management Strategy actions.

**Recovery and review of risk:** There are no specific measures in this category, over and above those included in Annex 1 of this document and the flood risk activities described in section 6.

More detail on the measures is included in Annex 1

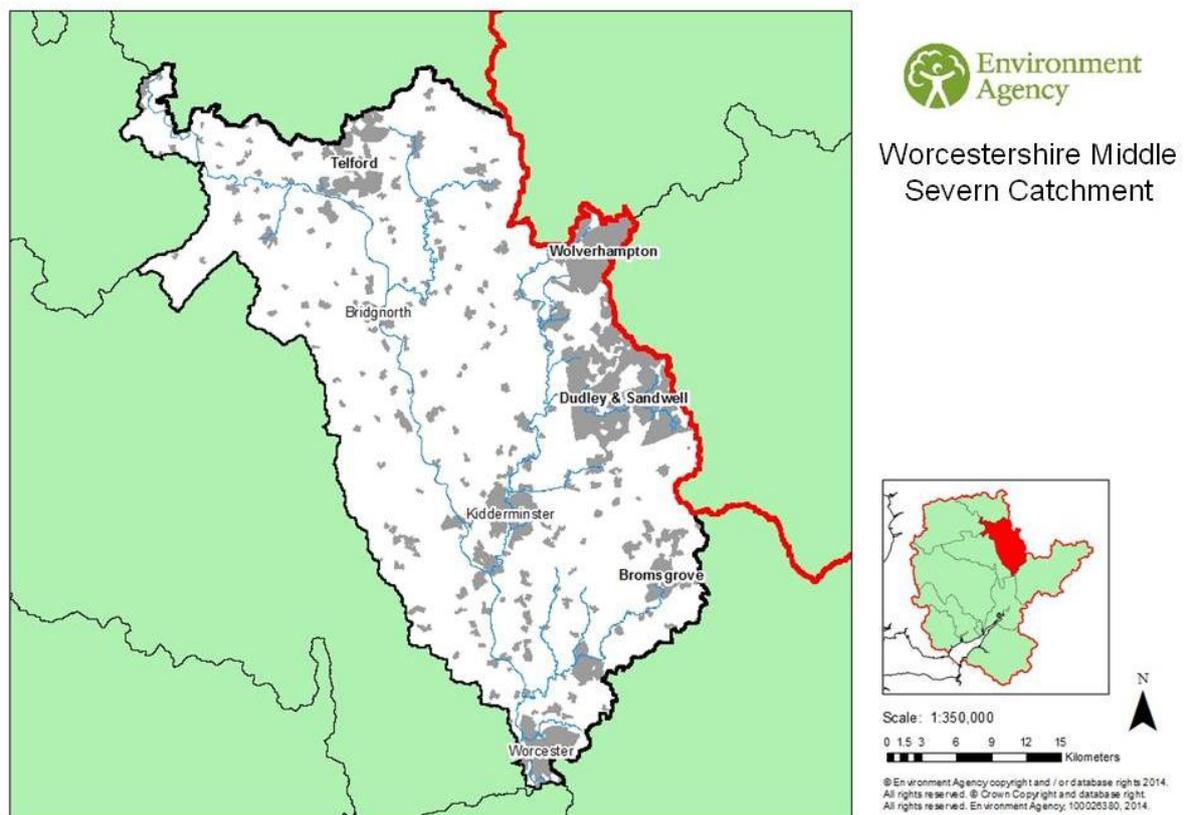
## 4.3. The Worcestershire Middle Severn Catchment

### Introduction to the catchment

The Worcestershire Middle Severn catchment extends from Worcester in the south up to Shrewsbury and Telford in the north covering an area of 1,510 km<sup>2</sup>.

The landscape is a mixture of woodland and open farmland on the undulating Midlands Plateau (including Ironbridge Gorge) and the broader flatter floodplain of the River Severn towards Worcester. The Shropshire Hills form the north west boundary to the area and land rises steadily on the eastern boundary towards the West Midlands conurbation.

**Figure 4.9: The Worcestershire Middle Severn catchment**



### Land use and management

The land use within the catchment is mainly agricultural (Grade 3 – good to moderate land quality or better), with a mixture of arable and managed grassland farming. There are also some larger areas of woodland in the centre of the catchment. The eastern edge is covered by parts of the West Midlands conurbation that includes the Black Country. These areas traditionally contained heavy industry much of which has now closed down. Other larger urban centres include Worcester, Kidderminster, Bromsgrove and the southern half of

Telford. Elsewhere tourism and small business are key to the financial well being of smaller rural communities.

Watercourses within the catchment are used for a variety of activities including recreation, public water supply, fisheries and conservation. The area is rich in landscape, wildlife and industrial heritage, including the World Heritage Site of Ironbridge Gorge.

## Geology

Geology in the Worcestershire Middle Severn area is divided in broadly the same way as the topography, with clays, mudstones and shales across the valley of the River Severn with igneous rocks forming the higher ground of the Shropshire Hills.

The clays and mudstones in the river valley lie close to the groundwater table for much of the year and are frequently saturated resulting in standing water across the floodplain. When this happens, rainfall is slow to drain away and may lead to localised flooding even when the River Severn is not in flood. Previous aggregate extractions have formed artificial lakes in several areas on the Severn floodplain. Often these sites maintain high water levels and provide little capacity for storing floodwater.

## National and international designations

There are a number of designated areas of nature conservation importance located within the catchment, including a SAC (Special Area of Conservation) at Fen Pools (near Dudley). Other European sites within the management catchment include the Midland Meres and Mosses (Phase 1) Ramsar site which is located on the northern boundary of the catchment and Lyppard Grange Ponds SAC located within the eastern suburbs of Worcester.

There are many Sites of Special Scientific Interest (SSSIs) especially within the Wyre Forest part of the catchment. These designated sites are located throughout the catchment and the way in which they are managed can have an effect on the risk of flooding (by affecting the surface run-off into the River Severn and its tributaries).

To the north west of the Worcestershire Middle Severn catchment is the Shropshire Hills Area of Outstanding Natural Beauty (AONB).

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. This catchment includes the Ironbridge Gorge World Heritage Site and a number of historic riverside towns including Bridgnorth, Bewdley and Worcester.

## Partnership working

Within the Worcestershire Middle Severn Catchment the Environment Agency has developed good working relationships with partners, including local councils. The catchment is covered by two unitary and eleven local councils, including Shropshire, Telford & Wrekin, Newcastle under Lyme Borough, Stafford Borough, South Staffordshire District, City of Wolverhampton, Sandwell Borough, Dudley Borough, Bromsgrove District, Wyre Forest District, Worcester City, Wychavon District and Malvern Hills District.

Staffordshire County Council and Shropshire County Council have agreed to work together to deliver a collaborative working approach towards flood risk management for their geographical areas. This approach fits in with the corporate values of both authorities and is providing opportunities for efficiencies through the sharing of resources and joint procurement of services as well as pooling of specialist flood risk management skills which are nationally in short supply.

The Environment Agency also work closely with the English Severn & Wye Regional Flood and Coastal Committee, Severn Trent Water, Canals & Rivers Trust, National Farmers Union, Natural England, Historic England and local authority archaeologists and conservation officers.

The Environment Agency will also continue to work, and strengthen links, with the Worcestershire Middle Severn Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the catchment to meet England Biodiversity Strategy (2020) targets.

## Historic flooding

Flooding in the Worcestershire Middle Severn Catchment is relatively slow on the River Severn but there are a number of rapidly responding catchments. These include those that drain from the western edge of the West Midlands urban conurbation and smaller steeper rural catchments such as Dick Brook near Bewdley.

There is a long and well documented history of fluvial flooding within the catchment, especially along the River Severn from Shrewsbury to Worcester that includes a number of urban areas including Worcester, Stourport, Bewdley, Ironbridge and Bridgnorth.

Urban areas on tributaries of the River Severn have suffered from flooding, including at Kidderminster (on the River Stour), and at Bromsgrove and Droitwich (both on the River Salwarpe).

The most recent events occurred in January/February 2014 and July 2007 resulting in varying degrees of property flooding within Worcester and other riverside towns. The events of 1947 had the greatest impacts catchment wide.

Other historical floods include those of October 1998 and October – December 2000 that impacted upon various communities along the River Severn and some of the urban areas on the tributaries.

## Current flood risk

The Worcestershire Middle Severn Catchment has a variety of flooding issues ranging from extended periods of elevated levels along the River Severn between Bewdley and Worcester to watercourses which respond rapidly to rainfall in some of the more urban areas.

High river levels and out of bank flooding from the River Severn between Shrewsbury and Worcester is a regular occurrence resulting in some disruption to local communities, although the number of properties affected in the most common events is low.

Larger events along the River Severn as witnessed in 2000, 2007 and 2014 cause wider disruption especially within Worcester where the city centre bridge may be closed as a result of high water levels.

Elsewhere many other smaller rural communities can be impacted upon either directly or as a result of flooding of local infrastructure such as roads.

There are a number of watercourses that react quickly to rainfall in the catchment, these include the Dick Brook (Astley), Coal Brook (Coalbrookdale) and Shyte Brook (Much Wenlock). Flood levels on these watercourses may rise suddenly resulting in a risk to life

and major disruption locally. It is difficult to provide accurate and timely warnings in such locations and these events may become more common as a result of climate change.

Isolated locations across the catchment are at risk of surface water flooding during periods of intense rainfall. Due to the urbanised nature of these parts of the catchment there are often significant interactions between sources of flooding (watercourses, surface water, sewers and groundwater), and it is not always possible to establish the source of the flooding.

It is likely that these issues will become more pronounced and regular as a result of climate change where it is difficult to upgrade current infrastructure.

## Recent flood risk management work

Following the floods of 2000 demountable flood defences were constructed in Bewdley Severn Side north, followed by Severnside South. Temporary flood defences have been trialled in Ironbridge, Beales Corner, Bewdley and parts of Worcester. In Kidderminster a permanent attenuation area was built to the north of the town to reduce the risk of flooding within the town centre from the River Stour. Along Hylton Road the temporary defences were upgraded to include a permanent earth bund. Following the event of early 2014 further reviews are currently being undertaken for small scale community led schemes in Worcester and provision of property level protection elsewhere in the catchment.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Worcestershire Middle Severn management catchment. The significant issues within this catchment are diffuse pollution from both agriculture and urban areas, physical modification of the watercourse and phosphates from sewage treatment works. In some areas changes to the natural level and flow of water is a significant issue.

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency has made an assessment of the measures needed to achieve positive benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

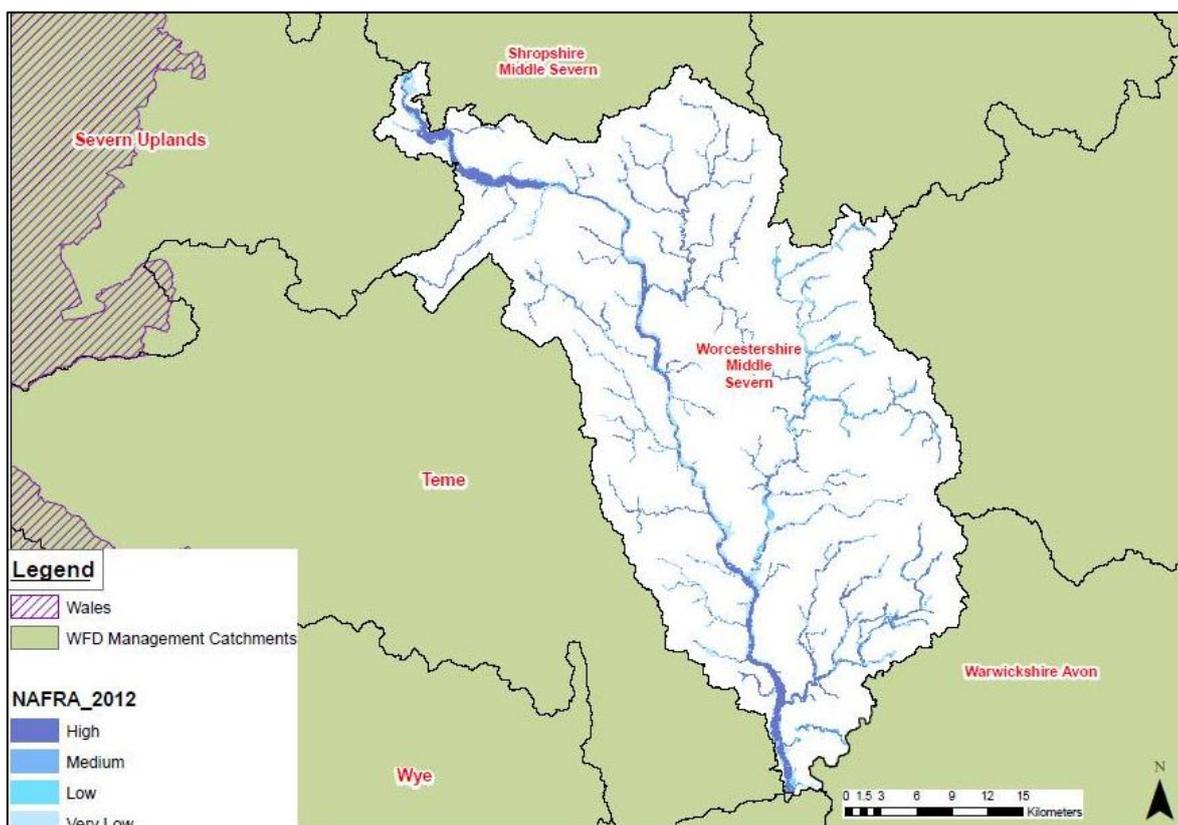
## Key statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 22,550 people at risk from river flooding, representing 2.7% of the total population. Nearly 4,850 non-residential properties are at risk of flooding from river of which 1,250 are considered to be at high risk. Approximately 5% of agricultural land within the catchment is at risk of flooding with around 3,400 hectares being at high risk.

**Figure 4.10: National Flood Risk Assessment (NAFRA) in the Worcestershire Middle Severn catchment**



The ivers and sea flood map has been developed and published by the Environment Agency

**Table 4.14: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Worcestershire Middle Severn Catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	834,900	2,850	2,850	3,800	13,050
Number of services:	1590	50	10	20	50
<b>Risk to economic activity:</b>					
Number of non-residential properties:	82,550	1,250	600	1,000	2,000
Number of airports:	0	0	0	0	0
Length of roads (km):	510	<10	<10	<10	10
Length of railway (km):	110	<10	<10	<10	<10
Agricultural land (ha):	116,100	3,400	450	450	1,500
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	50	1	1	1	0
Area of SAC within area (ha):	<50	0	0	0	0
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	<50	0	0	0	0
Area of World Heritage Site within area (ha):	550	<50	<50	<50	<50
Area of SSSI within area (ha):	3,650	150	<50	<50	50
Area of Parks and Gardens within area (ha):	3,200	100	<50	<50	50
Area of Scheduled Ancient Monument within area (ha):	400	50	<50	<50	<50
Number of Listed Buildings within area:	4,730	120	40	120	290
Number of Licensed water abstractions within the area:	580	180	<10	<10	<10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

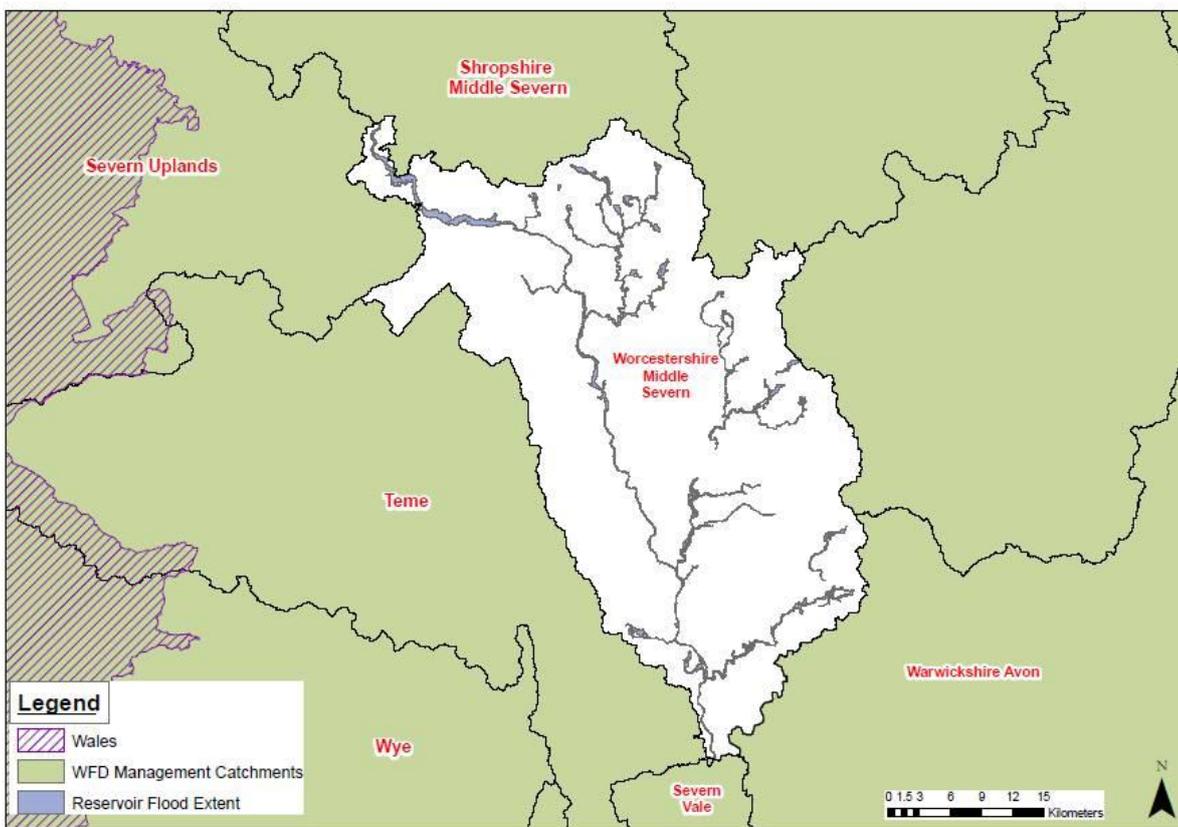
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 14,000 people are at risk of flooding from reservoirs in the Worcestershire Middle Severn Catchment, representing approximately 2 % of the total population within the catchment. Approximately 1,850 non-residential properties are at risk of flooding from reservoirs in the Worcestershire Middle Severn Catchment. Approximately 2.8% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 4.1% of SSSI sites and there are no Ramsar sites at risk of flooding in the area.

**Figure 4.11: Reservoir flood risk extents in the Worcestershire Middle Severn catchment**



The reservoirs flood map has been developed and published by the Environment Agency.

**Table 4.15: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Worcestershire Middle Severn Catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	834,900	14,200
Number of services:	1,590	80
<b>Risk to economic activity:</b>		
Number of non-residential properties:	82,550	1,850
Number of airports:	0	0
Length of roads (km):	510	<10
Length of railway (km):	110	<10
Agricultural land (ha):	116,100	3,350
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	50	0
Area of SAC within area (ha):	<50	<50
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	<50	0
Area of World Heritage Site within area (ha):	550	50
Area of SSSI within area (ha):	3,650	150
Area of Parks and Gardens within area (ha):	3,200	200
Area of Scheduled Ancient Monument within area (ha):	400	<50
Number of Listed Buildings within area:	4,730	210
Number of Licensed water abstractions within the area:	580	140

**Note:**

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the Worcestershire Middle Severn Catchment

### Conclusions

Flood risk will remain for many communities along the Severn Valley, including for communities along some of the tributaries which respond rapidly to rainfall. The latter includes Dick Brook (Astley), Coal Brook (Coalbrookdale) and Shyte Brook (Much Wenlock). There is also a risk of surface water and sewer flooding within some urban areas. Flood risk may increase as a result of climate change.

There is a continued need to work in partnership with others, where possible, to achieve flood risk management measures which will alleviate flooding from multiple sources, as well as providing wider environmental and other benefits to improve the natural, rural and built environment consistent with the principles of sustainable development.

### Objectives

The following objectives apply to this management catchment, where possible and viable to do so. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.16: Social objectives for the Worcestershire Middle Severn catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce or prevent an increase in harm to life as a result of flooding	RBD 2	Soc B
Minimise community disruption by reducing impact of flooding by increasing preparedness through improved flood warning service and public awareness	RBD 7, 9, 10	Soc D, G
Steer development towards areas of little or no risk of flooding, where development must occur in medium or high flood risk areas it must be sustainable, not increase flood risk and take account of the impacts of climate change	RBD 1, 11	Soc E
Improve awareness in catchments which react rapidly to rainfall	RBD 2, 9	Soc C
Increase understanding and management of flood risk impacts	RBD 6, 11	Soc A
Reduce the likelihood of death or serious injury resulting from rapid inundation or deep and fast flowing water	RBD 2	Soc C
Continue to work with utility providers to improve resilience of infrastructure and services	RBD 1, 8, 10, 11	Soc A, F
Continue to work with other bodies to improve resilience to the communication network and transport links	RBD 1, 8, 10, 11	Soc A, F
maintain existing assets that protect people where economically viable or find suitable alternatives by working in partnership with communities	RBD 6, 11, 12	Soc A

**Table 4.17: Economic objectives for the Worcestershire Middle Severn catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1	Ec A
Reduce flood risk to residential properties	RBD 1	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec E
Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5	Ec C
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B, Soc F
Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11	Ec D
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	Ec B, En D, G

**Table 4.18: Environmental objectives for the Worcestershire Middle Severn catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Take opportunities to restore sustainable natural storage of floodwater on tributaries in their upstream areas, in order to offset increasing flood risk from trends including climate change	RBD 11	En A
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydro-morphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Maintain and enhance habitat through flood risk management activities	RBD 4	En B
Help achieve WFD Objectives through Flood Risk Management	RBD 1, 4	En E
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	Env E
Protect and enhance designated landscapes and local landscape character	RBD 1, 4	En C, G
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures in the Worcestershire Middle Severn Catchment

Measures that are relevant to this catchment are included in the RBD and Severn England level measures shown in Annex 1. In addition, there are measures specific to this catchment as follows:

Across the Worcestershire Middle Severn Catchment there are 65 measures to manage flood risk. These include:

**Preventing risk:** There are 20 measures to prevent flood risk in the catchment (Measure codes M21/M23/M24, in Annex 1), including:

- work with communities to promote property level protection measures
- limit discharge to greenfield run-off rate
- reinstate natural river channel and restore functional floodplain
- deculvert where feasible and no building over existing culverts
- Severn Trent Water measures to reduce flood risk via investment, partnership funding opportunities, raising awareness and carrying out risk based maintenance.

**Preparing for risk:** There are 30 measures to prepare for flood risk that are specific to this catchment (Measure codes M41/M42/M43/M44 in Annex 1), including:

- raising awareness of communities in catchments that respond rapidly to rainfall at Much Wenlock, Coalbrookdale and Astley;
- Severn Trent Water will continue to contribute to development of surface water management plans and sewerage management plans;
- Measures taken from the Multi Agency Flood Plans including
  - develop and promote better understanding of flood and coastal erosion risk
  - enable communities to take effective action
  - work with others to continue to improve incident management

**Protecting from risk:** There are 15 measures that protect from flood risk that are specific to this catchment (Measure codes M32/M34/M35 in Annex 1) including:

- work with the community in Droitwich to identify measures to reduce flood risk;
- surface water disposal in line with national guidance and attenuation implemented into new developments
- property level protection scheme at Kinver;
- flood alleviation scheme at Dudley;
- continue with channel maintenance and flood warning at Shrewsbury, Monkmore, Ironbridge, Coalport, Hampton, Bridgnorth, Bewdley, Stourport-on-Severn, Holt Fleet, Bevere, and Worcester.

**Recovery and review of risk:** There are no specific measures in this category, over and above those included in Annex 1 and the flood risk activities described in section 6 of Part A.

More detail on the measures is included in Annex 1

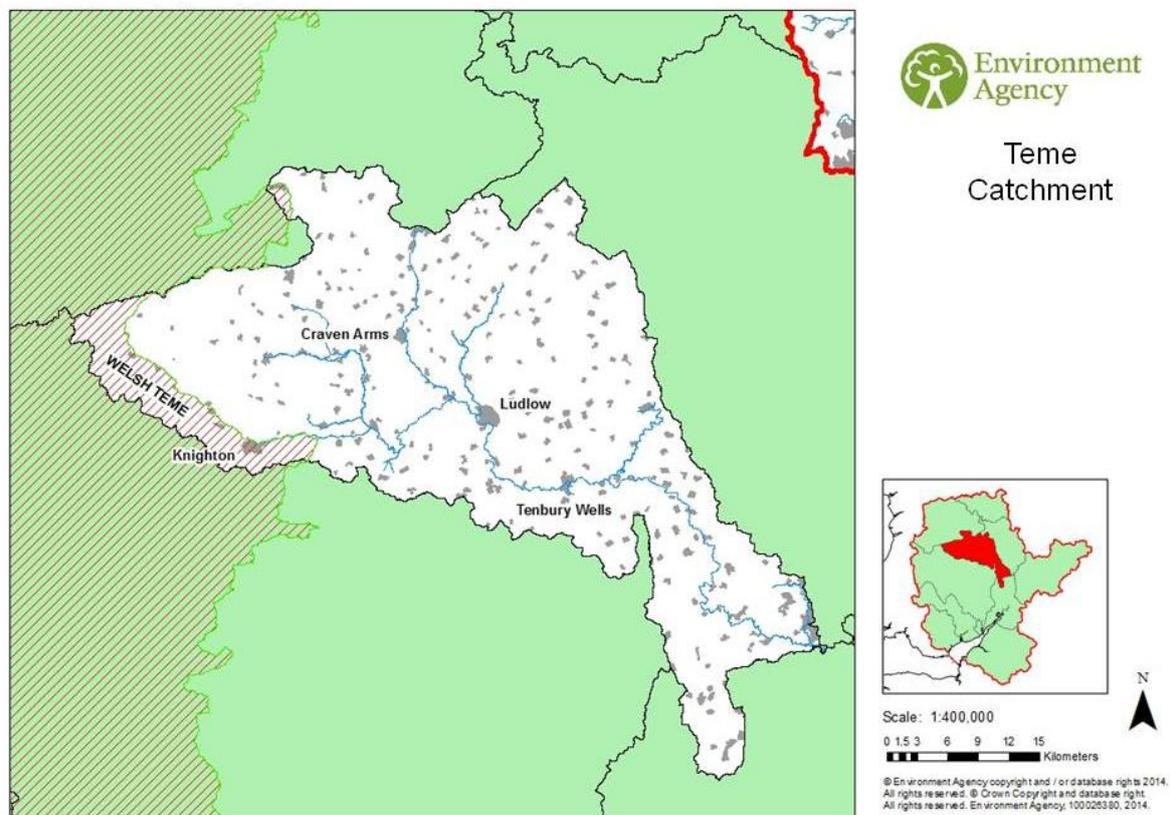
## 4.4. The Teme Catchment

### Introduction to the catchment

The Teme catchment extends from Worcester in a north westerly direction over the Welsh border at Knighton, covering an area of 1,650 km<sup>2</sup>. Its tributaries include the Rivers Clun, Onny and Corve which drains Wenlock Edge.

The landscape is varied, extending from low lying relatively flat areas around Worcester, before narrowing within the valley of the River Teme that extends into the upland region of the Shropshire Hills on the English/Welsh border.

**Figure 4.12: The Teme catchment**



### Land use and management

The land use within the catchment is predominantly agricultural (ranging from Grade 2/3 – good to moderate land quality in the Teme Valley to Grade 5 - poor quality in the upland areas), with a mixture of arable, managed grassland and rough grassland farming. The main urban centres are the market towns of Ludlow and Tenbury Wells with tourism and some small business key to the financial well-being of the surrounding rural communities.

Watercourses within the catchment are used for a variety of activities including recreation, public water supply, fisheries and conservation. The area is rich in landscape and wildlife heritage, including being partially within both the Shropshire Hills and Malvern Hills Areas of Outstanding Natural Beauty.

## Geology

Geology in the Teme catchment is divided in broadly the same way as the topography, with clays and mudstones across the bottom of the Teme Valley and its lower reaches around Worcester, and sandstones and igneous rocks forming the higher ground of the Shropshire Hills.

## National and international designations

There are some designated areas of nature conservation importance located within the catchment.

These include three internationally designated Special Areas of Conservation (SACs) including the River Clun SAC, Downton Gorge SAC, and The Stiperstones and The Hollies SAC. In addition, there are a number of Sites of Special Scientific Interest (SSSIs), including the River Teme for its full length, and one National Nature Reserve (NNR) at Downton Gorge, that are known for their species, habitats or geology.

The Shropshire Hills Area of Outstanding Natural Beauty (AONB) covers an extensive area in the north of the catchment.

These designated sites and the way in which they are managed can have an effect on the risk of flooding from the Teme catchment.

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. Examples of historic riverside towns in the catchment include Ludlow and Knighton.

## Partnership working

Within the Teme Catchment the Environment Agency and Natural Resources Wales have developed good working relationships with partners. These include local councils. The catchment is covered by three unitary councils (Herefordshire, Shropshire and Powys) and one local council (Malvern Hills District).

The Environment Agency also works closely with the Regional Flood and Coastal Committee, Severn Trent Water plc, Forestry Commission, National Farmers Union, Natural England, Historic England and local authority archaeologists and conservation officers.

The Environment Agency will also continue to work, and strengthen links, with the Teme Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the River Clun SAC River Restoration Plans and to meet England Biodiversity Strategy (2020) targets.

## Historic flooding

The River Teme is a medium sized catchment and hence the onset of flooding can be relatively rapid in parts, with the main channel reacting quickly during certain conditions.

Flooding in the catchment has been recorded over many years within those towns affected, such as Tenbury Wells, Craven Arms, Knighton and Ludlow, but due to its rural nature there are not many widespread historic records.

The most recent severe flood events occurred in 1947 and 2007 when a large number of properties were affected in Tenbury Wells.

There are few other significant recorded events.

## Current flood risk

Due to the rural nature of the upper catchment, flood risk is mainly constrained to agricultural land and isolated properties.

The onset of flooding is normally relatively quick due to the steep nature of the upstream catchment with its narrow river valleys.

In the lower parts of the catchment, west of Worcester, flood levels in the River Teme can combine with longer periods of flooding around its confluence with the River Severn. In larger events, such as those experienced in 1947 and 2007, flooding to properties in the few urban areas occurs, as highlighted in the previous section.

There is a risk of surface water and sewer flooding in some urban locations.

## Recent flood risk management work

Since 2007 properties in Tenbury Wells and surrounding rural areas have benefited from property level protection.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Teme management catchment. The significant issues within this catchment are pollution from rural areas, pollution from waste water and physical modifications.

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency has made an assessment of the measures needed to achieve positive benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment.
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

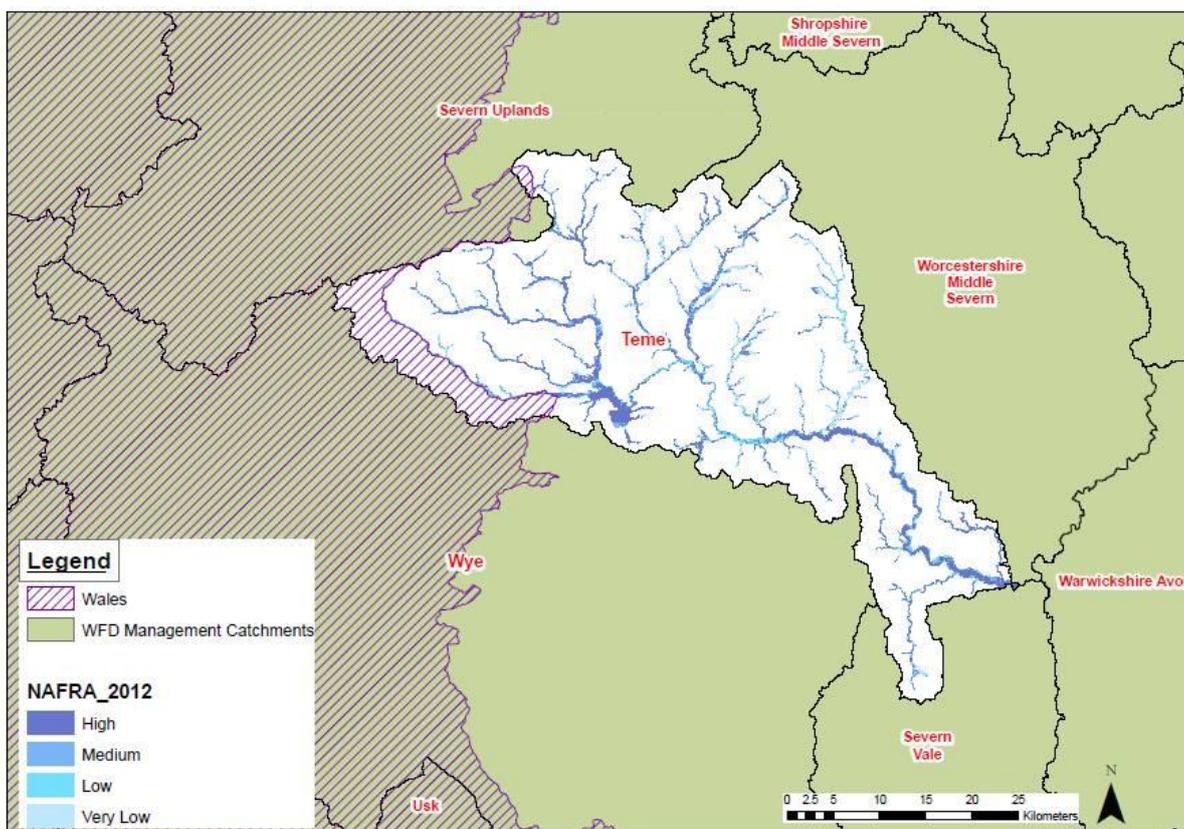
## Key Statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 4,050 people at risk from river flooding, representing 4% of the total population. Nearly 1,750 non-residential properties are at risk of flooding from river of which 500 are considered to be at high risk. Approximately 6% of agricultural land within the catchment is at risk of flooding with around 3,500 hectares being at high risk.

**Figure 4.13: National Flood Risk Assessment (NAFRA) in the Teme catchment**



The [rivers and sea flood map](#) has been developed and published by the Environment Agency

**Table 4.18: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Teme Catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	93,150	800	550	750	1,950
Number of services:	550	20	<10	<10	20
<b>Risk to economic activity:</b>					
Number of non-residential properties:	36,450	500	300	300	650
Number of airports:	0	0	0	0	0
Length of roads (km):	90	<10	<10	<10	<10
Length of railway (km):	70	<10	<10	<10	<10
Agricultural land (ha):	104,750	3,500	750	850	1,050
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	19	0	0	0	1
Area of SAC within area (ha):	300	<50	<50	<50	<50
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	4,250	450	<50	<50	<50
Area of Parks and Gardens within area (ha):	2,400	<50	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	550	<50	<50	<50	<50
Number of Listed Buildings within area:	3,600	100	50	50	60
Number of Licensed water abstractions within the area:	160	80	0	<10	<10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

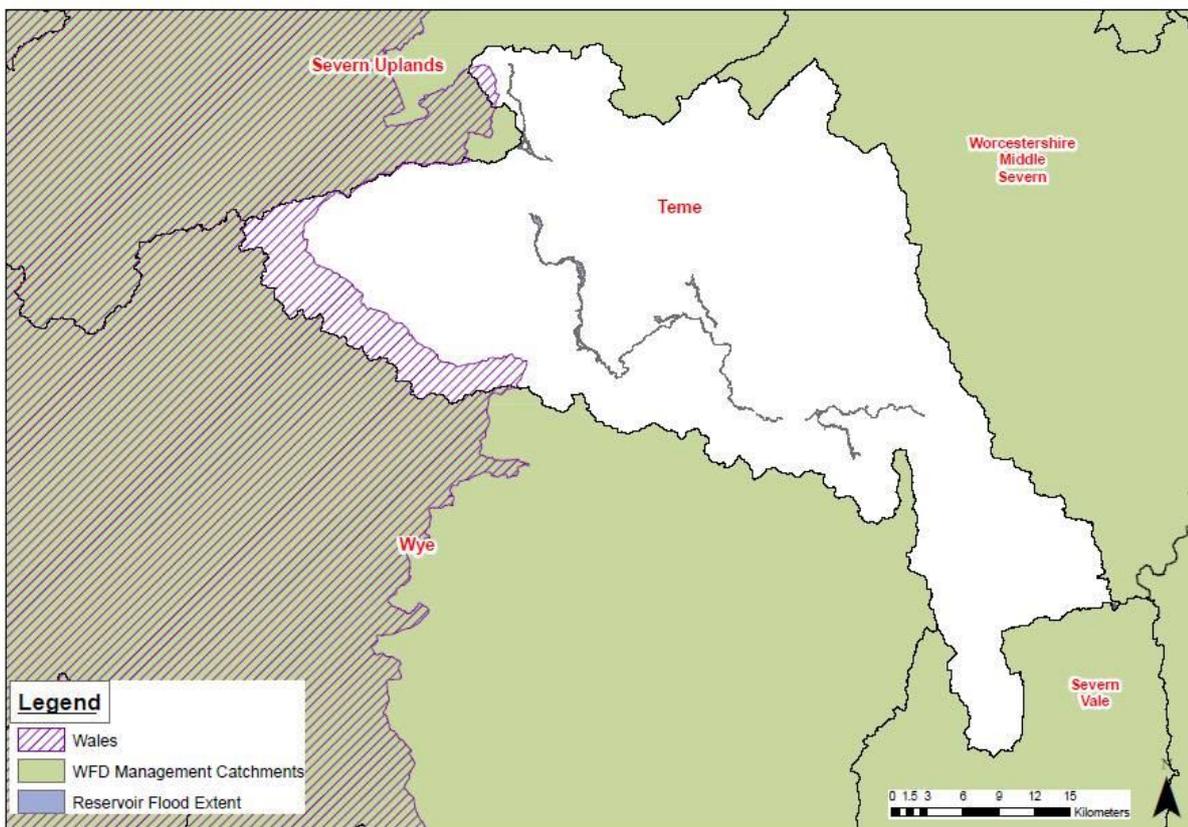
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 150 people are at risk of flooding from reservoirs in the Teme Catchment, representing approximately 0.2% of the total population within the catchment. Approximately 100 non-residential properties are at risk of flooding from reservoirs in the Teme Catchment. Approximately 0.4% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 3.5% of SSSI sites and no Ramsar sites are at risk of flooding in the area.

**Figure 4.14: Reservoir flood risk extents in the Teme catchment**



The reservoirs flood map has been developed and published by the Environment Agency

**Table 4.19: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Teme Catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	93,150	150
Number of services:	550	<10
<b>Risk to economic activity:</b>		
Number of non-residential properties:	36,450	100
Number of airports:	0	0
Length of roads (km):	90	<10
Length of railway (km):	70	<10
Agricultural land (ha):	104,750	450
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	19	0
Area of SAC within area (ha):	300	<50
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	4,250	150
Area of Parks and Gardens within area (ha):	2,400	<50
Area of Scheduled Ancient Monument within area (ha):	550	<50
Number of Listed Buildings within area:	3,600	30
Number of Licensed water abstractions within the area:	160	30

**Note:**

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the Teme catchment

### Conclusions

Flooding within the Teme catchment tends to be flashy in nature due to the steepness of much of the upper areas, affecting properties in some urban centres such as Craven Arms, Ludlow and Tenbury Wells, as well as isolated properties in smaller rural communities and agricultural land.

In the lower parts of the catchment west of Worcester, flood levels in the River Teme can combine with longer periods of flooding around its confluence with the River Severn.

The greatest impact on future flooding is considered to originate from changes in land use and farming practices, in addition to climate change. Further intensification in land use and removal of field margins would result in faster runoff and increase in transportation of silts into the natural river system. The results would be an increase in peak flows and reduction in channel capacity through increased siltation.

There is a continued need to work in partnership with others, where possible, to achieve flood risk management measures which will provide wider environmental and other benefits to improve the natural, rural and built environment consistent with the principles of sustainable development.

### Objectives

The following Objectives apply to this management catchment, where possible and viable to do so. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.20: Social objectives for the Teme catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce or prevent an increase in harm to life as a result of flooding	RBD 2	Soc B
Minimise community disruption by reducing impact of flooding by increasing preparedness through improved flood warning service and public awareness	RBD 7, 9, 10	Soc D, G
Steer development towards areas of little or no risk of flooding, where development must occur in medium or high flood risk areas it must be sustainable, not increase flood risk and take account of the impacts of climate change	RBD 1, 11	Soc E
Improve awareness in catchments which react rapidly to rainfall	RBD 2, 9	Soc C
Increase understanding and management of flood risk impacts	RBD 6,11	Soc A
Reduce the likelihood of death or serious injury resulting from rapid inundation or deep and fast flowing water	RBD 2	Soc C
Continue to work with utility providers to improve resilience of infrastructure and services	RBD 1, 8, 10, 11	Soc A, F
Continue to work with other bodies to improve resilience to the communication network and transport links	RBD 1, 8, 10, 11	Soc A, F
Maintain existing assets that protect people where economically viable or find suitable alternatives by working in partnership with communities	RBD 6,11,12	Soc A

**Table 4.21: Economic objectives for the Teme catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1	Ec A
Reduce flood risk to residential properties	RBD 1	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec E
Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5	Ec C
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B, Soc F
Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11	Ec D
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	Ec B, En D, G

**Table 4.22: Environmental objectives for the Teme catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Take opportunities to restore sustainable natural storage of floodwater on tributaries in their upstream areas, in order to offset increasing flood risk from trends including climate change	RBD 11	En A
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydro-morphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Maintain and enhance habitat through flood risk management activities	RBD 4	En B
Help achieve WFD Objectives through Flood Risk Management	RBD 1, 4	En E
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	Env E
Protect and enhance designated landscapes and local landscape character	RBD 1, 4	En C, G
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures in the Teme catchment

Measures that are relevant to this catchment are included in the RBD and Severn England level measures shown in Annex 1. In addition, there are measures specific to this catchment as follows:

Across the Teme Catchment are 12 measures to manage flood risk. These include:

**Preventing risk:** There are 4 specific measures in this category (Measure codes M21/M23/M24, in Annex 1):

- Severn Trent Water invest in reduction of flood risk to properties and partnership funding opportunities (2 measures);
- Severn Trent Water will continue to carry out risk based maintenance;
- Severn Trent Water will continue to raise awareness to help reduce preventable sewer flooding incidents.

**Preparing for risk:** There are 2 specific measures in this category (Measure codes M41/M42/M43/M44 in Annex 1):

- Severn Trent Water will continue to contribute to development of surface water management plans and sewerage management plans (2 measures).

**Protecting from risk:** There are 6 measures that protect from flood risk in this catchment (Measure codes M32/M34/M35 in Annex 1):

- work with partners to investigate where natural processes can be used to reduce flow;
- work with the community at Tenbury Wells to assess the long term strategy for delivering a viable flood alleviation scheme;
- work with the community at Cleobury Mortimer to assess the feasibility of carrying out measures to reduce flood risk;
- review maintenance operations;
- ensure weed control is carried out in the most effective way on the Teme;
- review the effectiveness of raised defences in the catchment.

**Recovery and review of risk:** There are no specific measures in this category, over and above those included in Annex 1 and the flood risk activities described in section 6.

More detail on the specific measures is included in Annex 1

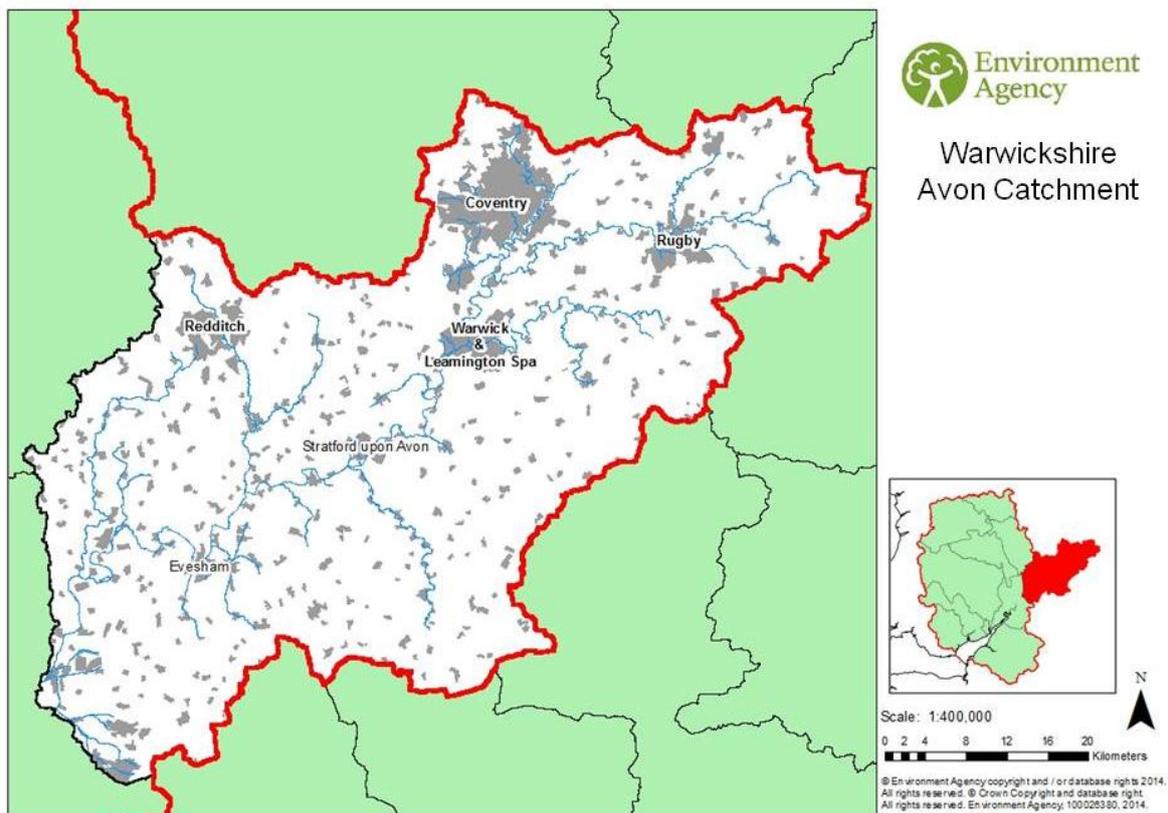
# 4.5. The Warwickshire Avon catchment

## Introduction to the Warwickshire Avon catchment

The Warwickshire Avon catchment extends from Rugby and Lutterworth in the north east to Tewkesbury and Cheltenham in the south west covering an area of 2,870 km<sup>2</sup>. The River Avon runs through the centre of the catchment in a south westerly direction with its main tributaries joining from the north and south. These include the River Sowe, River Leam, River Stour, River Arrow, River Isbourne and Bow Brook.

The landscape is mostly characterised by low lying undulating hills with the valley of the River Avon running north east to south west increasing in width until it joins the River Severn at Tewkesbury. The southern boundary of the catchment consists of the steep Cotswold escarpment off which many of the southern tributaries drain.

Figure 4.15: The Warwickshire Avon catchment



## Land use and management

The land use within the catchment is mainly agricultural (Grade 3 – good to moderate land quality or better), with a mixture of farming, including market gardening in the Vale of Evesham. A number of larger urban centres are located within the catchment including Coventry, Warwick, Leamington Spa, Rugby and Redditch, where the traditional manufacturing industries have declined and urban regeneration is beginning to take place.

Tourism and small business are also key to the financial well being of the area based in a number of urban centres including Stratford-upon-Avon, Tewkesbury, Chipping Campden, Evesham, Pershore, Henley in Arden, Warwick and Leamington Spa.

Watercourses within the catchment are used for a variety of activities. This includes recreation - the River Avon is navigable from Tewkesbury to just upstream of Stratford-upon-Avon. The area is rich in landscape and wildlife heritage, including being partially within an Area of Outstanding Natural Beauty.

## Geology

Geology in the Warwickshire Avon catchment is mostly made up of clays and mudstones with sand and gravels present along much of the length of the Avon Valley. Limestone forms the higher ground of the Cotswolds escarpment and glacial tills are present within the north western corner of catchment around Rugby.

## National and International designations

There are many designated areas of nature conservation importance located within the Warwickshire Avon catchment. There are two internationally designated Special Areas of Conservation (SACs) at Bredon Hill and Dixton Wood.

There are also many Sites of Special Scientific Interest (SSSIs) within the catchment that are known for their species, habitats or geology.

The Warwickshire Avon catchment is also partially situated within the Cotswolds Area of Outstanding Natural Beauty (AONB).

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. Examples of historic riverside towns in this catchment include Leamington Spa, Warwick, Stratford-on-Avon and Tewkesbury.

## Historic flood risk

The Warwickshire Avon catchment is characterised by a variety of flooding scenarios ranging from rapid responses off the Cotswold escarpment and urban areas to longer flooding events within the lower reaches downstream of Pershore.

Flooding below Bredon can also be influenced by larger events on the River Severn that impact on flows from the River Avon discharging into it.

The catchment has a long and well documented history of river flooding with larger events occurring in 1901, 1947, 1968, 1998 and most recently 2007. Each event has had its own characteristics and has affected different parts of the catchment.

The April 1998 Easter floods were caused by an active frontal zone becoming stationary across the south Midlands, causing extensive flooding in a number of communities including Leamington Spa, Stratford-upon-Avon and Evesham. The River Avon at Evesham rose 4.7m causing flooding up to a mile from the river, while the River Leam at Leamington Spa rose nearly 3m causing extensive flooding in the town centre.

In 2007 approximately 2,000 properties were flooded across Warwickshire with significant flooding in Shipston-on-Stour, Wellesbourne, Henley-in-Arden, Alcester and Bidford-on-Avon. In Worcestershire, properties in Evesham, Sedgeberrow and Pershore were also affected.

Other towns and cities affected by flooding include Coventry, Stratford-upon-Avon and Warwick. Flood risk in most other parts of the catchment with regards to property numbers is relatively low, owing to its rural nature.

Flooding from the Cotswold escarpment can be very rapid resulting in water levels rising quickly in watercourses such as the River Dene, River Leam, River Stour, River Isbourne, and Badsey Brook.

## Current flood risk

There are a number of larger urban areas and smaller communities that are at risk of flooding within the catchment.

In Rugby a large flood alleviation scheme protects parts of the town.

Some smaller communities also benefit from formal flood defences such as those at Alcester, Broom, Marlcliff, Clay Coton, Wootton Wawen, Henley in Arden, Barton, Wellesbourne, Sedgeberrow, Hinton on the Green, Pershore and North Littleton.

However a number of towns and communities remain at risk such as parts of Coventry, Leamington Spa, Warwick, Stratford upon Avon, Evesham and Shipston upon Stour.

In addition to fluvial flooding, there is risk of flooding from surface water and sewer flooding in many of the urban areas such as Rugby, Coventry, Bedworth, Leamington Spa, Warwick, Redditch and Evesham.

Severn Trent Water has recently invested significantly in capacity improvements in locations such as Leamington Spa.

There are a number of large raised reservoirs within the catchment, used for water supply, irrigation, and flood storage. Over 1 million people and over 2,000 services are at risk of flooding from reservoirs in this area.

## Partnership working

Within the Warwickshire Avon catchment risk management authorities have developed good working relationships with each other and other interested parties. They also work closely with the English Severn and Wye Regional Flood and Coastal Committee. Severn Trent Water and Anglian Water, the water and sewerage providers in this catchment, actively participate in partnership working to identify and address flood risk issues with the Warwickshire Avon catchment.

The catchment is covered by 4 lead local flood authorities: Warwickshire County Council, Coventry City Council, Worcestershire County Council, and Northamptonshire County Council.

The catchment is also covered by thirteen local councils: Tewkesbury Borough, Wychavon District, Redditch Borough, Stratford-on-Avon District, Warwick District, Coventry City, Rugby Borough and parts of Cheltenham Borough, Cotswold District, Bromsgrove District, Nuneaton & Bedworth Borough, Harborough District and Daventry District.

The Environment Agency also work closely with the Forestry Commission, National Farmers Union, Natural England, Historic England and local authority archaeologists and conservation officers.

The Environment Agency will also continue to work, and strengthen links, with the Warwickshire Avon Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the catchment to meet England Biodiversity Strategy (2020) targets.

## Linking with the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Warwickshire Avon catchment. The main issues within this catchment are physical modifications and wastewater and polluted runoff from rural and urban land.

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency has made an assessment of the measures needed to achieve positive benefits for the water environment and society. Some of these measures will benefit more than one water body or catchment and some are very specific. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

The actions proposed in this catchment focus on reducing the impact of diffuse pollution from rural and urban sources, reducing inputs of phosphate and ammonia from water industry point sources and opening up water bodies for fish movements by removing physical barriers and improving aquatic habitats. Actions to reduce diffuse pollution would involve exploring ways to manage manures, slurry, livestock and pesticides for the benefit of the water environment, incorporating SuDS within the catchment and removing misconnections and car wash effluent from surface water drainage systems. Delivery of these actions will require significant contributions from a variety of stakeholders including local councils, farmers, landowners, water companies, businesses, conservation bodies, anglers and community groups. All of these measures are considered to be needed to improve the water environment to as near to good status as practicable.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment.
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

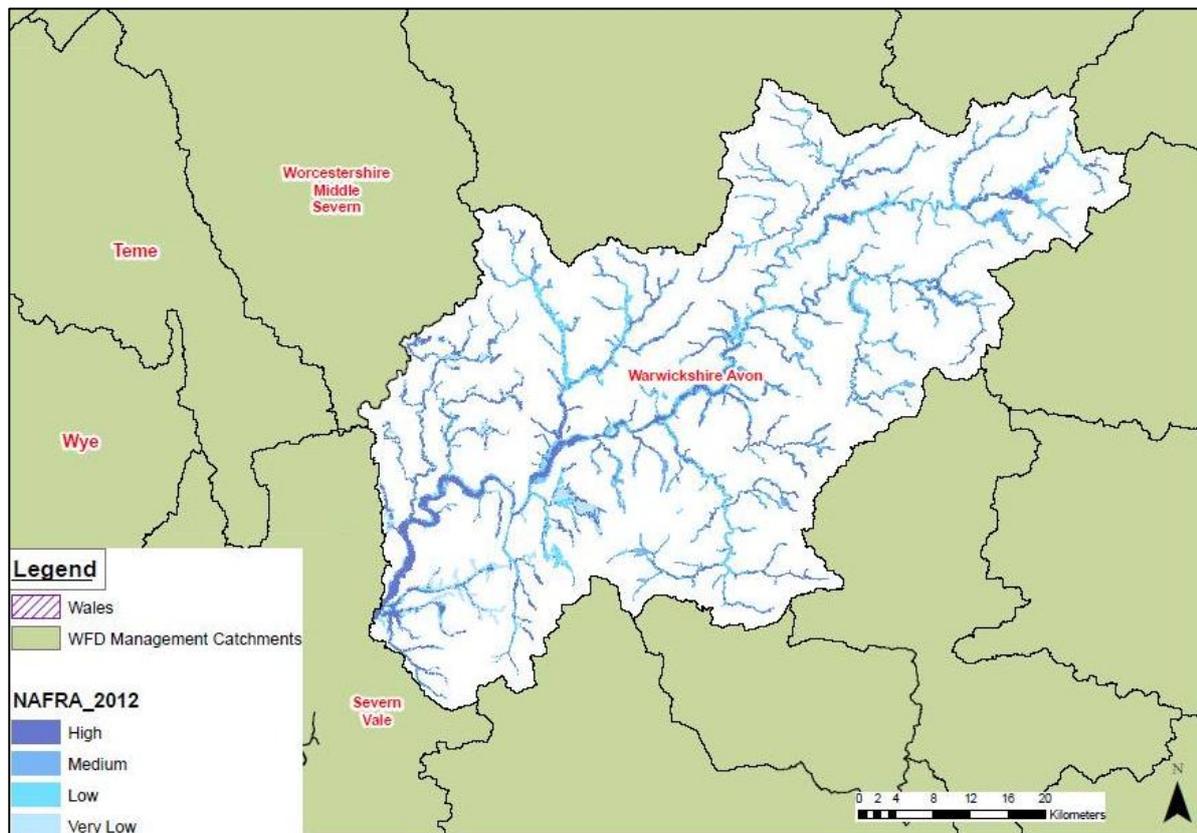
## Key statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 31,100 people at risk from river flooding, representing 3% of the total population. Nearly 6,800 non-residential properties are at risk of flooding from river of which 1,350 are considered to be at high risk. Approximately 7% of agricultural land within the catchment is at risk of flooding with around 8,000 hectares being at high risk.

Figure 4.16: National Flood Risk Assessment (NAFRA) in the Warwickshire Avon catchment



The rivers and sea flood map has been developed and published by the Environment Agency.

**Table 4.23: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Warwickshire Avon catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	1,020,550	2,750	6,600	18,200	3,550
Number of services:	2,210	70	60	60	10
<b>Risk to economic activity:</b>					
Number of non-residential properties:	119,600	1,350	1,450	3,200	800
Number of airports:	1	0	0	0	0
Length of roads (km):	880	10	20	20	<10
Length of railway (km):	250	<10	<10	<10	<10
Agricultural land (ha):	242,700	8,000	3,350	3,350	1,750
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	52	5	1	1	1
Area of SAC within area (ha):	350	0	0	0	0
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	2,450	350	<50	<50	<50
Area of Parks and Gardens within area (ha):	3,850	300	100	100	<50
Area of Scheduled Ancient Monument within area (ha):	1,450	100	50	50	<50
Number of Listed Buildings within area:	10,080	190	160	520	140
Number of Licensed water abstractions within the area:	930	420	40	40	<10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

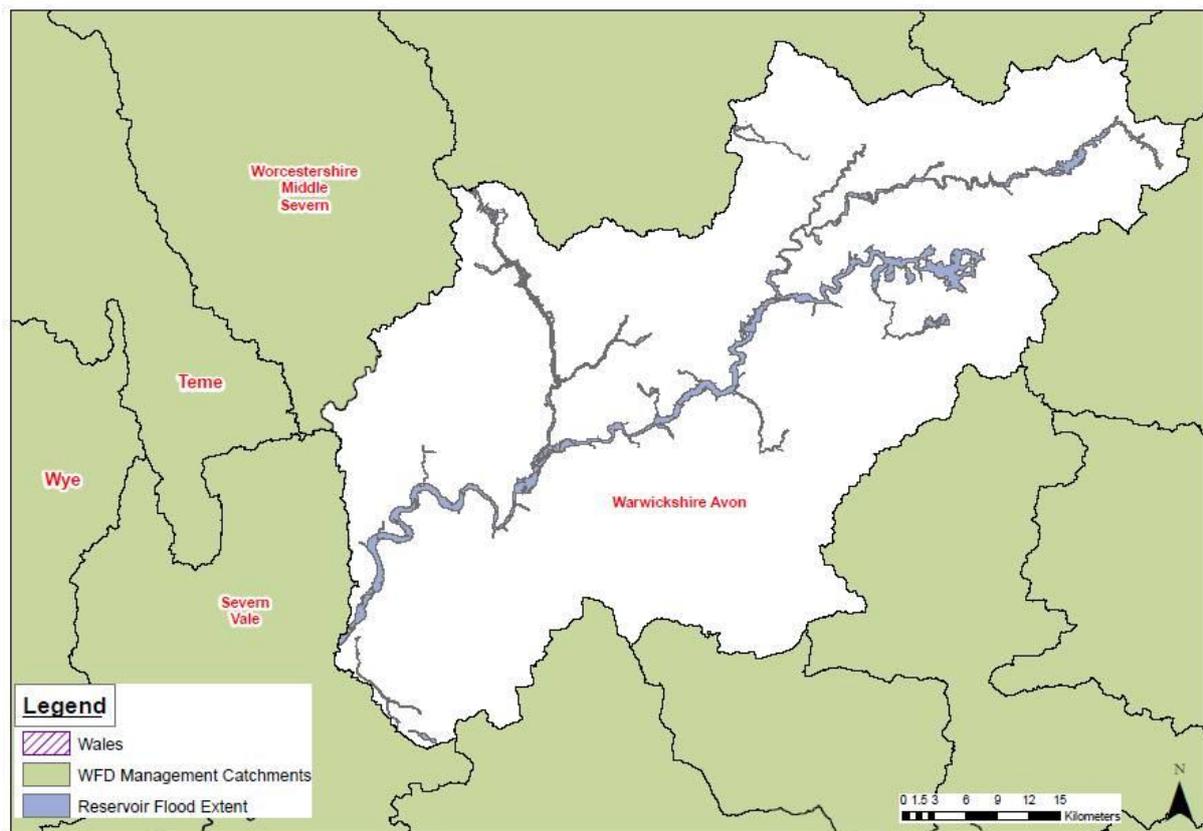
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 22,000 people are at risk of flooding from reservoirs in Warwickshire Avon catchment, representing approximately 2 % of the total population within the catchment. Approximately 3,350 non-residential properties are at risk of flooding from reservoirs in the Warwickshire Avon catchment. Approximately 3% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 12% of SSSI sites and there are no Ramsar sites at risk of flooding in the area.

Figure 4.17: Reservoir flood risk extents in the Warwickshire Avon catchment



The [reservoirs flood map](#) has been developed and published by the Environment Agency.

**Table 4.24: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Warwickshire Avon catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	1,020,550	22,350
Number of services:	2,210	90
<b>Risk to economic activity:</b>		
Number of non-residential properties:	119,600	3,350
Number of airports:	1	0
Length of roads (km):	880	30
Length of railway (km):	250	<10
Agricultural land (ha):	242,700	7,850
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	52	<10
Area of SAC within area (ha):	350	0
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	2,450	300
Area of parks and gardens within area (ha):	3,850	350
Area of Scheduled Ancient Monument within area (ha):	1,450	150
Number of listed buildings within area:	10,080	450
Number of licensed water abstractions within the area:	930	290

**Note:**

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the Warwickshire Avon catchment

### Conclusions

The Warwickshire Avon catchment has a long history of flooding, but the relatively dispersed nature of the settlements affected has meant that traditional flood defence schemes have often not been viable. Partnership working (between the Environment Agency, Regional Flood and Coastal Committee, lead local flood authorities, developers and the affected communities) to raise the necessary funds for new viable flood risk reduction schemes and to maintain existing schemes will continue to be vital.

There remains a requirement to influence the planning system to reduce flood risk by directing development away from the floodplain and to slow rates of runoff in the upstream catchment.

While there is good understanding of the flood risk from rivers, better information on the interaction between river and surface water flooding would help identify potential solutions and inform emergency planning in urban areas.

### Objectives

The objectives when preparing this flood risk management plan have been as follows. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.25: Social objectives for the Warwickshire Avon catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce risk to people	RBD 2	Soc B
Promote understanding of flood risk and work in partnership	RBD 3, 11	Soc A
Prepare communities and build resilience	RBD 1, 6, 10	Soc D
Minimise community disruption	RBD 1, 2, 8, 9	Soc E, F
Consider flood risk in development plans	RBD 1, 11	Soc A
Maintain existing assets that protect people	RBD 12	Ec C
River, watercourse and defence maintenance	RBD 1, 3	Ec C

**Table 4.26: Economic objectives for the Warwickshire Avon catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage	RBD 1, 4,	Ec A
Maintain existing assets that protect business	RBD 12	Ec C
Protect transport services	RBD 1, 8, 10	Ec B Soc F
Minimise flood risk to agricultural land	RBD 1	Ec D, E
Protect tourism when undertaking flood risk management	RBD 1, 4	Ec B En D, G

**Table 4.27: Environmental objectives for the Warwickshire Avon catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Achieve WFD objectives through flood risk management	RBD 1, 4	En E
Protect designated nature conservation sites	RBD 1, 4	En C, F
Protect designated heritage sites	RBD 1, 4	En F
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures to manage risk in the Warwickshire Avon catchment

Measures that are relevant to this catchment are included in the RBD and Severn England level measures shown in Annex 1. In addition, there are 123 measures specific to this catchment as follows:

**Preventing risk:** 47 measures (Measure codes M21/M23/M24, in Annex 1) including:

- Avoid inappropriate development in flood risk areas.
- Improve management of surface water and promote implementation of sustainable drainage systems (SuDS).
- Investigate potential solutions for reducing flood risk at: Bilton Road, Rugby; Butt Lane, Coventry; Kenilworth.
- Maintain current level of flood risk management in areas that benefit from flood defences, subject to availability of funding.
- Work in partnership to support implementation and review of local flood risk management strategies..

**Preparing for risk:** 39 measures (Measure codes M41/M42/M43/M44 in Annex 1) including:

- Provide incident response service.
- Maintain flood forecasting and warning capacity, improve accuracy where possible and seek opportunities to expand service where feasible.
- Work with partners and communities to understand risk of flooding from all sources and develop plans to manage the risks.
- Promote awareness of flood risk and encourage others to prepare for flooding in high risk areas.
- Promote awareness and advise on the need to avoid inappropriate development in flood risk areas and the need to manage land to avoid increasing risks.

**Protecting from risk:** 33 measures (Measure codes M32/M34/M35 in Annex 1) including:

- Investigate, develop and implement new flood risk management schemes and measures where feasible and subject to availability of funding.
- Identify locations where working with natural processes could reduce flood risk and improve resilience to climate change.
- Review maintenance operations and work with landowners/managers to identify opportunities for reducing intensity.
- Undertake maintenance programme to replace/refurbish flood risk assets where feasible and subject to availability of funding.
- Implement actions from local flood risk management strategies.

**Recovery and review of risk:** 1 measure (Measure codes M51/M53 in Annex 1):

- Northamptonshire County Council will investigate flooding incidents in accordance with Flood and Water Management Act (2010).

**Other measures:** 3 measures (Measure code M61 in Annex 1) including:

- Northamptonshire County Council will continue to promote partnership working, maintaining communication between all partners and stakeholders through the Flood and Water Management Framework;
- Northamptonshire County Council will ensure that strategic plans are influenced by the local flood risk management strategy and that developer funding is sought wherever appropriate;
- Northamptonshire County Council will continue to develop and establish funding arrangements to deliver the requirements of the Flood and Water Management Act.

More detail on the measures is included in Annex 1. In addition there are measures that are relevant to this catchment included in the Severn RBD and Severn England measures shown in Annex 1

Please note that identification of these measures is not a commitment to deliver. The need has been identified but assessment of benefit and affordability has yet to be carried out in many cases and will be subject to availability of funding.

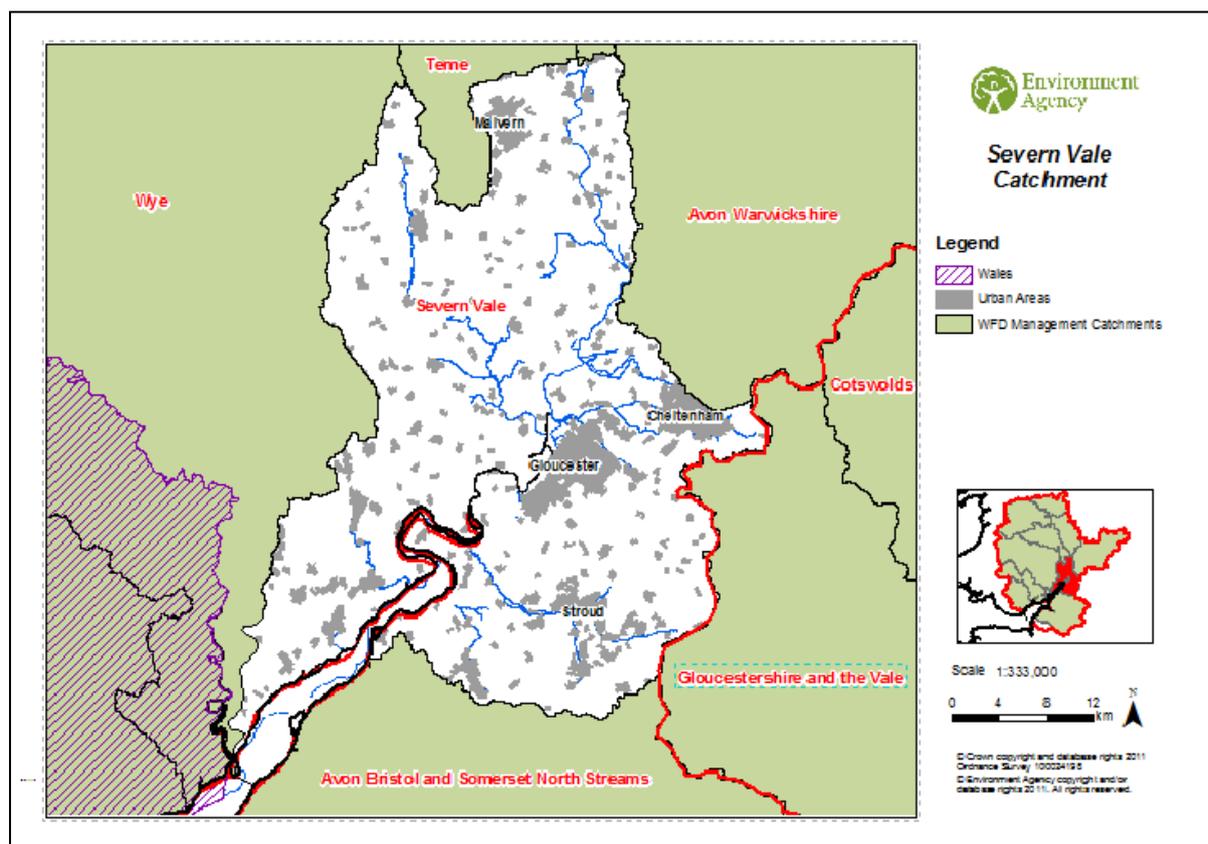
## 4.6. The Severn Vale catchment

### Introduction to the catchment

The Severn Vale catchment extends from Lydney and Dursley in the south to Ledbury and Great Malvern in the north, covering an area of 1,465 km<sup>2</sup>. It includes the lower reach of the fluvial River Severn and its tributaries, among which are the Rivers Leadon and Chelt. Below Gloucester the River Severn enters the tidal Severn Estuary, as do a number of tributaries such as the River Lyd on the west bank and River Frome on the east bank.

The landscape is mostly low lying including the wide valley of the River Severn running north to south, but is bounded by higher upland areas such as the heavily wooded Forest of Dean in the South West, the grass uplands of the Cotswold escarpment to the east and the Malvern Hills in the north.

**Figure 4.18: The Severn Vale catchment**



### Land use and management

The land use within the catchment is mainly agricultural (Grade 3 – good to moderate land quality or better), with a mixture of farming. Tourism and small business are also key to the financial wellbeing of the area and are based in a number of urban centres including Gloucester, Cheltenham, Stroud, Tewkesbury, Lydney, Cinderford, Malvern and rural communities.

Watercourses within the catchment are used for a variety of activities including recreation, public water supply, fisheries and conservation.

## Geology

Geology in the Severn Vale area is divided in broadly the same way as the topography, with clays and mudstones across the wide Severn valley. These lie close to the groundwater table for much of the year and are frequently saturated with standing water across the floodplain. When this happens, rainfall is slow to drain away and may lead to localised flooding even when the River Severn is not in flood.

Limestones, sandstones and igneous rocks form the higher ground of the Forest of Dean, Cotswolds and Malvern Hills. These areas are permeable and can absorb rainfall, but the slopes are often steep which causes rainwater to run-off the land. There are also numerous groundwater springs in these areas, which respond to prolonged periods of rainfall or seasonal variations in climate and make a significant contribution to the flow in many rivers. The limestone formations of the Cotswolds are nationally significant aquifers, which are used for supplying drinking water.

## National and international designations

There are many designated areas of nature conservation importance located within the catchment. These include eight European sites which comprise four Special Area of Conservation (SACs); two Special Protection Areas (SPAs); and two Ramsar sites, all of which are in the southern half of the management catchment. The Severn Estuary SAC, SPA and Ramsar site extends along the River Severn to Frampton on Severn, to the south of Gloucester, in the southern part of the catchment. Walmore Common SPA and Ramsar site is a discrete site to the west of Gloucester, whilst Rodborough Common SAC is immediately to the south of Stroud. The Cotswolds Beechwoods SAC is a complex of sites towards the east of the management catchment in an area north of Stroud and south west of Gloucester. The Wye Valley & Forest of Dean Bat Sites SAC is formed by a series of sites towards the west of the management catchment in the area north of Lydney and south of Mitcheldean.

In addition, there are many Sites of Special Scientific Interest (SSSIs) and one National Nature Reserve (NNR) within the catchment that are known for their species, habitats or geology. These designated sites cover a significant area of the catchment and the way in which they are managed can have an effect on the risk of flooding (by affecting the surface run-off into the River Severn and its tributaries).

The Severn Vale is also partially situated within the Cotswolds Area of Outstanding Natural Beauty (AONB) and contains the Malvern Hills AONB. These areas are rich in natural beauty and biodiversity, with a number of internationally and nationally designated landscape habitats.

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to

the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value, such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. Examples of historic riverside towns in this catchment include Upton upon Severn, Gloucester and Stroud.

## Partnership working

Within the Severn Vale Catchment the Environment Agency has developed good working relationship with partners, including local councils. The catchment is covered by the unitary and county council lead local flood authorities: Herefordshire Council, Gloucestershire County Council and Worcestershire County Council, and eight local councils: Malvern Hills District, Tewkesbury Borough, Cheltenham Borough, Gloucester City, Stroud District and Forest of Dean District with small parts of Cotswold District and Wychavon District.

The Environment Agency works closely with the English Severn & Wye Regional Flood and Coastal Committee, Lower Severn Internal Drainage Board, Severn Trent Water plc, Canal & River Trust, National Farmers Union, Historic England, Natural England, local authority archaeologists and conservation officers.

The Environment Agency will continue to work, and strengthen links, with the Severn Vale Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the Severn Estuary SAC to increase and enhance the extent of the salt marsh habitats within the estuary to ensure resilience against climate change. Recent habitat creation schemes at Steart Peninsula (in the South West River Basin District) and Plusterwine Farm have created in excess of 250 hectares of new habitat. This contributes towards the 300 hectares of compensatory habitat that is required by the Habitats Directive by 2030, to offset the impacts of climate change.

## Historic flooding

Flooding within the Severn Vale catchment can be divided into two categories, fluvially led or tidal. It is rare to have a combination of a significant event for both, though one will always influence the other, especially in the area between Haw Bridge and Minsterworth.

Flooding occurs relatively slowly along the River Severn but can remain for a number of weeks. Some of the smaller catchments, that are tributaries of the Severn, can react rapidly to rainfall events such as on the River Lyd and Chelt.

There is a well documented history of fluvial flooding within the catchment, especially along the River Severn from Worcester to Gloucester. The most severe events in living memory occurred in 1947 and July 2007 when significant numbers of properties were affected on the River Seven and its tributaries between Worcester and Gloucester. In July 2007 surface water flooding also affected properties in Worcestershire and Gloucestershire.

Flooding occurs regularly within the River Severn valley and affects small numbers of properties, mainly in rural communities, as well as some properties in the city of Gloucester and town of Tewkesbury.

Other events such as those experienced in January/February 2014 and October to December 2000 have also caused widespread disruption. The most recent flooding in 2014 affected around 150 homes and businesses (source: Tewkesbury Borough Council).

Tidal events are rarer, with the most recent incidents occurring in the beginning of 2014 when a series of high tides resulted in the overtopping of some flood defences below Gloucester.

## Current flood risk

Parts of the urban areas of Gloucester, Tewkesbury and Upton upon Severn, together with a number of smaller rural communities, are at risk of flooding from the River Severn. Small numbers of properties are affected frequently by flooding, but generally large scale property flooding is not seen until more significant River Severn events occur.

The River Severn has a floodplain of up to 1 mile wide in places, within its lower reaches.

Historically many properties, infrastructure and many of the transport links connecting communities have been built within the floodplain. Some roads and railways are themselves obstructions to flood flow, for example the A40 Northern Bypass, the Over Causeway (which carries the A417) and the main line railway which cross Alney Island at Gloucester.

Water can take many weeks to drain from the floodplain and this can delay the recovery of the communities affected.

Flooding from some of the smaller catchments such as the River Chelt, Horsbere Brook, Dimore Brook, River Twyver, Daniels Brook and Sud Brook will affect some of the larger urban areas of Gloucester and Cheltenham.

There are a number of catchments where river levels react quickly to rainfall, including in the Forest of Dean, Gloucester and the Stroud Valleys. The River Lyd (Lydney), Cinderford Brook (Ruspidge), Slad Brook (Slad Valley) and the River Chelt (Charlton Kings) are rapidly responding catchments where there is a high risk to communities.

Flood alleviation schemes existing prior to the floods of 2007 include those at Cheltenham (River Chelt), Deerhurst, Ashleworth and Lydney town centre.

A number of communities along the Severn Estuary are at risk of tidal flooding. The western edge of Gloucester City and associated communities are also at risk from tidal events. Many of these areas are currently defended by embankments or walls with varying standards of protection. Tidal flood risk and proposals for how this should be managed for the next 100 years has been set out in the draft Severn Estuary Flood Risk Management Strategy, published in May 2013.

There are also a number of communities and urban areas within the catchment that are at risk of surface water, ordinary watercourse and sewer flooding.

In July 2007, many of the 5,000+ properties that flooded in Gloucestershire from main river, ordinary watercourse and surface water flooding were in this catchment.

## Recent flood risk management work

Since 2007, flooding has been alleviated for a number of communities by constructing or improving flood defence schemes within the catchment. These include Kempsey, Upton upon Severn, Uckinghall, Deerhurst, The Leigh, Deerhurst Walton, Station Road Lydney, Prestbury, Cheltenham and parts of Gloucester associated with Horsbere and Daniels Brooks. Some of these have been community led schemes. Many of these schemes protected properties in subsequent flooding in 2012 and 2014.

Following the flooding of early 2014, an assessment was undertaken of defences affected and repair works were carried out over the summer/autumn of 2014.

Gloucestershire County Council has set out how local flood risk will be managed in its area in its Local Flood Risk Management Strategy published in 2014. Local Flood Risk Management Strategies for Herefordshire and Worcestershire are in progress. Local flood risk includes surface run off, groundwater and ordinary watercourses.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Severn Vale management catchment. The significant issues within this catchment are phosphates from sewage treatment works; diffuse pollution from both agriculture and urban areas; physical modifications; and old metal mines also contribute.

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency has made an assessment of the measures needed to achieve positive benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

## Key statistics

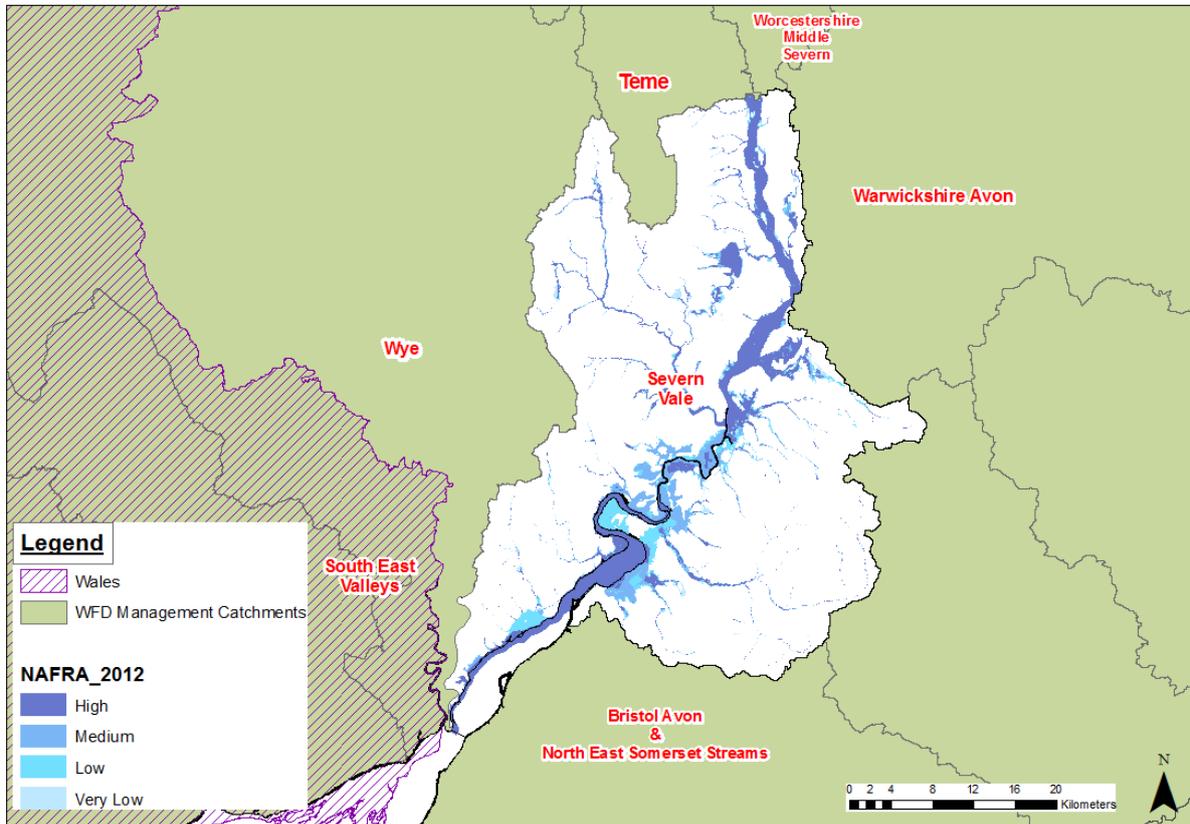
The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 23,200 people at risk from river flooding, representing nearly 5% of the total population. Nearly 6,450 non-residential properties are at

risk of flooding from river of which 1,200 are considered to be at high risk. Approximately 12% of agricultural land within the catchment is at risk of flooding with around 5,700 hectares being at high risk.

**Figure 4.19: National Flood Risk Assessment (NAFRA) in the Severn Vale catchment**



The ivers and sea flood map has been developed and published by the Environment Agency

**Table 4.28: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Severn Vale catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	502,150	2,600	4,050	12,300	4,250
Number of services:	1,080	30	10	30	20
<b>Risk to economic activity:</b>					
Number of non-residential properties:	75,800	1,200	1,150	3,050	1,050
Number of airports:	1	0	0	0	0
Length of roads (km):	400	<10	<10	10	<10
Length of railway (km):	120	<10	<10	<10	<10
Agricultural land (ha):	106,200	5,700	2,900	2,700	1,100
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	33	4	2	2	2
Area of SAC within area (ha):	1,100	300	<50	<50	<50
Area of SPA within area (ha):	500	300	200	<50	<50
Area of RAMSAR site within area (ha):	500	300	200	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	3,950	600	250	<50	<50
Area of Parks and Gardens within area (ha):	1,750	50	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	550	<50	<50	<50	<50
Number of Listed Buildings within area:	7,540	180	80	360	80
Number of Licensed water abstractions within the area:	310	70	20	20	<10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

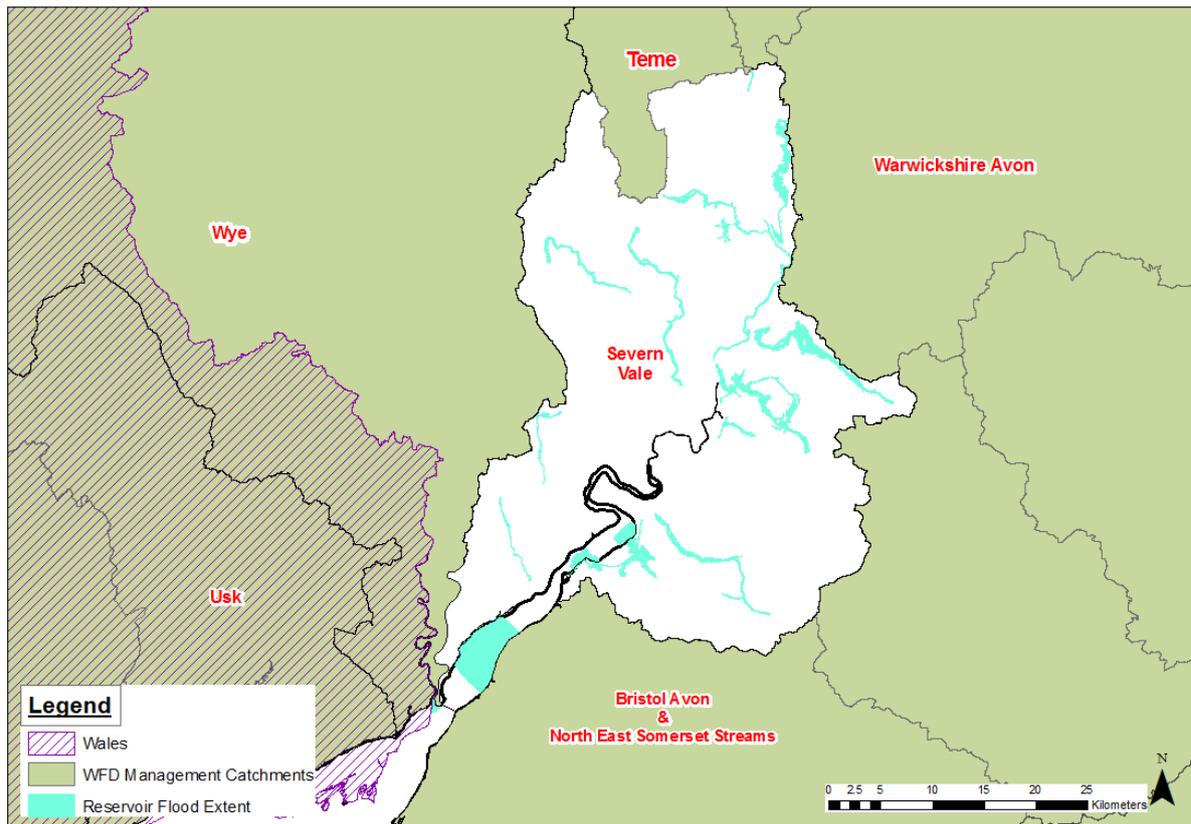
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 16,400 people are at risk of flooding from reservoirs in the Severn Vale Catchment, representing approximately 3 % of the total population within the catchment. Approximately 2,400 non-residential properties are at risk of flooding from reservoirs in the Severn Vale Catchment. Approximately 2% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 4% of SSSI sites and there are no Ramsar sites at risk of flooding in the area.

**Figure 4.20: Reservoir flood risk extents in the Severn Vale catchment**



The reservoirs flood map has been developed and published by the Environment Agency

**Table 4.29: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Severn Vale catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	502,150	16,400
Number of services:	1,080	30
<b>Risk to economic activity:</b>		
Number of non-residential properties:	75,800	2,400
Number of airports:	1	0
Length of roads (km):	400	30
Length of railway (km):	120	<10
Agricultural land (ha):	106,200	2,000
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	33	2
Area of SAC within area (ha):	1,100	<50
Area of SPA within area (ha):	500	<50
Area of RAMSAR site within area (ha):	500	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	3,950	150
Area of Parks and Gardens within area (ha):	1,750	100
Area of Scheduled Ancient Monument within area (ha):	550	<50
Number of Listed Buildings within area:	7,540	250
Number of Licensed water abstractions within the area:	310	30

**Note:**

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the Severn Vale catchment

### Conclusions

The Severn Vale has a wide variation of flooding issues, including extended periods of elevated levels within the River Severn Valley that affect many rural communities, watercourses which respond rapidly to rainfall and tidal flooding from the Severn Estuary.

Flooding from the River Severn between Gloucester and Worcester occurs regularly. While the more commonly occurring events are disruptive to local communities, the number of properties directly affected is relatively low.

During larger events such as that experienced in 2007 there are significant numbers of properties affected throughout the catchment. National and regional infrastructure, including utility sub stations and major transport routes, are also affected. Flood risk is likely to increase with climate change.

There are a number of rivers that can respond quickly to rainfall that affect rural and some urban communities such as Lydney, Cinderford, Cheltenham, Gloucester and the Stroud Valleys. Flood levels on these watercourses may rise suddenly and in the rapidly responding rivers result in a risk to life. It is difficult to provide accurate and timely warnings in such locations and these events may become more common as a result of climate change.

There are also a number of communities and urban areas within the catchment that are at risk of surface water, ordinary watercourse and sewer flooding. It is likely that these issues will become more pronounced and regular as a result of climate change where it is difficult to upgrade current infrastructure.

Tidal flood risk will increase as sea levels rise with climate change.

There is a continued need to work in partnership with others, where possible, to achieve flood risk management measures which will alleviate flooding from multiple sources, improve resilience and recovery, and provide wider environmental and other benefits to improve the natural, rural and built environment consistent with the principles of sustainable development.

### Objectives

The following objectives apply to this management catchment, where possible and viable to do so. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.30: Social objectives for the Severn Vale catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce or prevent an increase in harm to life as a result of flooding	RBD 2	Soc B
Minimise community disruption by reducing impact of flooding by increasing preparedness through improved flood warning service and public awareness	RBD 7, 9, 10	Soc D, G
Steer development towards areas of little or no risk of flooding, where development must occur in medium or high flood risk areas it must be sustainable, not increase flood risk and take account of the impacts of climate change	RBD 1, 11	Soc E
Improve awareness in catchments which react rapidly to rainfall	RBD 2, 9	Soc C
Increase understanding and management of flood risk impacts	RBD 6, 11	Soc A
Reduce the likelihood of death or serious injury resulting from rapid inundation or deep and fast flowing water	RBD 2	Soc C
Continue to work with utility providers to improve resilience of infrastructure and services	RBD 1, 8, 10, 11	Soc A, F
Continue to work with other bodies to improve resilience to the communication network and transport links	RBD 1, 8, 10, 11	Soc A, F
maintain existing assets that protect people where economically viable or find suitable alternatives by working in partnership with communities	RBD 6, 11, 12	Soc A

**Table 4.31: Economic objectives for the Severn Vale catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1	Ec A
Reduce flood risk to residential properties	RBD 1	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec E
Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5	Ec C
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B, Soc F
Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11	Ec D
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	Ec B, En D, G

**Table4.32: Environmental objectives for the Severn Vale catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Take opportunities to restore sustainable natural storage of floodwater on tributaries in their upstream areas, in order to offset increasing flood risk from trends including climate change	RBD 11	En A
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydro-morphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Maintain and enhance habitat through flood risk management activities	RBD 4	En B
Help achieve WFD Objectives through Flood Risk Management	RBD 1, 4	En E
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	Env E
Protect and enhance designated landscapes and local landscape character	RBD 1, 4	En C, G
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures in the Severn Vale catchment

Measures that are relevant to this catchment are included in the RBD and Severn England level measures shown in Annex 1. In addition, there are 77 measures specific to this catchment as follows:

**Preventing risk:** There are 20 measures to prevent flood risk in the catchment (Measure codes M21/M23/M24, in Annex 1), including:

- work with others to encourage a more strategic approach to reducing flood risk and improving resilience and recovery in the area of the River Severn from Tewkesbury to Gloucester;
- maintain defences at a number of locations in the Severn Estuary, as set out in the Severn Estuary Flood Risk Management Strategy;
- take the Shoreline Management Plan into account in Strategic Flood Risk Assessments for council development/land use plans;
- encourage utility providers (water and electricity ) to assess the current and future risks and resilience of their assets from Severn Estuary;
- Severn Trent Water measures to reduce flood risk via investment, partnership funding opportunities, raising awareness and carrying out risk based maintenance.

**Preparing for risk:** There are 21 measures to prepare for flood risk that are specific to this catchment (Measure codes M41/M42/M43/M44 in Annex 1), including:

- measures to encourage communities to take action to prepare for flooding in communities along the River Severn between Tewkesbury and Gloucester, in Gloucester (including Saintbridge), and along the Severn Estuary;
- work with communities in Kempsey, Charlton Kings, Ruspidge, Lydney and along the Slad Brook, to raise awareness of flood risk and produce flood plans;
- work with communities in Gloucester and along the River Severn from Tewkesbury to Gloucester to promote property level protection measures;
- understanding feasibility of providing flood warning service to Gloucester Streams;
- The Environment Agency, landowners, communities and other organisations exploring what could be achieved by working in partnership to maximise maintenance of defences.

**Protecting from risk:** There are 34 measures that protect from flood risk that are specific to this catchment (Measure codes M32/M34/M35 in Annex 1), including:

- work with partners and communities to assess the feasibility of reducing River Severn flood risk in Gloucester and the surrounding area;
- continue channel maintenance and flood warning at various locations within the catchment;
- work with the communities to assess the feasibility of increasing the standard of protection of defences at Westbury on Severn and Upper Framilode;
- assess the feasibility of constructing a flood alleviation scheme at Severn Stoke;
- promote the use of rural sustainable drainage systems in the Frome catchment (Stroud Valleys).

**Recovery and review of risk:** There are no specific measures in this category, over and above those included in Annex 1 and the flood risk activities described in section 6.

**Other measures:** There are 2 other measures in the FRMP which do not fall within the above four categories (Measure code M61 in Annex 1):

- reduce flood risk by working with the Stroud Water Canal restoration project;
- ensure environmental issues are taken into account in the design and construction of new defences on the Severn Estuary.

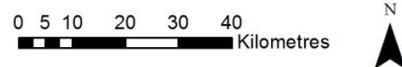
More detail on the specific measures is included in Annex 1.

# 4.7a. The Welsh Wye catchment



**Legend**

- Main Rivers
- Wye Management Catchment
- Severn RBD Other Management Catchments



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**Figure 4.21: The Welsh Wye catchment**

## Catchment description/overview

The Wye catchment rises in the Cambrian Mountains joining with the Elan, which flows from the Elan Reservoir cascade, near Rhayader. The river then flows through Builth Wells and on into England before returning into Wales North of Monmouth and eventually flowing into the Severn Estuary at Chepstow. The catchment covers an area of 4,180 km<sup>2</sup>.

The landscape is mainly rural, made up of a mixture of woodland and open farmland varying from the steep upland of the Cambrian Mountains in the upper part of the catchment. Below Hay on Wye the landscape changes to a flatter lowland characteristic as the River Wye floodplain widens.. As the Wye winds back into Wales the floodplain begins to narrow again as it cuts through the surrounding limestone to form a steeper sided valley from Symonds Yat all the way to Chepstow where the Wye joins the Severn Estuary.

The land use within the catchment is mainly agricultural, with a mixture of arable managed grassland and rough grassland farming. Much of the upper area of the catchment above Rhayader is covered by heath land and scrub with some forestry. Within the lowland areas of the Wye Valley the land use is mostly intensive agriculture with some market gardening.

There are a number of urban centres including Builth Wells, Monmouth and Chepstow. Elsewhere tourism is key to the financial well being of smaller rural communities especially in the lower reaches of the Wye Valley from Monmouth to Chepstow.

Watercourses within the catchment are used for a variety of activities including recreation, public water supply, fisheries and conservation. The area is rich in landscape and wildlife.

Within the upper catchment soils are relatively poorly drained which can result in rapid runoff.

There are a number of designated areas of nature conservation importance located within the catchment, including two Special Protection Areas (SPA), Elenydd-Mallaen and Severn Estuary. The latter is also a Ramsar site.

There are a number of Special Areas of Conservation (SAC) within the catchment along with numerous Sites of Special Scientific Interest (SSSIs) and some National Nature Reserves (NNR). These designated sites are located throughout the catchment and the way in which they are managed can have an effect on the risk of flooding (by affecting the surface run-off into the River Severn and its tributaries).

The Wye catchment includes the Wye Valley Area of Outstanding Natural Beauty (AONB) and is partially within the Brecon Beacons National Park.

Within the Wye catchment Natural Resources Wales have developed a good working relationship with partners. These include, but are not limited to, local councils. The Welsh part of the catchment is covered by three unitary authorities Powys, Monmouthshire and Newport.

Natural Resources Wales also work closely with the Regional Flood and Coastal Committees, Local Resilience Fora, Severn Trent Water plc, Dwr Cymru\Welsh Water and local stakeholders.

## Historical flooding in the catchment

There is a long history of fluvial flooding within the catchment. The most significant flooding event recorded occurred in 1947 affecting large numbers of properties whilst also isolating the town of Monmouth. This was catchment wide in its impacts. More recently flooding has occurred to varying degrees in 2012, 2007 and 2000 impacting on many communities, though the extents were not so great. Other notable events occurred in 1929, 1960, 1979 and 1998.

In the lower reaches of the River Wye tidal flooding has also impacted on communities around Chepstow such as Brockweir and Tintern. The most recent events occurred in 2014 with the previous highest recorded event occurring in December 1981.

A number of communities have flooded from surface water and ordinary watercourses in the catchment, including most recently in 2012.

## Current flood risk in the catchment

There is frequent, low level flooding in the Wye Valley, with agricultural and rural floodplain affected. Flooding from the River Wye near Hay on Wye and Monmouth is a regular occurrence and while the more commonly occurring events are disruptive to local communities, the number of properties directly affected is relatively low.

During larger events such as that experienced in 1947 there are significant numbers of properties affected throughout the catchment. National and regional infrastructure, including utility sub stations and major transport routes, are also affected resulting in many rural communities becoming isolated. The main fluvial flood risks on the Wye are in Builth Wells and Glasbury and lower downstream at Monmouth. Other towns on the River Wye with some flood risk include Hay on Wye, Tintern and Chepstow. A number of small communities are at risk of fluvial flooding from main river tributaries of the River Wye, including at Disserseth, Skenfrith, Presteigne and Knighton. The highest areas of tidal risk are at Chepstow, Tintern and the Caldicot Levels. A number of properties flood and the main road at Tintern is closed for the hours around high tide. Chepstow is at risk from high tides at the area upstream of the railway bridge. The Caldicot Levels are an area of very flat reclaimed land, served by flood defences that would become compromised should there be any overtopping. The effect of these defences being compromised would be similar to those experienced elsewhere in the country, such as the Somerset Levels during the winter of 2013/14.

Surface water and sewer flooding occurs throughout the catchment, most commonly in the more urban areas such as Builth Wells, Monmouth and Chepstow. A number of communities are also at risk from ordinary watercourse flooding.

Most of the main population centres along the Wye have flood alleviation measures in place which reduce flood risk to property and infrastructure. This includes at Builth Wells, Glasbury, Monmouth and Chepstow.

## Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future. This scenario would be expected to have a significant effect on areas such as the Caldicot Levels, Tintern and Chepstow. In future scenarios the heavily defended areas of this catchment will be more prone to overtopping and areas such as Builth Wells, Glasbury, Monmouth and Chepstow may experience more surface water flooding.

## Recent flood risk management activity in the catchment

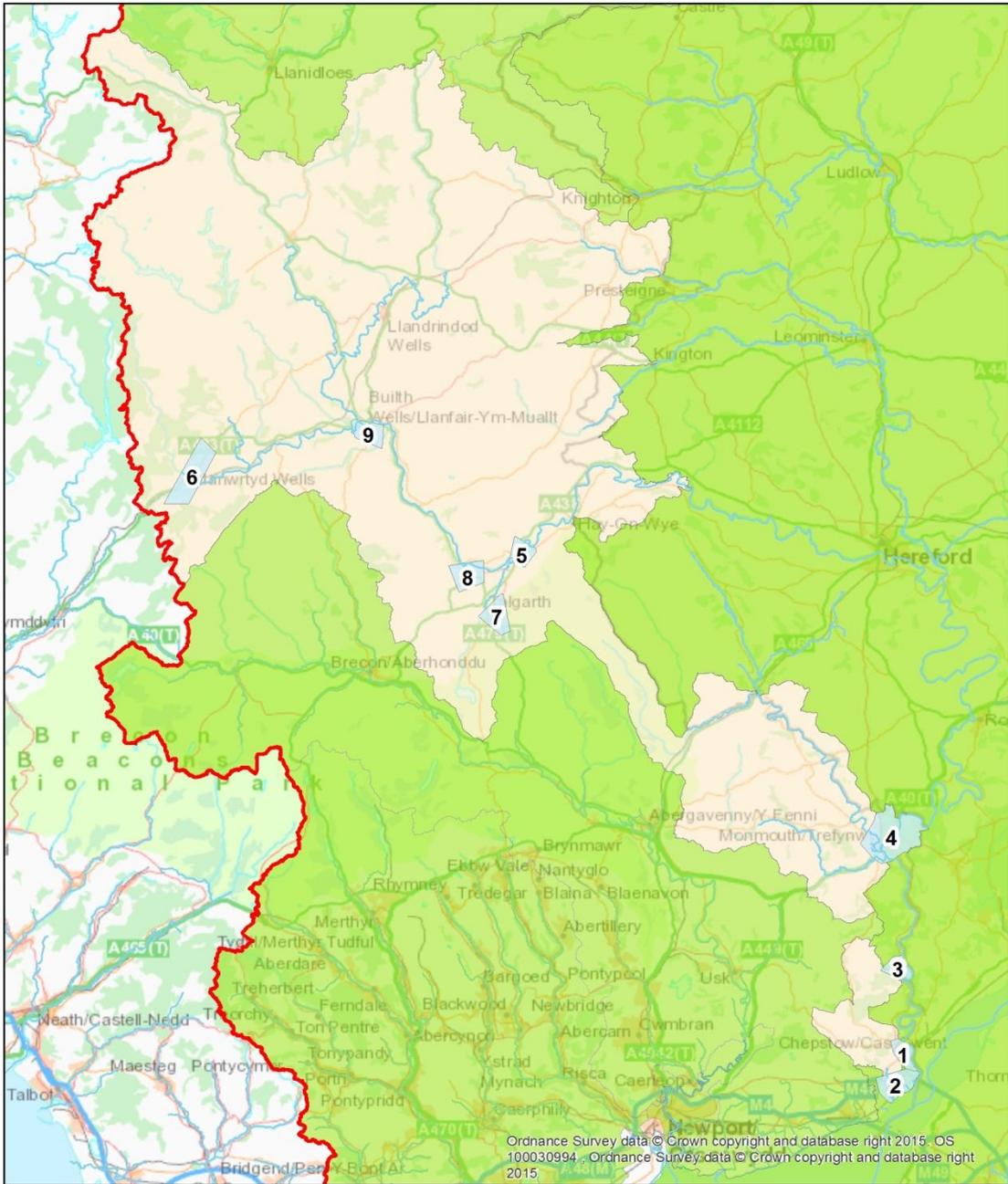
The upper Wye, in Wales, has a new flood forecasting model in development which will benefit all the communities which have a flood warning service and will also help improve the forecasting for the mid and lower parts of the Wye catchment. In addition to these flood risk management actions, there has also been a great deal of flood awareness work in the catchment consisting of door knocking, drop in sessions in conjunction with partner organisations and development of personal, community, school and business flood plans. Natural Resources Wales have also worked on increasing the sign-up for the free flood warning service to ensure the correct actions can be taken to protect people and property.

## Key communities where Natural Resources Wales are planning actions (Bold Communities are in Top 50 Wales)

There are a number of communities within the catchment where there is still more to be done to manage and reduce the risk of flooding. Section 2.2 of this report sets out how Natural Resources Wales prioritise work on a risk basis so that those communities that are most at risk are addressed first.

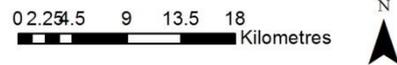
**Table 4.33: Key communities**

Label	Community	Label	Community
1	Chepstow	6	Llanwrtyd Wells
2	Mathern	7	Talgarth
3	Tintern Parva	8	Llyswen
4	Monmouth	9	Builth Wells
5	Glasbury		



**Legend**

- Main Rivers
- Wye Key Communities
- Wye Management Catchment
- Severn RBD Other Management Catchments



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**Figure 4.22: Key communities in the Welsh Wye catchment**

## Table 4.34: The Welsh Wye catchment – measures

The following catchment delivery plan sets out on a community basis, the measures that Natural Resources Wales have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures Natural Resources Wales intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Monmouth	Main River	Improve existing flood warning service	M4 - Preparedness	1 2 4	Current	High	On-going	Natural Resources Wales
		Maintain completed community flood plan	M4 - Preparedness	1 4 5	Current	High	On-going	Natural Resources Wales
		Undertake initial assessment and feasibility work for reducing flood risk.	M2 - Prevention	1 2 3 8	Current	High	Not Started	Natural Resources Wales
Chepstow	Main River / Sea	Design and construction of flood risk asset improvements.	M3 - Protection	1 2	Current	Very High	Not Started	Natural Resources Wales
		Carry out assessment on existing structures to ensure they are fit for purpose.	M2 - Prevention	1 2 3	Current	Very High	Not Started	Natural Resources Wales
		Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	High	On-going	Natural Resources Wales

Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Glasbury	Main River	Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	High	Proposed	Natural Resources Wales
Glasbury	Main River	Upgrade hydraulic model	M2 - Prevention	3	Current	High	Proposed	Natural Resources Wales
Llanwrtyd Wells	Main River	Design and construction of flood risk asset improvements.	M2 - Prevention	1 2	Current	Medium	Not Started	Natural Resources Wales
Builth Wells	Main River	Improve existing flood warning service	M4 - Preparedness	1 2 4	Current	Medium	Not Started	Natural Resources Wales
Builth Wells	Main River	Develop new flood forecasting model	M4 - Preparedness	1 2 3 4	Current	Medium	On-going	Natural Resources Wales
Llyswen	Main River	Review hydrology	M4 - Preparedness		Current	Medium	Not Started	Natural Resources Wales
Talgarth	Ordinary Watercourse	Engage with community to establish community flood plan	M4 - Preparedness	1 4 5	Current	High	On-going	Powys CC
Mathern	Main River / Sea	Design and construction of flood risk asset improvements.	M2 - Prevention	1 2	Current	High	Not Started	Natural Resources Wales
Tintern Parva	Main River / Sea	Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	High	On-going	Natural Resources Wales

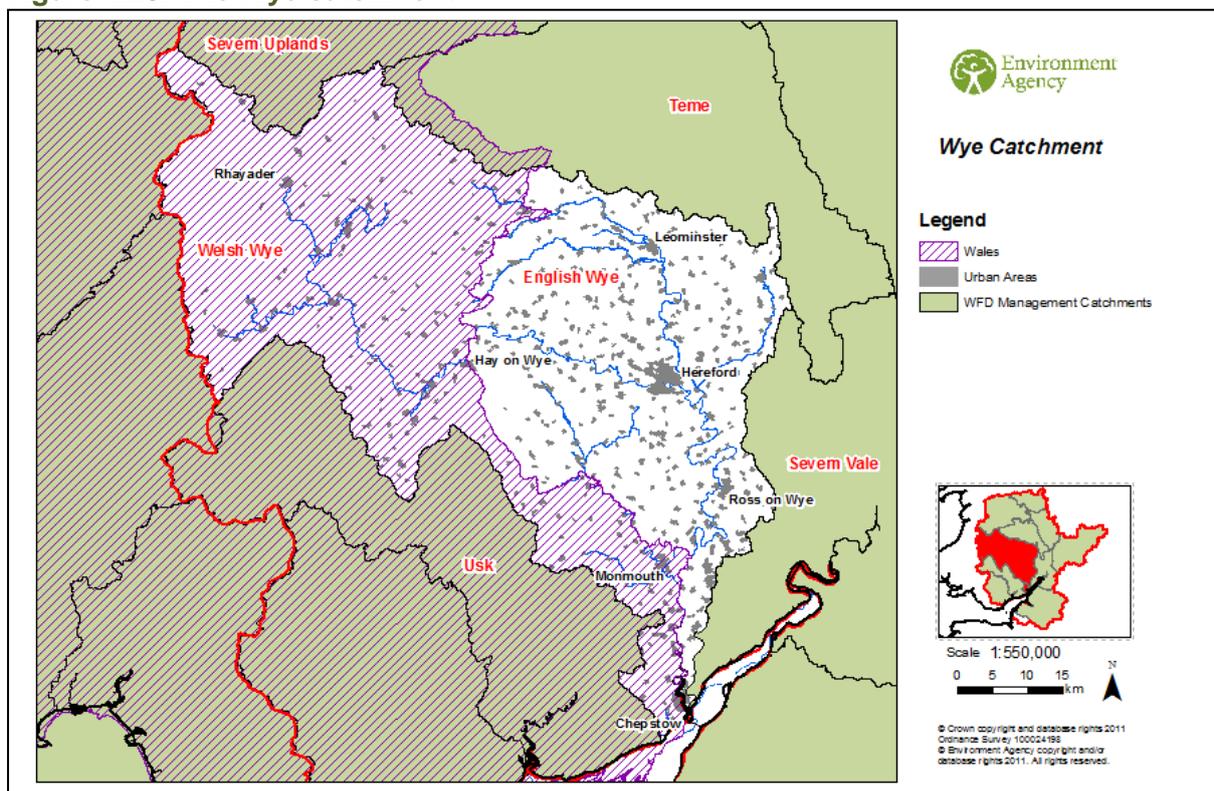
# 4.7b. The English Wye catchment

## Introduction to the catchment

The Wye catchment extends from Chepstow in the south east up to Rhayader in the north west covering an area of 4,180 km<sup>2</sup>.

The landscape is mainly rural, made up of a mixture of woodland and open farmland varying from the steep upland of the Cambrian Mountains in the upper part of the catchment. Below Hay-on-Wye (which lies on the Welsh-English border) the landscape changes to a flatter lowland characteristic as the River Wye floodplain widens. Letton Lakes provides natural water storage that helps attenuate river flows and during flood events reduces peak flow downstream in Hereford. Past Ross-on-Wye the floodplain begins to narrow again as the Wye cuts through the surrounding limestone to form a steep sided gorge/valley from Symonds Yat all the way to Chepstow where the Wye joins the Severn Estuary.

Figure 4.23: The Wye catchment



## Land use and management

The land use within the catchment is mainly agricultural, with a mixture of arable managed grassland and rough grassland farming. Within the lowland areas of the Wye Valley between Leominster, Ross-on-Wye and Hay-on-Wye the land use is mostly intensive agriculture with some market gardening.

There are a number of urban centres including Hereford, Leominster, Ross on Wye. Elsewhere tourism is key to the financial well being of smaller rural communities especially in the lower reaches of the Wye Valley.

Watercourses within the catchment are used for a variety of activities including recreation, public water supply, fisheries and conservation. The area is rich in landscape and wildlife.

## Geology

Geology in the Wye catchment is dominated by Old Red Sandstone. Within the Upper Wye catchment fine grained siltstones and mudstones/shales are also present. Along the eastern boundary and at the very southern extent there are areas of limestone and measures of coal (the western edge of the Forest of Dean).

Within the upper catchment soils are relatively poorly drained which can result in rapid runoff.

## National and international designations

The Wye management catchment crosses the border of England and Wales, with the area in England containing a number of Special Areas of Conservation (SAC) within the catchment along with numerous Sites of Special Scientific Interest (SSSIs) and some National Nature Reserves (NNR). The six European sites within the management catchment comprise of the Wye Valley and Forest of Dean Bat Sites SAC, Wye Valley Woodlands SAC, River Wye SAC, and the Severn Estuary SAC/SPA and Ramsar site. The Wye Valley and Forest of Dean Bat Sites SAC is a complex of sites located towards the south of the management catchment in the general area of Cinderford and Lydney. The Wye Valley Woodlands SAC comprises a series of sites along the River Wye extending from Chepstow to near Ross-On-Wye. By contrast the River Wye SAC is an extensive linear designation extending throughout the length of the River Wye from its confluence with the Severn estuary at Chepstow to the Welsh uplands at the western border of the catchment. This also includes a stretch of the River Lugg up to south of Leominster. For all of its length the River Lugg is also a Nationally designated SSSI, this extends into the cross border area of Wales. The Wye catchment includes the Wye Valley Area of Outstanding Natural Beauty (AONB) which also extends into the cross border area of Wales.

These designated sites are located throughout the catchment and the way in which they are managed can have an effect on the risk of flooding (by affecting the surface run-off into the River Severn and its tributaries).

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. Examples of historic riverside towns in the catchment include Hereford and Leominster.

## Partnership working

Within the Wye catchment the Environment Agency and Natural Resources Wales have developed good working relationship with partners. These include local councils. The English Wye catchment is covered by one unitary authority and part of two local councils, including Herefordshire Council, Forest of Dean District and Malvern Hills District.

We also work closely with the Regional Flood and Coastal Committee, Local Resilience Fora, Severn Trent Water plc, Dwr Cymru\Welsh Water, Natural England, Historic England and local authority archaeologists and conservation officers.

The Environment Agency will also continue to work, and strengthen links, with the Wye Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the Wye and Lugg SAC River Restoration Plans and to meet England Biodiversity Strategy (2020) targets.

## Historic flooding

Flooding within the Wye catchment can be divided into two categories, fluvially led or tidal. It is rare to have a combination of a significant event on both, though one will always influence the other, especially in the area downstream of Monmouth.

There are a number of locations that are impacted upon including Hereford, Ross-on-Wye, Leominster, Redbrook and Brockweir, the latter two are also impacted upon by tidal flooding.

There is a long history of fluvial flooding within the catchment. The most significant flooding event recorded occurred in 1947 affecting large numbers of properties in Hereford. This was catchment wide in its impacts. More recently flooding has occurred to varying degrees in 2012, 2007 and 2000 impacting on many communities including Lydbrook, Ross-on-Wye and Hampton Bishop, though the extents were not so great. Other notable events occurred in 1929, 1960, 1979 and 1998.

In the lower reaches of the River Wye tidal flooding has also impacted on communities such as Brockweir. The most recent events occurred in 2014 with the previous highest recorded event occurring in December 1981.

Fluvial flooding from the Wye or its tributaries has also affected communities including Ewylas Harold, Kington, Eardisland, Pontrilas Mordiford and Bishops Frome.

A number of communities have flooded from surface water and ordinary watercourses in the catchment, including most recently in 2012.

## Current flood risk

There is frequent, low level flooding in the Wye Valley, with agricultural and rural floodplain affected. Flooding from the River Wye at Letton Lakes near Hay-on-Wye is a regular occurrence and while the more commonly occurring events are disruptive to local communities, the number of properties directly affected is relatively low.

During larger events such as that experienced in 1947 there are significant numbers of properties affected throughout the catchment. National and regional infrastructure, including utility sub stations and major transport routes, are also affected resulting in many rural

communities becoming isolated. The main fluvial flood risks on the Wye are in Hereford and lower downstream at Monmouth. Other towns on the River Wye with some flood risk include Hay and Ross-on-Wye and parts of Leominster on the River Lugg are also at risk of flooding. A number of small communities are at risk of fluvial flooding from main river tributaries of the River Wye, including at Ewylas Harold, Kington, Eardisland, Mordiford and Bishops Frome.

There are a number of watercourses in the catchment that respond quickly to rainfall. These include the River Dore affecting Dorestone and Peterchurch and an unnamed watercourse affecting Pontshill. Flood levels in these flashier catchments can rise suddenly increasing risk to life.

Communities at risk of tidal flooding from the Wye Estuary include Elmdale on the English side of the Wye at Chepstow and Brockweir.

There is a risk of surface water and sewer flooding in some urban locations in the catchment. A number of communities are also at risk from ordinary watercourse flooding.

Most of the main population centres along the Wye have flood alleviation measures in place which reduce flood risk to property and infrastructure. This includes part of Hereford and at Hampton Bishop (The Stank). There is also a flood alleviation scheme at Leominster to alleviate flooding for parts of the town from the River Lugg.

## Recent flood risk management work

There are a small number of flood alleviation schemes that have been constructed along the River Wye in the last decade. These include demountable defences through Hereford. A local council led scheme on the Yazor Brook in Hereford was constructed to reduce flood risk in this part of the city as part of a general regeneration programme. Permanent flood defences have also been constructed downstream of Hereford around the village of Hampton Bishop. Flood defences have also been constructed in Ross-on-Wye to protect properties from a number of urban watercourse including the Rudhall Brook that are tributaries of the River Wye.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Wye management catchment. The significant issues within this catchment are diffuse pollution, sewage discharges and physical modifications, mainly weirs.

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency and Natural Resources Wales have made an assessment of the measures needed to achieve positive benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'protected areas' within the operational catchment
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

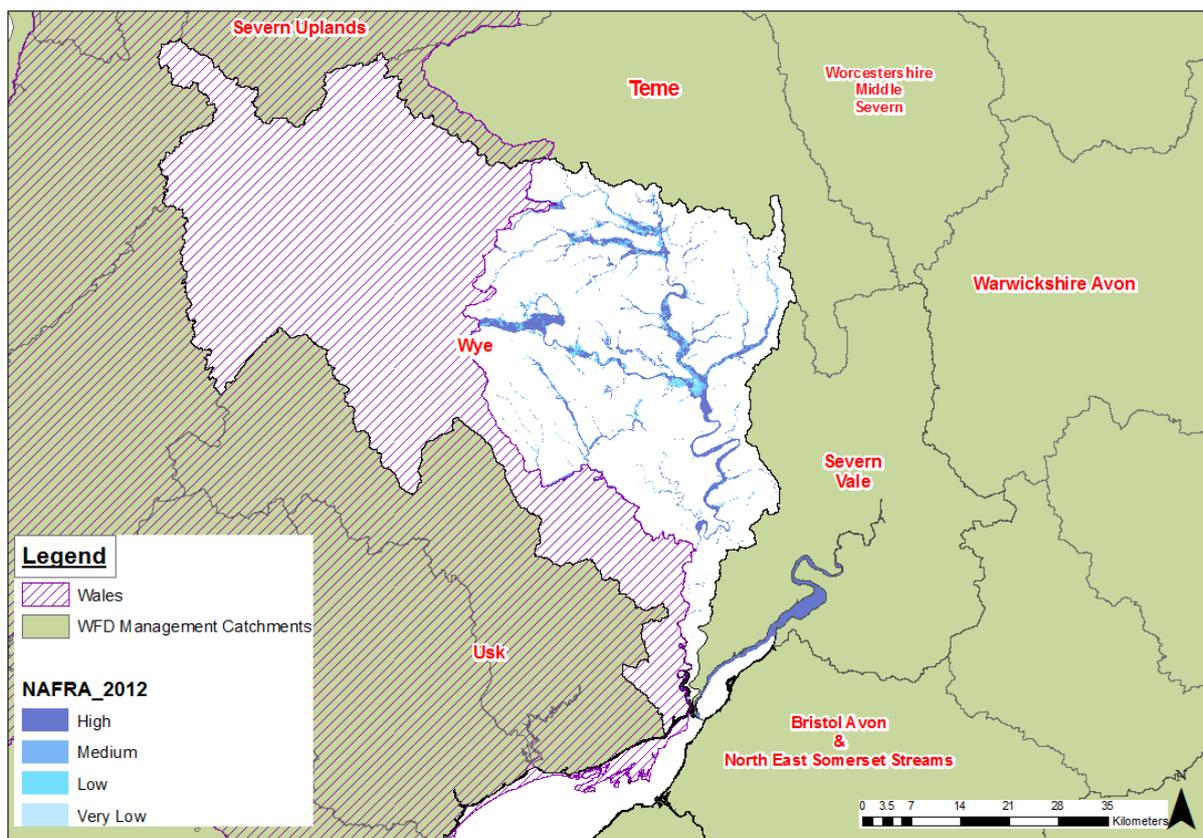
## Key statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 23,600 people at risk from river flooding, representing 9% of the total population. Nearly 6,950 non-residential properties are at risk of flooding from river of which 1,900 are considered to be at high risk. Approximately 10% of agricultural land within the catchment is at risk of flooding with around 10,100 hectares being at high risk.

**Figure 4.24: National Flood Risk Assessment (NAFRA) in the English Wye catchment**



The ivers and sea flood map has been developed and published by the Environment Agency

**Table 4.35: Summary of flood risk from rivers and the sea to people, economic activity and the natural and historic environment across the Wye catchment.**

<b>River &amp; Sea</b>	<b>Total in Catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	261,150	3,950	5,150	10,500	4,000
Number of services:	1,250	80	20	60	<10
<b>Risk to economic activity:</b>					
Number of non-residential properties:	87,750	1,900	1,600	2,650	800
Number of airports:	0	0	0	0	0
Length of roads (km):	530	20	20	20	<10
Length of railway (km):	130	<10	<10	<10	<10
Agricultural land (ha):	176,450	10,100	3,300	3,350	1,450
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	85	4	2	3	1
Area of SAC within area (ha):	10,350	1,950	300	50	<50
Area of SPA within area (ha):	19,950	200	150	<50	<50
Area of RAMSAR site within area (ha):	50	50	0	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	35,700	2,300	450	100	<50
Area of parks and gardens within area (ha):	5,150	100	50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	1,000	<50	<50	<50	<50
Number of listed buildings within area:	7,570	290	180	380	80
Number of licensed water abstractions within the area:	770	320	50	20	<10

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

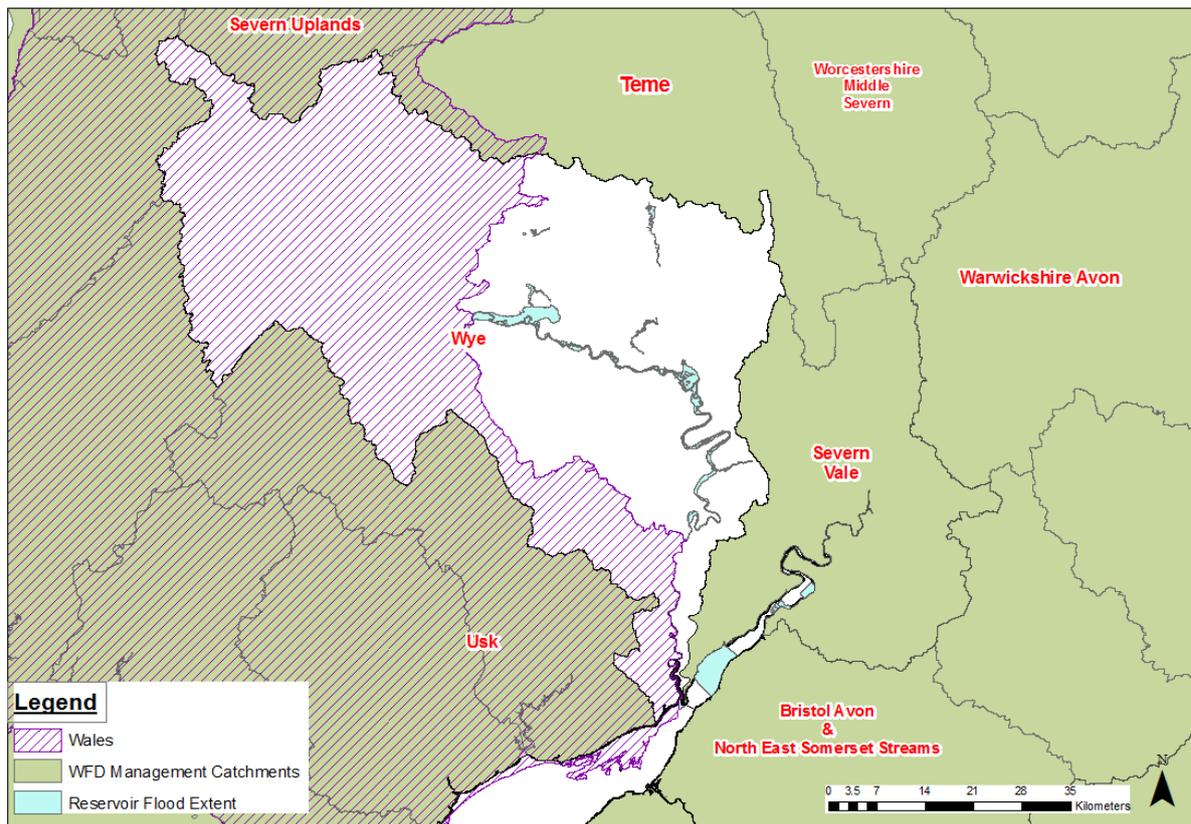
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 4,200 people are at risk of flooding from reservoirs in the English Wye Catchment, representing approximately 2 % of the total population within the catchment. Approximately 1,600 non-residential properties are at risk of flooding from reservoirs in the English Wye Catchment. Approximately 3.2% of the agricultural land within the catchment is at risk of flooding from reservoirs. Approximately 4.8% of SSSI sites and there are less than 50 Ramsar sites at risk of flooding in the area.

**Figure 4.25: Reservoir flood risk extents in the English Wye catchment**



The reservoirs flood map has been developed and published by the Environment Agency

**Table 4.36: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Wye catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	261,150	4,200
Number of services:	1,250	50
<b>Risk to economic activity:</b>		
Number of non-residential properties:	87,750	1,600
Number of airports:	0	0
Length of roads (km):	530	30
Length of railway (km):	130	<10
Agricultural land (ha):	176,450	5,650
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	85	1
Area of SAC within area (ha):	10,350	1,450
Area of SPA within area (ha):	19,950	200
Area of RAMSAR site within area (ha):	50	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	35,700	1,700
Area of parks and gardens within area (ha):	5,150	100
Area of Scheduled Ancient Monument within area (ha):	1,000	<50
Number of listed buildings within area:	7,570	270
Number of licensed water abstractions within the area:	770	130

**Note:**

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Conclusions and objectives for the Wye catchment

### Conclusions

The Wye catchment has a wide variation of fluvial flooding issues including extended periods of elevated levels within the River Wye valley that affect many rural communities, flooding from tributaries of the River Wye that run through some smaller urban areas, flooding from quickly responding catchments and tidal flooding from the Severn Estuary.

In the future, the increased frequency and intensity of rainfall events in combination with fast responding catchments will be the greatest threat to the upper areas and some tributaries where a relatively large number of small to medium sized communities are distributed over a wide area. It is difficult to provide accurate and timely warnings in the rapidly responding catchments. In addition climate change is likely to increase the pressure on existing locations where surface water flooding occurs.

There is a continued need to work in partnership with others, where possible, to achieve flood risk management measures which will alleviate flooding from multiple sources, as well as providing wider environmental and other benefits to improve the natural, rural and built environment consistent with the principles of sustainable development.

### Objectives

The following objectives apply to this management catchment, where possible and viable to do so. The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.37: Social objectives for the English Wye catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce or prevent an increase in harm to life as a result of flooding	RBD 2	Soc B
Minimise community disruption by reducing impact of flooding by increasing preparedness through improved flood warning service and public awareness	RBD 7, 9, 10	Soc D, G
Steer development towards areas of little or no risk of flooding, where development must occur in medium or high flood risk areas it must be sustainable, not increase flood risk and take account of the impacts of climate change	RBD 1, 11	Soc E
Improve awareness in catchments which react rapidly to rainfall	RBD 2, 9	Soc C
Increase understanding and management of flood risk impacts	RBD 6, 11	Soc A
Continue to work with utility providers to improve resilience of infrastructure and services	RBD 1, 8, 10, 11	Soc A, F
Continue to work with other bodies to improve resilience to the communication network and transport links	RBD 1, 8, 10, 11	Soc A, F
maintain existing assets that protect people where economically viable or find suitable alternatives by working in partnership with communities	RBD 6, 11, 12	Soc A

**Table 4.38: Economic objectives for the English Wye catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1	Ec A
Reduce flood risk to residential properties	RBD 1	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec E
Ensure current and future investment in the catchment is proportional to flood risk	RBD 3, 5	Ec C
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B, Soc F
Support the agricultural sector to manage catchment flood risk and ongoing improvements in sustainable agriculture	RBD 1, 11	Ec D
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	Ec B, En D, G

**Table 4.39: Environmental objectives for the English Wye catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Take opportunities to restore sustainable natural storage of floodwater on tributaries in their upstream areas, in order to offset increasing flood risk from trends including climate change	RBD 11	En A
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydro-morphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Maintain and enhance habitat through flood risk management activities	RBD 4	En B
Help achieve WFD Objectives through Flood Risk Management	RBD 1, 4	En E
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	Env E
Protect and enhance designated landscapes and local landscape character	RBD 1, 4	En C, G
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures specific to the Wye catchment

Measures that are relevant to this catchment are included in the RBD and Severn England level measures shown in Annex 1. In addition, there are measures specific to this catchment as follows:

Across the English Wye catchment there are 13 measures to manage flood risk. These include;

**Preventing risk:** There are 3 measures already in place to prevent flood risk in the catchment (Measure codes M21/M23/M24, in Annex 1):

- continue to support the development of flood risk management schemes in Hereford.
- work with communities along the Wye Estuary and at Bishops Frome to promote property level protection (2 measures).

**Preparing for risk:** There are 3 measures to prepare for flood risk that are specific to this catchment (Measure codes M41/M42/M43/M44 in Annex 1):

- work with communities at Bodenham and on the Wye Estuary to encourage action to prepare for flooding (2 measures);
- develop a flood awareness plan for the Lower Wye;

**Protecting from risk:** There are 7 measures that protect from flood risk that are specific to this catchment (Measure codes M32/M34/M35 in Annex 1), including:

- investigate measures to optimise the standard of protection provided by the Leominster Flood Alleviation Scheme;
- work with the community at Ewyas Harold to assess the feasibility of measures to reduce flood risk;
- continue with watercourse maintenance on the Lower Wye;
- maintain the existing level of defences on the Lower Wye and Hereford;
- support the River Wye and Lugg SAC Restoration Plans.

**Recovery and review of risk:** There are no specific measures in this category, over and above those included in Annex 1 and the flood risk activities described in section 6.

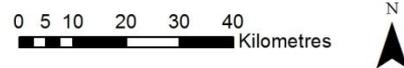
More detail on the specific measures is included in Annex 1.

# 4.8. The Usk catchment



**Legend**

- Main Rivers
- Usk Management Catchment
- Severn RBD Other Management Catchments



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**Figure 4.26: The Usk catchment**

## Catchment description / overview

The River Usk rises on the northern slopes of the Black Mountains and flows in a long narrow catchment of great scenic beauty for approximately 125km south easterly through the towns of Brecon, Crickhowell, Abergavenny and Usk, before discharging to the Usk estuary at Newbridge and then to the Severn estuary at Newport. The catchment includes the Gwent Levels to the south; a large area of reclaimed coastal grasslands of historical and nature conservation importance.

The upper catchment is composed predominantly of Old Red Sandstone, with limited permeability which promotes rapid run-off of rainfall. The thin soils and grassland landtype also result in river flows responding rapidly to heavy rainfall. The lower catchment areas remain relatively responsive to rainfall although the valley becomes less incised and the floodplain opens out until it reaches the Caldicot Levels. The lower catchment from the Caerleon area is more susceptible to tidal influence than fluvial flooding.

Tourism is important to the local economy, with the Brecon Beacons National Park and the Monmouthshire and Brecon Canal attracting visitors in search of outdoor recreation. The Usk catchment is rich in wildlife, including three species of lamprey and bullhead and a variety of habitats. This high ecological value is recognised through national and international designations. The Usk catchment is within the Brecon Beacons National Park in its upper and middle sections and has designations including part or all of 70 SSSI's, 9 Local Nature Reserves, 9 Special Areas of Conservation of which the river itself is both a SAC and a SSSI.

Land is predominantly used for agriculture, with sheep farming in the northern and western uplands, and beef, dairy, mixed and arable farming in the lowlands of the south and east. As a result, pollution from rural sources is a threat to the quality of wildlife and plants living in the water environment. There are many schemes in place to promote responsible farming and land management practices and these will reap benefits to both flooding and ecological status in future. There is some limited industry in the major towns, and Newport has a commercial port. Pollution from sewage and contaminated run-off is a pressure in the larger urban areas.

The headwaters and some of its tributaries are modified by dams to create the Usk, Crai, Talybont and Grwyne Fawr reservoirs. At Brecon some of the river's flow is diverted to feed the Monmouthshire and Brecon Canal and water from the lower River Usk is pumped to Llandegfedd water storage reservoir. On the Gwent Levels flows are regulated by the Caldicot and Wentlooge Internal Drainage District. Water is taken from rivers and underground sources to use in agriculture, industry, hydropower and fish farms. It is necessary to continue to work with Dwr Cymru Welsh Water and others to minimise the impact on the natural environment caused by the physical modifications and abstraction, while securing this valuable resource and maintaining flow levels.

## Historical flooding in the catchment

- January 1925: Brecon was flooded by the Usk;
- May 1931: Abergavenny suffered with flooding from the Usk causing one recorded death. In the same flood event there was flooding experienced at Malpas, Caerleon Road and Maindee in Newport;
- 1979 saw flooding at Llanfaes and Brecon town centre to a depth of 1.5 metres, with damages estimated at greater than one million pounds. The water levels remain the highest on record in most locations along the Usk;
- April 1998 saw the Usk flood the Elvicta Business Park in Crickhowell;
- December 2000: the Malpas Brook in Newport flooded 130 properties with the Usk flooding an additional 9 properties;
- February 2002 saw flooding at Crickhowell and Brecon causing 100 people to be isolated in Crickhowell and substantial road flooding along the A40 between Brecon and Llandovery;
- Christmas 2013 saw the highest recorded level along the Usk in recent years, but there was very little recorded flooding to properties;
- January 2014 saw the highest Tides recoded at Newport in several years and saw 6 properties flood in the Crindau area.

## Current flood risk in the catchment

The Flood risk in the Usk catchment varies as the topography and source of risk changes. The areas of highest hazard are in the Usk Estuary and the more developed towns such as Brecon, Usk and Crickhowell. 6 of the top 100 risk communities in Wales are to be found in the Usk catchment, these are predominantly at risk from tidal flooding, around the Newport area. The tidal risk in Newport is managed predominantly by a succession of flood alleviation schemes and the residual risk in the area is from the potential overtopping or failure of these schemes. The hazard in the aforementioned towns is similarly managed via schemes built from the 1960's through to recent times and the residual risk is from failure or overtopping. All key locations of high risk benefit from a flood warning service and have been targeted by flood awareness and other engagement activities.

## Future flood risk and issues in the catchment

In the future, the increased frequency and intensity of rainfall events in combination with fast responding catchments will be the greatest threat to the upper areas where a relatively large number of small to medium sized communities are distributed over a wide area.

The greatest threat to the lower catchment is from sea level rise which could increase flood risk significantly in Newport and surrounding low-lying areas, and potentially change the character of more than 2,000 hectares of low-lying land which is currently designated as three separate SSSIs across the Caldicot Levels.

## Recent flood risk management activity in the catchment

A flood forecasting model was delivered for the Usk catchment in early 2014. In addition to this a major data collection exercise during and after the floods experienced over the

Christmas and new year of 2013/4 has generated a major calibration and threshold review for the flood warning service in the Usk catchment.

In the Maindee and Riverside communities in Newport a new flood alleviation scheme was constructed in 2012. The scheme was a new flood wall of sheet piled retaining walls with cantilevered re-enforced concrete wall tied into an existing brick wall.

There is a major modelling exercise being undertaken that will look to improve Natural Resources Wales knowledge of all the coastal risk along the South East of Wales, this includes all tidal risk along the Usk coastal reaches.

Rogiet, Caldicot and Nash communities all benefited from recent sea door CCTV surveys that have helped inform the sea door maintenance programme.

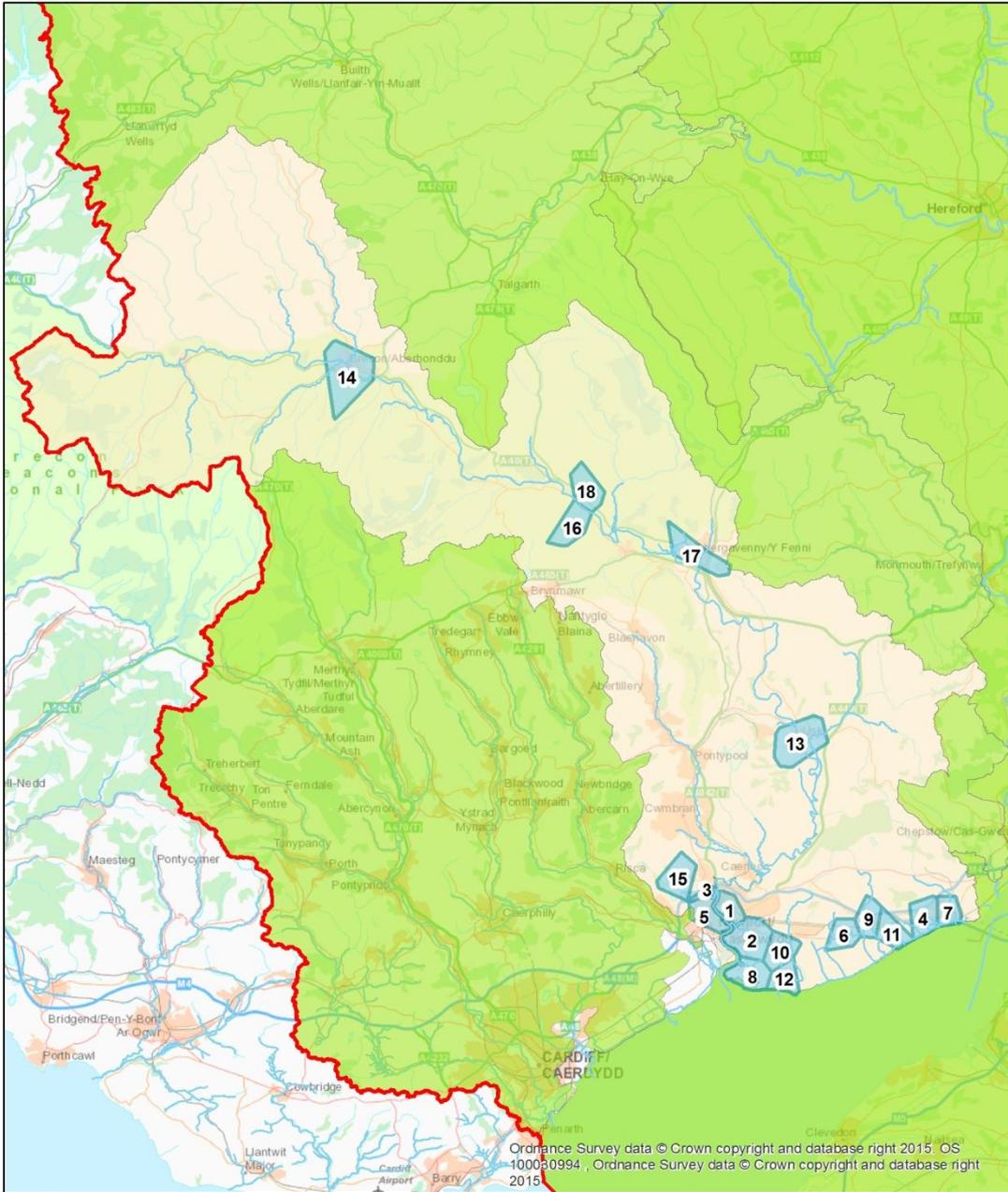
Brecon has recently had a flood wall repaired near the Brecon medical Centre, which has ensured the community retains an acceptable standard of flood risk.

## Key communities where Natural Resources Wales are planning actions (Bold Communities are in Top 50 Wales)

There are a number of communities within the catchment where there is still more to be done to manage and reduce the risk of flooding. Section 2.2 of this report sets out how Natural Resources Wales prioritise work on a risk basis so that those communities that are most at risk are addressed first.

**Table 4.40: Key communities**

Label	Community	Label	Community
1	<b>Maindee</b>	10	Broadstreet Common
2	<b>Liswerry</b>	11	Undy
3	<b>Crindau</b>	12	Goldcliff
4	<b>Rogiet</b>	13	<b>USK</b>
5	<b>NEWPORT/ CASNEWYDD</b>	14	BRECON/ ABERHONDDU
6	Llandevenny	15	Bettws
7	Caldicot	16	Llangattock
8	Nash	17	ABERGAVENNY
9	Magor	18	Crickhowell



**Legend**

-  Main Rivers
-  Usk Key Communities
-  Usk Management Catchment
-  Severn RBD Other Management Catchments

0 1.75 3.5 7 10.5 14  
 Kilometres



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**Figure 4.27: Key communities in the Usk catchment**

## Table 4.41: Usk catchment delivery plan

The following catchment delivery plan sets out on a community basis, the measures that Natural Resources Wales have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures Natural Resources Wales intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Maindee	Sea	Raise flood awareness within the community	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales
Liswerry	Sea	Develop scheme appraisal for flood alleviation scheme.	M2 - Prevention	1 2 8	Current	High	On-going	Natural Resources Wales
Crindau	Sea	Develop scheme appraisal for flood alleviation scheme.	M2 - Prevention	1 2 8	Current	Very High	On-going	Natural Resources Wales
		Raise flood awareness within the community	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales
Rogiet	Sea	Design and construction of flood alleviation scheme.	M3 - Protection	1 2 8	Current	High	On-going	Natural Resources Wales
		Design and construction of flood risk asset improvements.	M3 - Protection	1 2	Current	Very High	Not Started	Natural Resources Wales
Croesyceiliog	Main river	Undertake initial assessment and feasibility work for reducing flood risk.	M2 - Prevention	1 2 3 8	Current	High	Not Started	Natural Resources Wales
Usk	Main river	Undertake initial assessment and feasibility work for reducing flood risk.	M2 - Prevention	1 2 3 8	Current	Very High	Proposed	Natural Resources Wales

Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Newport / Casnewydd	Sea	Develop scheme appraisal for flood alleviation scheme.	M3 - Protection	1 2 8	Current	Critical	On-going	Natural Resources Wales
Llandeenny	Sea	Design and construction of flood alleviation scheme.	M3 - Protection	1 2 8	Current	High	On-going	Natural Resources Wales
Caldicot	Sea	Design and construction of flood alleviation scheme.	M3 - Protection	1 2 8	Current	High	On-going	Natural Resources Wales
Brecon / Aberhonddu	Main river	Assess conveyance requirements and implement maintenance.	M2 - Prevention	1 2 3	Current	High	Not Started	Natural Resources Wales
Cwm Ffrwd-oer	Main river	Build Hydraulic Model	M2 - Prevention	3	Current	Very High	On-going	Natural Resources Wales
Caerleon	Sea/Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M2 - Prevention	1 2 3 8	Current	Very High	On-going	Natural Resources Wales
Nash	Sea	Design and construction of flood risk asset improvements.	M3 - Protection	1 2	Current	Very High	On-going	Natural Resources Wales
Magor	Sea	Design and construction of flood alleviation scheme.	M3 - Protection	1 2 8	Current	High	On-going	Natural Resources Wales
Pontypool	Main river	Undertake initial assessment and feasibility work for reducing flood risk.	M2 - Prevention	1 2 3 8	Current	High	Not Started	Natural Resources Wales
Ponthir	Main river	Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	Very High	Not Started	Natural Resources Wales

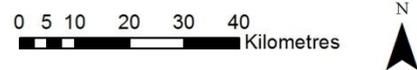
Location	Source	Measure Name	Measures	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
		Build Hydraulic Model	M2 - Prevention	3	Current	Very High	On-going	Natural Resources Wales
Llangattock	Main river	Maintain completed community flood plan	M4 - Preparedness	1 4 5	Current	High	On-going	Natural Resources Wales
Broadstreet Common	Sea	Implement alternative risk reduction measures.	M2 - Prevention	1 2 8	Current	Low	Not Started	Natural Resources Wales

# 4.9. South East Valleys catchment



**Legend**

- Main Rivers
- South East Valleys Management Catchment
- Severn RBD Other Management Catchments



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**Figure 4.28: South East Valleys catchment**

## Catchment description / overview

The main rivers in the South East Valleys catchment are the Ebbw and Sirhowy, which flow into the Usk Estuary and the Rhymney, Taff and Ely, which discharge to the Severn Estuary. The major urban centres include Aberdare, Caerphilly, Merthyr Tydfil, Pontypridd and Cardiff, which has an important commercial port. The 'valleys' rivers begin high in the Brecon Beacons and flow through steep-sided valleys to the low-lying coastal areas of Cardiff and the Wentlooge and Caldicot Levels. The valley slopes have managed grassland and forest, while the narrow valley floors are extensively urbanised.

In the upper catchment, the headwaters of the Taff have been modified by a series of dams and reservoirs to supply water to the industries and residents of South Wales. The rivers have a flashy flow regime, many being classified as rapid response catchments, and due to the underlying geology some smaller tributaries can dry up in very dry summers.

The Ebbw and Sirhowy catchments are mostly rural, interspersed with urban areas that are constrained by the steep valley sides. All the other catchments are steep sided and heavily urbanised with associated infrastructure such as roads, rail and services which are all typically located close to the rivers. The steep valley topography of much of the catchment has meant that urban development has been constrained within the valley floors, adjacent to the rivers. As a result there are significant numbers of people and property close to a watercourse. Flood risk is thus concentrated in a number of main areas and is not widely dispersed across the catchments.

Cardiff Bay was created in 2000 by fully impounding the Rivers Taff and Ely, allowing redevelopment of Cardiff and Penarth and providing flood defence against the extreme tides of the Severn Estuary.

The coastal and estuarine environments in the South Eastern Valleys contain a number of important and diverse habitats and species, including three internationally designated conservation areas and numerous nationally designated areas. The Severn Estuary is an important Ramsar site, Special Protection Area (SPA) and a candidate Special Area of Conservation (cSAC).

## Historical flooding in the catchment

The Taff catchment has experienced widespread flooding on a number of occasions over the last 60 years. The most notable flooding occurred in 1960 and 1979, when thousands of properties were affected. The most widespread flooding in the last 40 years happened on 27 and 28 December 1979. Several thousand properties flooded across South Wales and in many cases rivers reached levels that remain the highest on record. In contrast, the Ely catchment has only suffered from two significant events in the last few decades. These were a result of heavy rainfall falling on an already wet catchment in March 1998 and in October 2000. Only a small number of properties were affected.

## Current flood risk in the catchment

There are 20 of the top 50 highest risk communities in Wales in this catchment, indicating that it's a very important catchment in flood risk terms. Most of the urban areas that are next to the main rivers are defended, but not all to a 1% Annual Exceedance Probability (AEP)

standard of protection (SoP). The steep sided valleys are all prone to surface water flooding, with run-off from the slopes around and there is also a high risk from culvert blockage in the upper limits of these fast reacting catchments. The greatest flood risk to people and property is from overtopping or failure of defences, especially in some areas of the valleys where third party defences may be of unknown condition. These types of events would be exceptional and likely to affect large swaths of South Wales.

Tidal risk in this catchment is low in terms of likelihood due to the Cardiff Bay Barrage which affords a significant protection against high tidal levels. The largest tidal risk to these catchments is on the Wentlooge Levels, although there is significant work ongoing and planned to assess and maintain defences.

## Future flood risk and issues in the catchment

Future flood risk will be influenced primarily by climate change, but also by changes in land use and rural land management. Future increase in flood risk tends to be largest in towns located near the mouth of rivers, or where the tidal influence travels inland up an estuary. This is where the effects of sea level rise and increased rainfall combine, resulting in more frequent, deeper and more extensive flooding in the future. In future scenarios the heavily defended areas of this catchment will be more prone to overtopping and significant urban areas such as Cardiff, Pontypridd and Caerphilly may experience more surface water flooding.

## Recent flood risk management activity in the catchment

There has been extensive mapping and modelling work undertaken in the Valleys area to better understand the risk and to assess the current standard of protection of the defences in key locations. This modelling will also help inform and improve the flood warning service.

The Rhondda valley has been chosen as a pilot study for Natural Resources Wales new ecosystem approach to managing all aspects of the environment including flood risk. There is a lot of work going on to restore large tracts of upland peat bog to assist in slowing down the run-off rates and controlling the speed that water can flow through the catchment before it reaches the river networks. There is also an ongoing review (Rhondda Asset Management Strategy) of the assets that assist the flood management of the area, including a wider review of the effects and benefits of dredging.

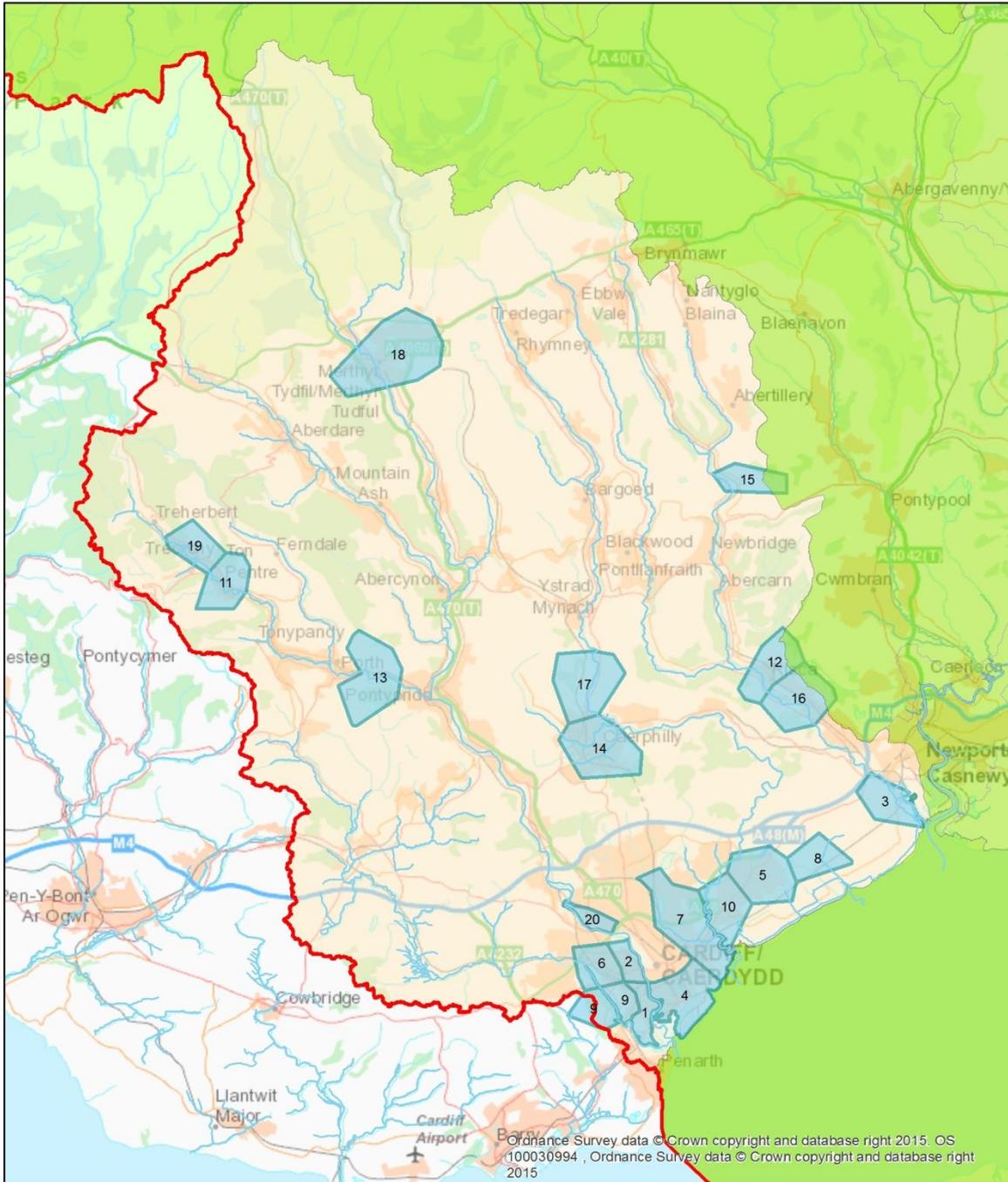
There has recently been a new flood forecasting service developed for the Taff Rivers which should assist with improving lead times for flood warnings in the catchment and allow people to take the appropriate actions to protect themselves and their property.

## Key communities where Natural Resources Wales are planning actions (Bold Communities are in Top 50 Wales)

There are a number of communities within the catchment where National Resources Wales feel there is still more to be done to manage and reduce the risk of flooding. Section 2.2 of this report sets out how National Resources Wales prioritise the work on a risk basis so that those communities that are most at risk are addressed first.

**Table 4.42: Key communities where Natural Resources Wales are planning actions**

<b>Label</b>	<b>Community</b>	<b>Label</b>	<b>Community</b>
1	<b>Grangetown</b>	11	<b>Rhondda</b>
2	<b>Riverside</b>	12	<b>Risca</b>
3	<b>Duffryn</b>	13	<b>Trehafod</b>
4	<b>Butetown</b>	14	<b>Caerphilly</b>
5	<b>St Mellons</b>	15	<b>Llanhilleth</b>
6	<b>Canton</b>	16	<b>Pontymister</b>
7	<b>Roath</b>	17	<b>Llanbradach</b>
8	<b>Marshfield</b>	18	<b>Merthyr Tydfil</b>
9	<b>Leckwith</b>	19	<b>Treorchy</b>
10	<b>Rumney</b>	20	<b>Llandaff North</b>



**Legend**

- Main Rivers
- South East Valleys Key Communities
- South East Valleys Management Catchment
- Severn RBD Other Management Catchments

0 1.25 2.5 5 7.5 10  
Kilometres



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Cyfoeth Naturiol Cymru, 100019741, 2013.

**Figure 4.29: Key communities in South East Valleys catchment**

## Table 4.43: South East Valleys catchment delivery plan

The following catchment delivery plan sets out on a community basis, the measures that Natural Resources Wales have already undertaken; are in the process of undertaking; or plan to undertake to help manage the risk of flooding to that community. This provides a list of measures Natural Resources Wales intend to undertake within this catchment over the coming years, subject to assessment and funding justification.

Location	Source	Measures	Measure Type	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Grangetown	Main River	Assess conveyance requirements and implement maintenance.	M3 - Protection	1 2 3	Current	High	Not Started	Natural Resources Wales
		Upgrade Hydraulic Model	M3 - Protection	3	Current	Very High	On-going	Natural Resources Wales
		Raise flood awareness within the community	M4 - Preparedness	1 4 5	Current	Very High	Proposed	Natural Resources Wales
Riverside	Main River	Assess conveyance requirements and implement maintenance.	M3 - Protection	1 2 3	Current	High	Not Started	Natural Resources Wales
		Upgrade Hydraulic Model	M3 - Protection	3	Current	Very High	On-going	Natural Resources Wales
		Maintain completed community flood plan	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales

Location	Source	Measures	Measure Type	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Duffryn	Main River	Design and construction of flood risk asset improvements.	M3 - Protection	1 2	Current	High	Not Started	Natural Resources Wales
Canton	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M3 - Protection	1 2 3 8	Current	Very High	On-going	Natural Resources Wales
		Improve existing flood warning service	M4 - Preparedness	1 2 4	Current	Very High	Proposed	Natural Resources Wales
Butetown	Main River	Assess conveyance requirements and implement maintenance.	M3 - Protection	1 2 3	Current	High	Not Started	Natural Resources Wales
		Improve existing flood warning service	M4 - Preparedness	1 2 4	Current	Very High	Proposed	Natural Resources Wales
Roath	Main River / Sea	Design and construction of flood alleviation scheme.	M3 - Protection	1 2 8	Current	Very High	On-going	Natural Resources Wales
		Maintain completed community flood plan	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales
St Mellons	Main River / Sea	Design and construction of flood alleviation	M3 - Protection	1 2 8	Current	Very High	On-going	Natural Resources Wales

Location	Source	Measures	Measure Type	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
		scheme.						
Treorchy	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M3 - Protection	1 2 8	Current	Very High	Not Started	Natural Resources Wales
		Update Hydraulic Model	M3 - Protection	3	Current	Very High	On-going	Natural Resources Wales
Llandaff North	Main River	Assess conveyance requirements and implement maintenance.	M3 - Protection	1 2 3	Current	High	Not Started	Natural Resources Wales
		Raise flood awareness within the community	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales
Rhondda	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M3 - Protection	1 2 8	Current	Very High	Not Started	Natural Resources Wales
		Update Hydraulic Model	M3 - Protection	3	Current	Very High	On-going	Natural Resources Wales
Leckwith	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M3 - Protection	1 2 3 8	Current	High	Not Started	Natural Resources Wales

Location	Source	Measures	Measure Type	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
		Raise flood awareness within the community	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales
Risca	Main River	Develop scheme appraisal for flood alleviation scheme.	M3 - Protection	1 2 8	Current	Very High	On-going	Natural Resources Wales
		Improve existing flood warning service	M4 - Preparedness	1 2 4	Current	Very High	Proposed	Natural Resources Wales
		Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	Very High	Proposed	Natural Resources Wales
Marshfield	Main River / Sea	Design and construction of flood risk asset improvements.	M3 - Protection	1 2	Current	High	Not Started	Natural Resources Wales
Rumney	Main River / Sea	Design and construction of flood alleviation scheme.	M3 - Protection	1 2 8	Current	Very High	On-going	Natural Resources Wales
Pontymister	Main River	Develop scheme appraisal for flood alleviation scheme.	M3 - Protection	1 2 8	Current	Very High	On-going	Natural Resources Wales
Trehafod	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M3 - Protection	1 2 3 8	Current	Very High	Not Started	Natural Resources Wales

Location	Source	Measures	Measure Type	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
		Update Hydraulic Model	M3 - Protection	3	Current	Very High	On-going	Natural Resources Wales
		Maintain completed community flood plan	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales
Llanhilleth	Main River	Carry out assessment on existing structures to ensure they are fit for purpose.	M3 - Protection	1 2 3	Current	Very High	Not Started	Natural Resources Wales
		Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	Very High	Not Started	Natural Resources Wales
Caerphilly	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M3 - Protection	1 2 3 8	Current	Very High	On-going	Natural Resources Wales
		Undertake hydrometry and telemetry improvements	M4 - Preparedness	1 3 4	Current	Very High	Not Started	Natural Resources Wales
		Update Hydraulic Model	M3 - Protection	3	Current	Very High	On-going	Natural Resources Wales
Llanbradach	Main River	Implement alternative risk reduction measures.	M3 - Protection	1 2 8	Current	High	Not Started	Natural Resources Wales

Location	Source	Measures	Measure Type	Link to FRMP Welsh objective	Timing	Priority	Measure Status	Responsible authority
Merthyr Tydfil	Main River	Undertake initial assessment and feasibility work for reducing flood risk.	M2 - Prevention	1 2 3 8	Current	Moderate	Not Started	Natural Resources Wales
		Raise flood awareness within the community	M4 - Preparedness	1 4 5	Current	Very High	On-going	Natural Resources Wales

## 4.10. The Bristol Avon and North Somerset Streams catchment

### Introduction to the catchment

#### **Lower Severn Vale (Little Avon and Bristol North Rhynes):**

The Lower Severn Vale Operational Catchment consists of the Bristol North Rhynes and Little Avon catchments.

The North Bristol Rhynes are a series of small catchments, draining west to the Severn Estuary. They start as springs or drainage from the higher land to the east, bordered approximately by the M5 and A38 roads. These watercourses are a mixture of natural and manmade systems mostly termed Rhynes or Pills.

The Little Avon catchment comprises of the rivers: Little Avon, Ozleworth Brook, Tortworth Brook and Doverte Brook. The Little Avon rises from its source at Horton in the arable and grassland uplands of the Cotswold escarpment, before being joined by the Ozleworth and Tortworth Brooks. Then gently descends before slowly flowing through the open flat flood plains of the Berkeley Vale, where the Doverte Brook joins before discharging to the Severn Estuary via Berkeley Pill. The tributaries to the north arise from springs higher up on the Cotswold plateau, and have relatively steep, narrow short valleys before joining the main river.

The Severn Estuary and shoreline has very high conservation status and valuable habitats.

#### **Bristol Avon:**

The Bristol Avon is a large, complex catchment area of approximately 2,220 km<sup>2</sup> encompassing the 2 major cities of Bristol and Bath. The primary river flows south then west from its source upstream of Malmesbury, through gentle rural landscapes and towns such as Bradford-on-Avon, before flowing through Bristol City centre and the Clifton Gorge to Avonmouth and into the Severn Estuary.

The significant tributaries in the catchment include the Somerset Frome and River Chew (from the Mendips), the River Marden and Semington Brook (from Salisbury Plain), the Tetbury and Sherston Avon and the Bristol Frome (from the Cotswolds), the Ladden Brook, Bradley Brook and the River Boyd. There are more than 70 additional waterbodies that feed into the Bristol Avon operational catchment, either directly or via a network of a dozen associated clusters.

#### **North Somerset Streams:**

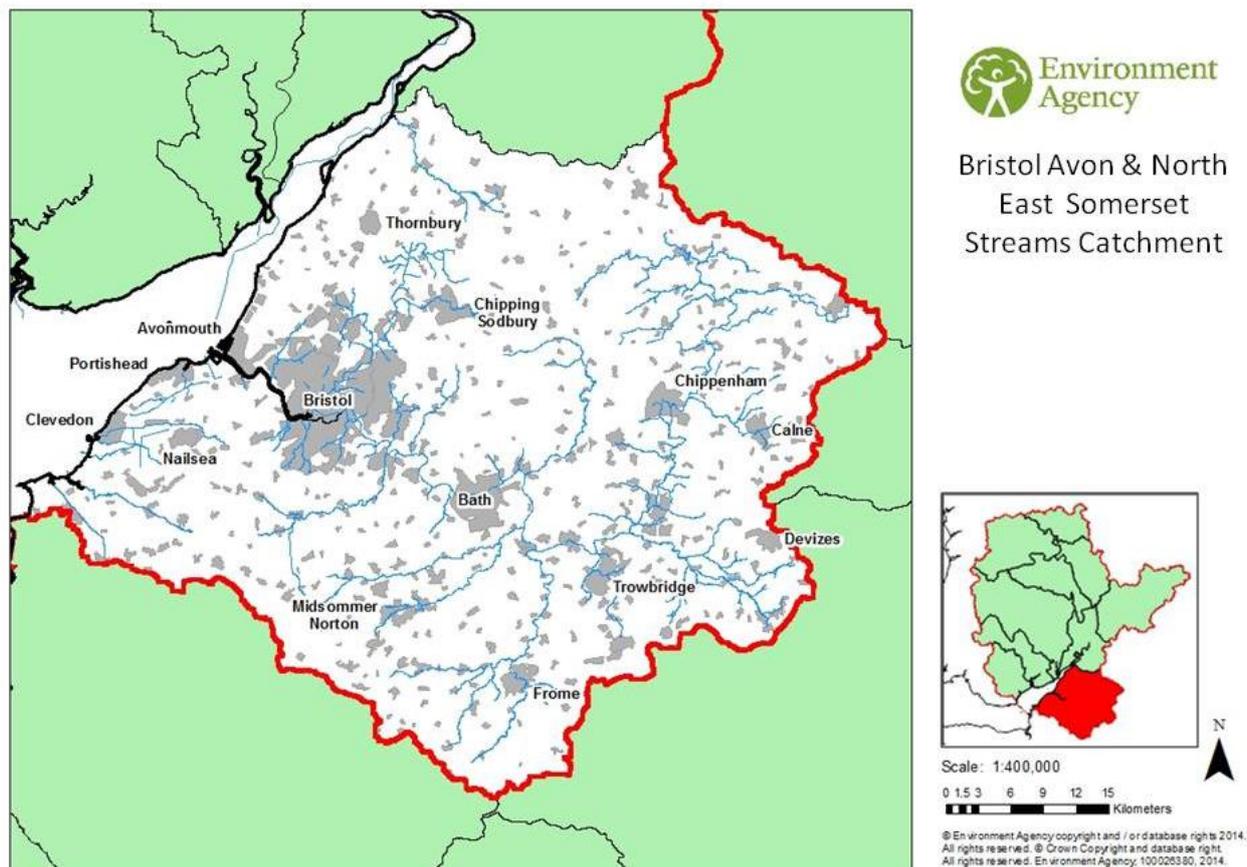
The North Somerset Streams Operational Catchment starts at Brean Down in the south and extends east to just beyond Blagdon Lake and then north to the mouth of the Avon.

The greater part of the population is concentrated in the coastal towns of Clevedon and Portishead. Inland, the larger settlements are Nailsea, Yatton and Congresbury.

This catchment combines the smaller catchments of the rivers Oldbridge, Yeo, Kenn, Blind Yeo and Land Yeo, as well as the Drove Rhyne and the Portbury Ditch.

The rivers are characterised by having short upland and long lowland reaches with very low gradients. Much of the area is low-lying levels and moors, where water is managed by Internal Drainage Boards.

**Figure 4.30: The Bristol Avon and North Somerset Streams catchment**



## Land use and management

Rural land cover, consisting mostly of managed grassland and arable farming is scattered widely throughout the catchment. There are also smaller areas of shrub, orchard and deciduous woodland, occurring most extensively along the By Brook. The extent of urban areas has a notable effect on flood risk. Approximately 10% of the Bristol Avon and North Somerset Streams catchment is urban. The main settlements include Bristol and Avonmouth, Bath, Trowbridge, Melksham, Chippenham, Portishead and Clevedon. There are many modified watercourses and flood defence systems throughout the catchment.

## Geology

The geology of the Bristol Avon catchment exhibits significant variability and spans a large geological timescale (approximately 300 million years). Typically strata exposed at the surface increases in age from east to west; from Cretaceous Lower Chalk in the east to Carboniferous, Devonian and Silurian strata in the west.

The geology along the coastal areas of the catchment consists of estuarine alluvial deposits. The clays and mudstones of the valley lie close to the groundwater table for much of the year and are frequently saturated with standing water across the floodplain. When this happens, rainfall is slow to drain away and may lead to localised flooding even when the River Severn is not in flood.

There are permeable uplands in the catchment, consisting of a wide range of limestones, sandstone and mudstones. Groundwater seeping out through springs in the limestone hills of the Mendips forms the headwaters of the Congresbury Yeo.

## National and international designations

The North Somerset Levels and Moors support some nationally important areas of high nature conservation value including one National Nature Reserve at Gordano Valley.

The Avon Bristol and North Somerset Streams management catchment contains 12 European sites. The majority of these sites are in the southern half of the management catchment, although the Severn Estuary Special Area of Conservation (SAC)/Special Protection Area (SPA)/Ramsar site extends along the entire length of the catchment's border with the estuary. The Avon Gorge Woodlands SAC is located on the western edge of Bristol, whilst the Chew Valley Lake SPA is located further to the south of Bristol. The Mendip Woodlands SAC and North Somerset & Mendip Bats SAC comprise a complex of sites along the southern border of the catchment to the south of Yatton and Midsomer Norton. Only a small part of the Salisbury Plain SAC/SPA is within the catchment to the west of Westbury. The Bath & Bradford on Avon Bats SAC comprises a series of sites between Bath and Chippenham. Similarly the Mells Valley SAC is a complex of sites between Frome and Holcombe. It is also worth noting that the complex of sites comprising the Somerset Levels and Moors SPA/Ramsar site are located immediately to the south of the management catchment, south of Wedmore and to the east of Glastonbury.

The Avon Bristol and North Somerset Streams management catchment includes a number of designated landscapes in the form of Areas of Outstanding Natural Beauty (AONB), including the Cotswold AONB, the Mendip Hills AONB and the North Wessex Downs AONB.

The catchment has a diverse range of designated heritage assets including scheduled monuments, listed buildings, registered parks and gardens and conservation areas, as well as a broad variety of non-designated heritage assets as identified in local authority Historic Environment Records. This resource of heritage assets includes those directly connected to the water environment such as dams, water mills and bridges as well as the potential for archaeological remains, including peat deposits and palaeo-environmental channels linked to former river channels, floodplains and other water features. Many heritage assets are also of historic landscape value such as those associated with field patterns, hedgerows, woodland and ancient trees, and contribute to the character and distinctiveness of the wider landscape. The catchment includes the City of Bath World Heritage Site and other historic riverside towns including Bristol.

## Partnership working

The Environment Agency have developed good working relationships with RMA partners. In future cycles of planning the intention is to include information on measures taken by other authorities, however this first plan has only included information provided by those Lead Local Flood Authorities who have a statutory duty to create a FRMP or that have chosen to contribute to this plan on a voluntary basis. The catchment is covered by 7 Lead Local Flood Authorities, 4 of which

are contributing to a joint FRMP for the Severn RBD. These are South Gloucestershire Council, Bristol City Council, North Somerset Council and Bath and North East Somerset Council. This information is covered in section 3 of this document.

The Environment Agency will continue to work, and strengthen links, with the Bristol Avon and North Somerset Streams Catchment Partnership and other partners to deliver a range of environmental and ecological improvements within the Severn Estuary SAC to increase and enhance the extent of the salt marsh habitats within the estuary to ensure resilience against climate change. Recent habitat creation schemes at Steart Peninsula (in the South West River Basin District) and Plusterwine Farm (in the Severn Vale catchment) have created in excess of 250 hectares of new habitat. This contributes towards the 300 hectares of compensatory habitat that is required by the Habitats Directive by 2030, to offset the impacts of climate change.

## Historic flooding

This catchment has a long history of flooding, which resulted in many flood defence schemes being built, particularly in the period 1935 to 2000. Since then, high flows on the River Avon in 2000 and 2008 which would have caused widespread flooding resulted in little damage. There have been flood events more recently in Chew Magna, Wrington, Malmesbury, Keynsham and Bradford on Avon.

## Current flood risk

The Bristol Avon catchment has areas of both tidal and fluvial flood risk. Much of the catchment benefits from flood defences, however there remain a large number of properties still at high risk of flooding. This is due to the nature of the floodplain, which is widely dispersed throughout the catchment and the large number of people living in the catchment. The River Avon corridor runs through some large urban areas including Malmesbury, Chippenham, Melksham, and Bradford on Avon, Bath, Keynsham, Bristol and Avonmouth. There is a large strip of land at risk from tidal flooding, relying on engineered defences for flood alleviation. The remainder of the flood risk is scattered throughout the catchment along the river corridors. The Environment Agency are currently managing flood risk in many ways including working on several schemes to mitigate against the effects of flooding in communities such as Wrington, Chew Magna and Radstock.

## Linking to the Severn River Basin Management Plan

The Severn River Basin Management Plan (RBMP) sets out what is required to achieve Water Framework Directive standards in the Bristol Avon and North Somerset Streams management catchment. The significant issues within this catchment are;

- Pollution from rural areas - sediments in rivers from poor land management
- Pollution from towns, cities and transport
- Pollution from waste water - phosphorus in rivers from treated waste discharge
- Physical modification – alterations such as weirs and bridges
- Negative effects of invasive non-native species (INNS)
- Changes to the flow and level of rivers

Where a failure has been identified, a range of measures have been assessed that would be needed to improve the status of water bodies. The Environment Agency has made an assessment of the measures needed to achieve positive benefits for the water environment and society. The measures have been grouped together to ensure the cumulative 'catchment' effect is considered.

As well as the measures needed to improve the status of water bodies, other measures are needed to:

- Protect or improve 'Protected Areas' within the operational catchment
- Prevent water bodies deteriorating from their current status.

Some of these measures will benefit more than one water body or catchment and some are very specific. The cumulative effect and benefits of measures for the operational catchment have been considered.

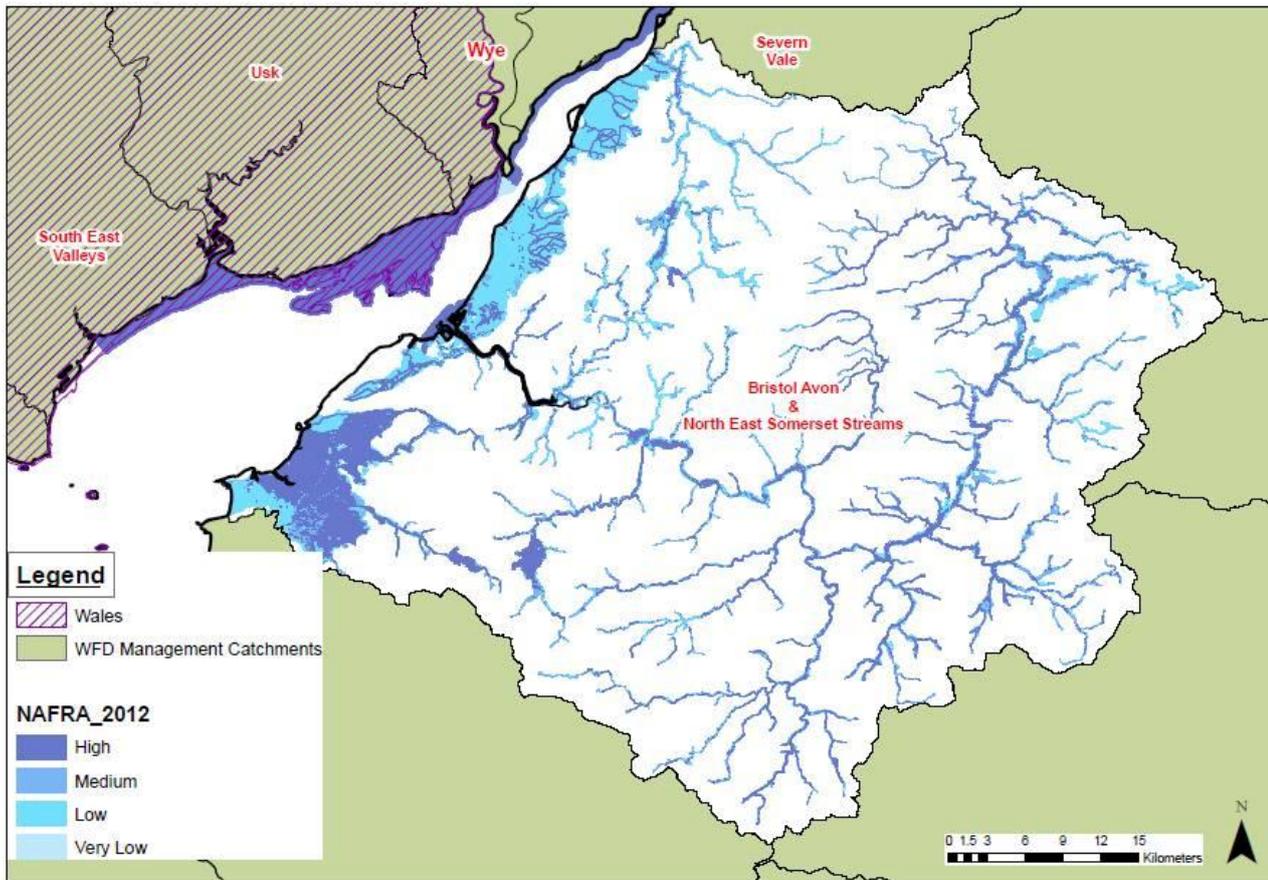
## Key statistics

The following sections provide key statistics relating to different sources of flood risk within the catchment.

### Flooding from rivers and the sea

In this catchment there are approximately 82,150 people at risk from river flooding, representing 6% of the total population. Nearly 15,913 non-residential properties are at risk of flooding from river of which 4,500 are considered to be at high risk. Approximately 9% of agricultural land within the catchment is at risk of flooding with around 8,700 hectares being at high risk.

Figure 4.31: National Flood Risk Assessment (NAFRA) in the catchment



The rivers and sea flood map has been developed and published by the Environment Agency

**Table 4.44: Summary flood risk from rivers & sea to people, economic activity and the natural and historic environment across the Bristol Avon & North Somerset Streams catchment.**

<b>River &amp; Sea</b>	<b>Total in catchment</b>	<b>High risk</b>	<b>Medium risk</b>	<b>Low risk</b>	<b>Very low risk</b>
<b>Risk to people:</b>					
Number of people in area:	1,355,700	11,450	9,250	61,350	100
Number of services:	2,440	90	30	120	<10
<b>Risk to economic activity:</b>					
Number of non-residential properties:	161,150	4,500	2,250	9,150	<50
Number of airports:	1	0	0	0	0
Length of roads (km):	680	20	20	90	<10
Length of railway (km):	320	10	<10	30	<10
Agricultural land (ha):	214,650	8,700	2,550	8,450	<50
<b>Risk to the natural and historic environment:</b>					
Number of EU designated bathing waters within 50m:	1	1	0	0	0
Number of EPR installations within 50m:	74	6	4	16	0
Area of SAC within area (ha):	1,400	350	<50	<50	<50
Area of SPA within area (ha):	1,500	850	<50	<50	<50
Area of RAMSAR site within area (ha):	450	400	<50	<50	<50
Area of World Heritage Site within area (ha):	2,850	100	50	100	<50
Area of SSSI within area (ha):	5,950	1,350	50	200	<50
Area of Parks and Gardens within area (ha):	6,900	100	50	50	<50
Area of Scheduled Ancient Monument within area (ha):	900	<50	<50	<50	0
Number of Listed Buildings within area:	17,500	440	230	510	<10
Number of Licensed water abstractions within the area:	360	100	20	<10	0

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

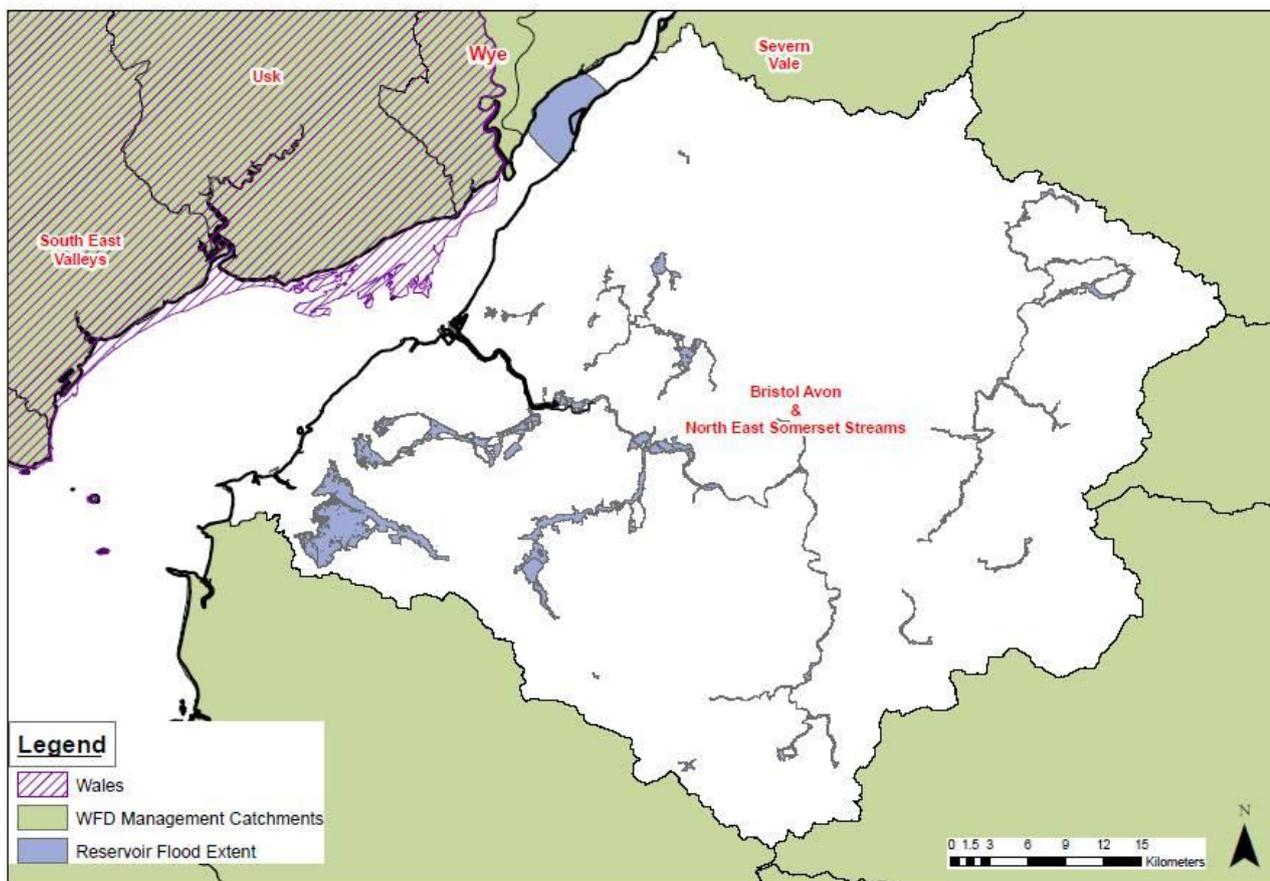
Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

## Flooding from reservoirs

Over 23,350 people are at risk of flooding from Reservoirs in the Bristol Avon and North Somerset Streams catchment, representing approximately 2% of the total population within the catchment. Approximately 5,550 non-residential properties are at risk of flooding from Reservoirs in the Bristol Avon and North Somerset Streams catchment. Approximately 3% of the agricultural land within the catchment is at risk of flooding from Reservoirs. Approximately 10% of SSSI sites and there are less than 50 Ramsar sites at risk of flooding in the area.

**Figure 4.32: Reservoir flood risk extents in the catchment**



The reservoirs flood map has been developed and published by the Environment Agency

**Table 4.45: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Bristol Avon & North Somerset Streams catchment.**

<b>Reservoirs</b>	<b>Total in Catchment</b>	<b>Maximum extent of flooding</b>
<b>Risk to people:</b>		
Number of people in area:	1,355,700	23,350
Number of services:	2,440	70
<b>Risk to economic activity:</b>		
Number of non-residential properties:	161,150	5,550
Number of airports:	1	0
Length of roads (km):	680	20
Length of railway (km):	320	20
Agricultural land (ha):	214,650	5,500
<b>Risk to the natural and historic environment:</b>		
Number of EU designated bathing waters within 50m:	1	0
Number of EPR installations within 50m:	74	3
Area of SAC within area (ha):	1,400	<50
Area of SPA within area (ha):	1,500	400
Area of RAMSAR site within area (ha):	450	<50
Area of World Heritage Site within area (ha):	2,850	<50
Area of SSSI within area (ha):	5,950	600
Area of Parks and Gardens within area (ha):	6,900	50
Area of Scheduled Ancient Monument within area (ha):	900	<50
Number of Listed Buildings within area:	17,500	480
Number of Licensed water abstractions within the area:	360	60

Note:

SAC - Special Area of Conservation

SPA - Special Protection Area

SSSI - Site of Special Scientific Interest

Ramsar - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

For a summary of flood risk from surface water to people, economic activity and the natural and historic environment across the Bristol Flood Risk Area see section 3 of this document.

## Conclusions and objectives for the Bristol Avon and North Somerset Streams catchment

### Conclusions

Bristol City is the largest urban area in the catchment, which is on the UK's eight Core Cities and is the most significant economic hub in the southwest. The city is built on a hilly landscape resulting in fast surface water run-off. Several watercourses are also subject to tidelocking, causing an increased fluvial flood risk during high tides. Bristol also has many deprived areas and heavily modified watercourses. However it is surrounded by rural areas that would benefit from better catchment management. The city is at risk from tidal and fluvial flooding and in particular is at risk from rising sea levels due to climate change, particularly in the Avonmouth area.

Bath is a major tourism centre with a recent history of flooding. The main challenge is the re-development of the River Avon corridor through the city.

The Chew Valley and Brislington are both high risk rapid response catchments, which could see fast flowing water that could pose a risk to life. Measures to improve preparedness in the community are of particular importance in these locations.

Properties at risk are dispersed throughout the catchment creating funding challenges and due to the complexity of the flooding mechanisms and sources throughout the catchment, there are locations where there is a need to understand these better so as to identify the best way to manage it. There are therefore several studies included in the proposed measures.

### Objectives

The columns on the right indicate how the catchment objectives link to the Severn in England and RBD level objectives:

**Table 4.46: Social objectives in the catchment**

Social Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce risk to life	RBD 2	Soc B
Improved flood warning service	RBD 9	Soc G
Minimise community disruption by reducing impact of flooding - improve resilience of infrastructure and services and community preparedness through improved flood warning service and increased public awareness	RBD 7, 9, 10	Soc D, F, G
Take a sequential approach to locating development	RBD 1, 11	Soc E
Reduce flood risk to historic environment	RBD 4	En F
Understand the effects of coastal erosion	RBD 1	Soc A
Increased understanding and management of flood risk impacts	RBD 6, 11	Soc A

**Table 4.47: Social objectives in the catchment**

Economic Objectives	Links	
	RBD level objectives	Severn, England level objectives
Reduce economic damage to commercial properties	RBD 1, 2	Ec A
Reduce flood risk to private properties	RBD 1, 2	Ec A
Reduce flood risk to agricultural land	RBD 1	Ec D, E
Support tourism by reducing flood risk and enhancing river corridors	RBD 1, 4	En D, G Ec B
Reduce risk of flooding to major infrastructure	RBD 1, 8, 10	Ec B Soc F
Encourage sustainable development that manages flood risk appropriately	RBD 4	Ec B

**Table 4.48: Social objectives in the catchment**

Environmental Objectives	Links	
	RBD level objectives	Severn, England level objectives
Work with natural processes wherever possible to achieve WFD objectives	RBD 1, 4	En E
Improve water environment through flood risk management activities	RBD 1, 4	En D, E
Improve hydromorphology of rivers	RBD 1, 4	En D
Minimise impacts of flooding on designated sites or areas of environmental interest	RBD 1, 4	En C, F
Create habitat through flood risk management activities	RBD 4	En B
Conserve and enhance heritage assets (designated and non-designated) and minimise harm to their significance from flooding	RBD 1, 4	En F
Contribute to integrated catchment water management and/or sustainable drainage approach	RBD 11	En A

## Measures across the Bristol Avon and North Somerset Streams catchment

The following section describes the measures put in place by the Environment Agency to manage flood risk in the Bristol Avon and North Somerset Streams catchment.

These measures have been taken from the Shoreline Management Plans (SMP), Catchment Flood Management Plans (CFMP) and some other unpublished plans or programmes. Only actions where the Environment Agency has been identified as having a delivery role have been included in this consultation document.

Please refer to the relevant SMP for your area of interest for additional information. The SMP for the Bristol Avon and North Somerset Streams catchment can be found at the following location:

Select the relevant coastal group, the Bristol Channel Coastal Advisory Group or Severn Estuary Coastal Group from the Home menu and navigate to the current SMP documents.

Across the Bristol Avon and North Somerset Streams catchment the measures to manage flood risk include:

**Preventing risk:** there are 39 measures to prevent flood risk in the catchment including:

- 23 measures from the SMP to encourage utility providers to undertake an assessment of resilience to flooding of their assets at various locations;
- A beach monitoring programme;
- Improvements to trash screens and installing webcams to monitor assets;
- Engaging with Local Enterprise Partnerships to ensure development is safe from flooding;
- Improve or maintain assets.

**Preparing for risk:** there are 13 measures to prepare for flood risk in the catchment including:

- Flood warning improvements including the use of new CATMAX alarms;
- Carry out community engagement to raise awareness of flood risk;
- Deliver property level protection at various communities;
- Individual property resilience;
- Better gauging of a watercourse.

**Protecting from risk:** there are 64 measures that protect from flood risk including:

- Developing an integrated drainage plan for the Royal Portbury Docks;
- The investigation of options for a strategic flood defence solution in Bristol;
- 6 measures to undertake a study into opportunities to remove flood embankments;
- 10 measures to improve outfalls, gates, tunnels or other assets;
- 2 measures to work with partners to identify new ways to protect communities in the catchment.

More detail on the specific measures is included in Annex 1

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