



South East River Basin District

Flood Risk Management Plan 2015 -
2021

**PART B: Sub Areas in the South East river
basin district**

March 2016

Published by:

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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.
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
FCRM	Flood and Coastal 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.
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
HRA	Habitats Regulations Assessment: an assessment undertaken in relation to a site designated under the Habitats and Birds Directives
IDB	Internal drainage board
IDD	Internal drainage district
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
MTP	Medium Term Plan

MSFW	Making Space for Water
NaFRA	National Flood Risk Assessment
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.
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NRW	Natural Resources Wales. The NRW took over the functions of the Environment Agency in Wales on 1 April 2013.
Ordinary watercourses (OW)	All watercourses that are not designated main river, and which are the responsibility of local councils 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.
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
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
uFMfSW	Updated Flood Map for Surface Water Flooding produced in 2013
UKCIP	United Kingdom Climate Impact Projections
WFD	Water Framework Directive

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.

Name	Audience
Summary Document	For those who 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
Part B: Catchment Summaries	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 program of work for individual communities

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

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

During December 2015, Storms Desmond, Eva and Frank brought record breaking levels of rainfall and significant flooding to some parts of the country. On 5 and 6 December the highest ever river flows were registered in several large catchments including the Eden, Lune and Tyne. On 25 and 26 December further record river levels were registered for many large rivers draining the Pennines. The Met Office confirmed that December 2015 was the wettest on record in parts of the UK, including Cumbria which experienced more than two and a half times expected monthly rainfall.

Across the country over 19,000 homes were flooded, with thousands more affected by loss of power supply and travel disruption. Existing flood defences played an essential part in protecting thousands of homes during December with 12,500 benefitting during Storm Desmond and 10,900 during Storm Eva. Support to affected communities, business and the agricultural sector is in place, along with a programme of inspections and repairs to damaged defences.

It is essential to ensure that we have the very best possible plans in place for flood management across the whole country. Following the December 2015 floods, Defra announced a National Flood Resilience Review, to assess how the country can be better protected from future flooding and increasingly extreme weather events. The review is looking at climate modelling, infrastructure, resilience and future investment strategy. Government is also working to strengthen or establish partnerships in the areas most flood affected to encourage a more integrated approach to managing risk across the whole catchment. These partnerships are considering improvements to flood defences, upstream options to help slow the flow and surface water runoff, and how planning and design of urban areas can help reduce flood risk. They are also aiming to build stronger links between local residents, community groups and flood management planning and decision making. The resulting actions from the Local Flood Partnerships in Cumbria and Yorkshire will complement the measures in the relevant FRMPs and the learning from this approach will be shared across the country. In England, the Government is investing £2.3bn on 1,500 flood defence schemes between 2015-2021. Investment in flood risk management infrastructure not only reduces the risks of flooding but also supports growth by helping to create new jobs, bringing confidence to areas previously affected by floods and creating and restoring habitats.

1 Sub-areas in the South East river basin district

Introduction

There are a number of sub-areas within the South East river basin district (Figure 1). These sub-areas and the flood risk issues in them are described in sections 3 and 4.

- ▶ Flood Risk Areas (identified in the [Preliminary Flood Risk Assessment](#)): areas that require flood risk management plans for local sources of flooding.
- ▶ Catchments (which are set out according to Water Framework Directive Management Catchments)

Flood Risk Areas

There is one Flood Risk Area in the river basin district. This was identified through the Preliminary Flood Risk Assessment process as an area of potentially significant local flood risk (for instance surface run-off, groundwater and ordinary watercourses), for which a FRMP needed to be prepared.

- ▶ **Brighton and Hove Flood Risk Area.** The Brighton and Hove Flood Risk Area coincides with Brighton and Hove City Council's unitary boundary.

Management catchments

These are areas where engagement is focused to enable a catchment based approach to water management. There are 9 Water Framework Directive catchments in the South East river basin district, as listed below and shown in Figure 1:

- ▶ New Forest
- ▶ Isle of Wight
- ▶ Test and Itchen
- ▶ East Hampshire
- ▶ Arun and Western Streams
- ▶ Adur and Ouse
- ▶ Cuckmere and Pevensey Levels
- ▶ Rother and Romney
- ▶ Stour

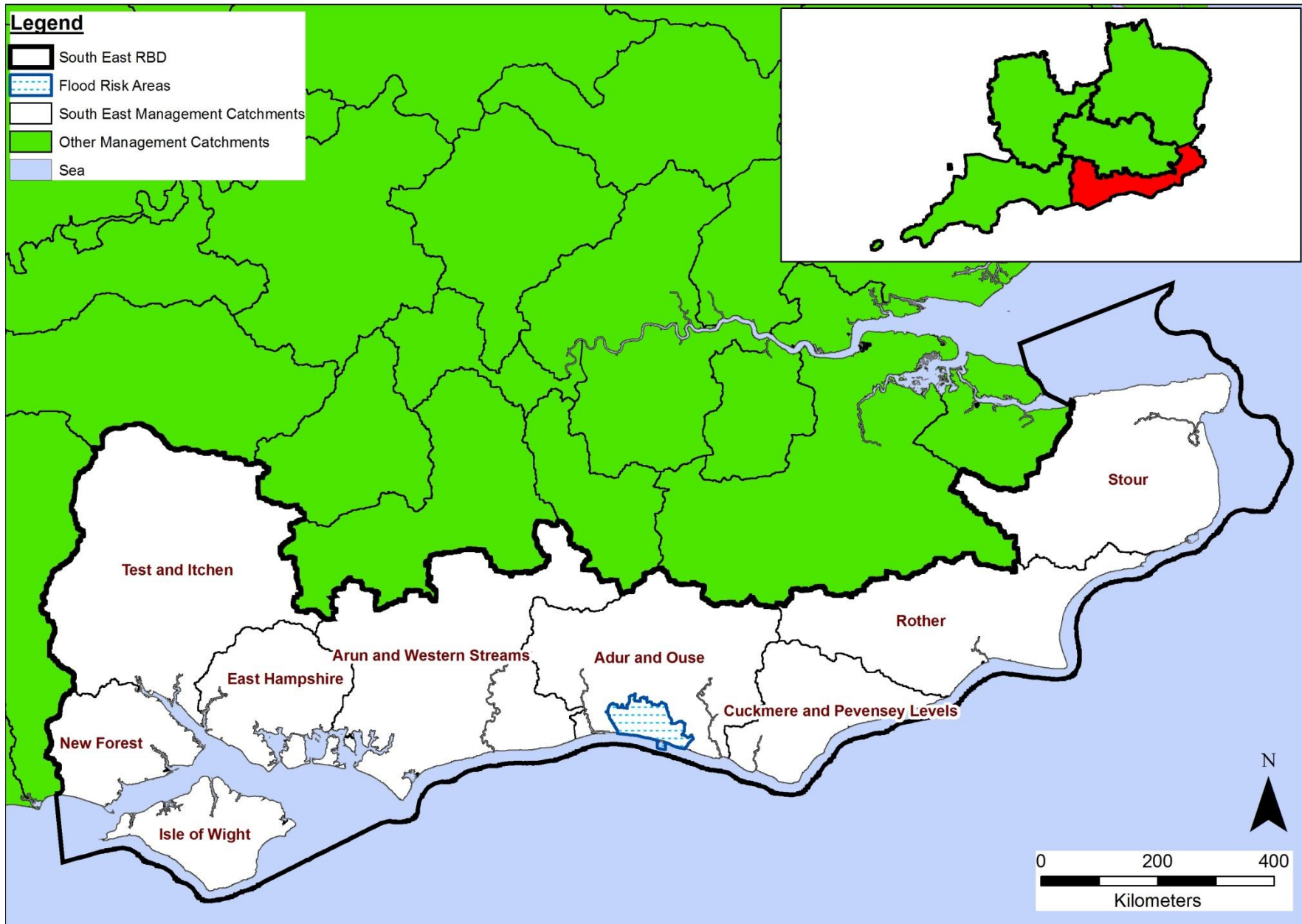


Figure 1 South East river basin district showing catchments and Flood Risk Areas.

2 Conclusions, objectives and measures to manage risk for the Brighton and Hove Flood Risk Area

Introduction to the Brighton and Hove Flood Risk Area

Using the Flood Map for Surface Water and the Environment Agency's flood risk thresholds, a Flood Risk Area (FRA) was identified in Brighton and Hove. This Area coincides with Brighton and Hove City Council's unitary authority boundary and is approximately 84.5 square kilometres in size.

The topography of the area is influenced by the hills of the South Downs which constrain the area to the north, valleys which run through the city and the coastline which makes up approximately 14km of the area's southern boundary. This coastline extends from Shoreham Port in the west to Saltdean in the east. The low lying land of the coastal strip extends eastwards to Pool Valley and the Old Steine, both of which used to be influenced by the sea. From this point a cliff line rises towards the east behind Madeira Drive and runs on to Saltdean and beyond to Newhaven.

There are no watercourses within this Flood Risk Area. There is however historical evidence relating to the River Wellesbourne, a spring-fed watercourse which was reported to run below Preston Park, London Road and The Level, discharging to the sea in the vicinity of Brighton Pier. However, over time this has been combined into the city's drainage system.

The three potential sources of flooding for this area are surface water, groundwater and flooding from the sea. The areas of the city that are most at risk from surface and groundwater flooding are those bordering rural areas, where rainwater running from the South Downs meets rising groundwater. Parts of the city's western coastline are the most susceptible to flooding from the sea.

Land Use and Management

More than half of the city's land use is made up of urban development, with green spaces accounting for the rest. The area is a popular tourist resort, due to its close proximity to the South Downs National Park and its location on the south coast, giving access to the beach and promenade. The area is also home to Brighton Marina, which is the largest marina complex in Europe in addition to the historic Royal Pavilion and Brighton Pier.

Geology

The geology within the area is largely dominated by the South Downs Chalk, with southern areas of the city (adjacent to the sea) having variable superficial deposits consisting of sand, silty clay, local gravel pockets, chalks or flints. The highly permeable nature of this chalk bedrock means it acts as an aquifer, providing the city with its main water supply. However, its permeable nature also significantly contributes to flood risk when groundwater rises.

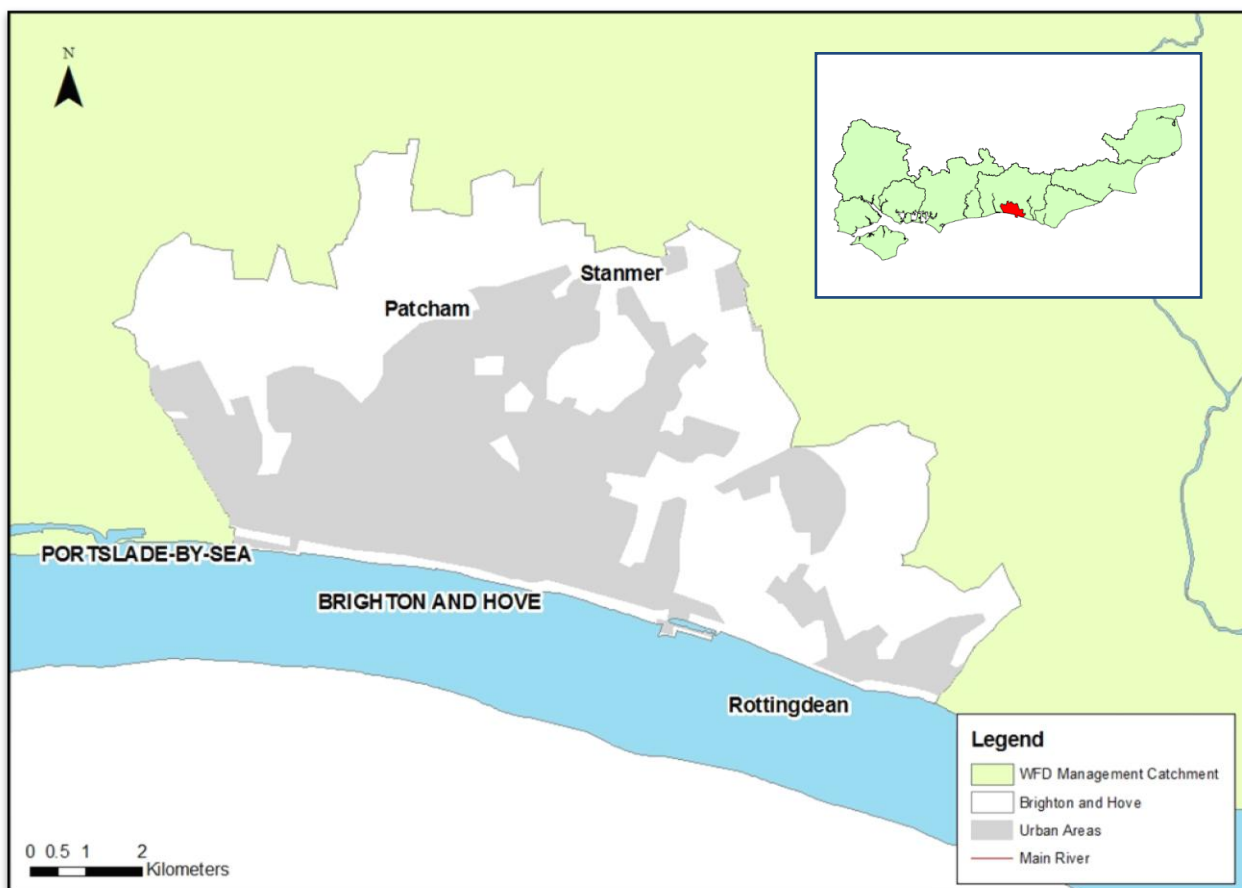


Figure 2: Overview Map of the Brighton and Hove Flood Risk Area

National and International Designations

Brighton to Newhaven Cliffs Site of Special Scientific Interest (SSSI) is located within the city boundary. This coastal site comprises the length of chalk cliffs stretching from Brighton to Newhaven and includes the wave cut platform at the cliff base. Although the main interest of the site is geological, some rare plants grow on the cliff face. Castle Hill SSSI and National Nature Reserve (NNR) is also located in the north east of the area and is listed for its biological importance due to its chalk grassland habitat which supports a variety of flora and fauna. Both of these designated areas cross over Brighton and Hove's administrative boundary into East Sussex.

Brighton and Hove are also now part of an international family of 'Biosphere Reserves' spanning over one hundred countries, which are recognised by the United Nations body UNESCO as international sites of excellence of how to meet the needs of the population and improve the environment.

Brighton and Hove is officially the world's first designated One Planet Living city. Brighton and Hove City Council's Sustainability Action Plan received independent accreditation from BioRegional for its plans to enable residents to live well within a fairer share of the earth's resources.

Partnership Working

The Brighton and Hove Flood Risk Management Partnership is actively working to identify and address flood risk issues within the Flood Risk Area. This group is chaired by Brighton and Hove City Council and includes the Environment Agency and Southern Water Services (who is both the water and sewerage provider in this area). Brighton and Hove City Council and the Environment Agency are working alongside Southern Water Services to share information and resources to achieve the best possible outcomes for the city.

Brighton and Hove City Council together with the Environment Agency also work closely with the Southern Regional Flood and Coastal Committee.

Linking with the South East River Basin Management Plan

The Brighton Chalk Block is a groundwater body located within the Brighton and Hove Flood Risk Area and is designated as a Drinking Water Protected Area (DWPA). Although it was at good chemical status in 2009, rising trends of nitrate means that the Brighton Chalk Block is now at poor status. Quantitative status also remains poor.

Current analysis suggests that the Brighton Chalk Block catchment should have a long term objective of achieving good status. Groundwater recovery time means that positive benefits of actions may take tens of years to achieve.

Based on catchment knowledge and understanding there is medium confidence that the Brighton Chalk catchment will see an improvement towards the proposed long term objectives by 2021; however the scale of changes required is large. There are 11 Safeguard Zones designated in the Brighton Chalk and it is hoped some progress can be made in specific Safeguard Zones due to the Brighton Catchment Management (CHAMP) Partnership and Water Company Catchment Schemes, but not all measures can be in place by 2021. Groundwater recovery time means that status change will take even longer to achieve.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Brighton and Hove Flood Risk Area are described in the table and figures below.

Flood risk from the Sea

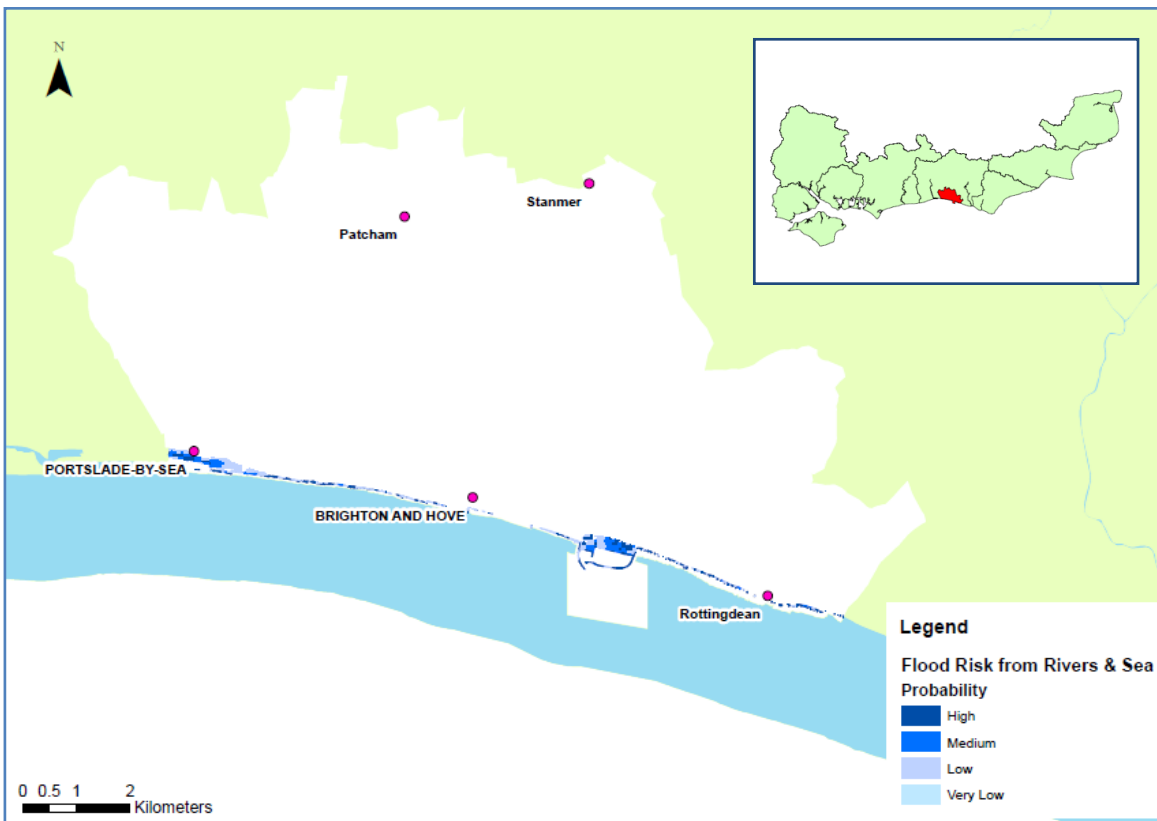


Figure 3: National Flood Risk Assessment (NaFRA) in the Brighton and Hove FRA

Table 1: Summary flood risk from the sea to people, economic activity and the natural and historic environment across the Brighton and Hove Flood Risk Area

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	283,700	550	1,100	350	0
Number of services:	240	0	0	0	0
Risk to economic activity:					
Number of non-residential properties:	12,300	<50	50	150	0
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	40	0	0	0	0
Length of railway (km):	20	0	0	0	0
Agricultural land (ha):	1,150	0	0	0	0
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	2	2	0	0	0
Number of EPR installations within 50m:	0	0	0	0	0
Area of SAC within area (ha):	0	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):	<50	0	0	0	0
Area of Parks and Gardens within area (ha):	300	0	0	0	0
Area of Scheduled Ancient Monument within area (ha):	50	0	0	0	0
Number of Listed Buildings within area:	1,140	<10	<10	<10	0
Number of Licensed water abstractions within the area:	20	0	0	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Coastal Flood Risk and Erosion

The Brighton and Hove seafront is protected from sea flooding and coastal erosion by formal defences consisting of shingle beaches, groynes and sea walls. The city's beaches are divided in character at Black Rock, where the Marina now lies. To the west are large shingle beaches controlled by a 'field' of concrete and timber groynes which have developed over the decades. The shingle that forms the beaches drifts along the coast from the west to east by a process known as longshore drift.

To the east of Black Rock and the Marina a chalk cliff line runs all the way to the River Ouse at Newhaven. The foot of the cliffs is now protected by a seawall and Undercliff Walk through to Rottingdean. There is much less shingle in this section, with the beaches at the Marina, Ovingdean, Rottingdean and Saltdean only maintained by the large groynes which prevent the shingle from moving away. The beaches at Rottingdean and Saltdean were artificially created by the importation of shingle.

The extent of tidal flooding from storms is limited to damage caused by wave overtopping of the beach and is most severe during storms with large waves. In some areas shingle is thrown onto the promenade but the seawater drains back onto the beach. Flooding as a result of overtopping has caused damage to the businesses housed in the arches under the Kings Road. At two areas along the open coast the existing standard of defence is very low; at Aldrington, where damage to the houses on the beach crest can occur during a 1 in 1 year storm event, and Basin Road South, where significant volumes of water can overtop the defences.

The city's coastal defences are regularly inspected and maintenance work is carried out by the council's contractors. The development of defences to keep on top of overall deterioration and the effects of the changing climate are dealt with through shoreline management plans and strategic studies.

Flood risk from Surface Water

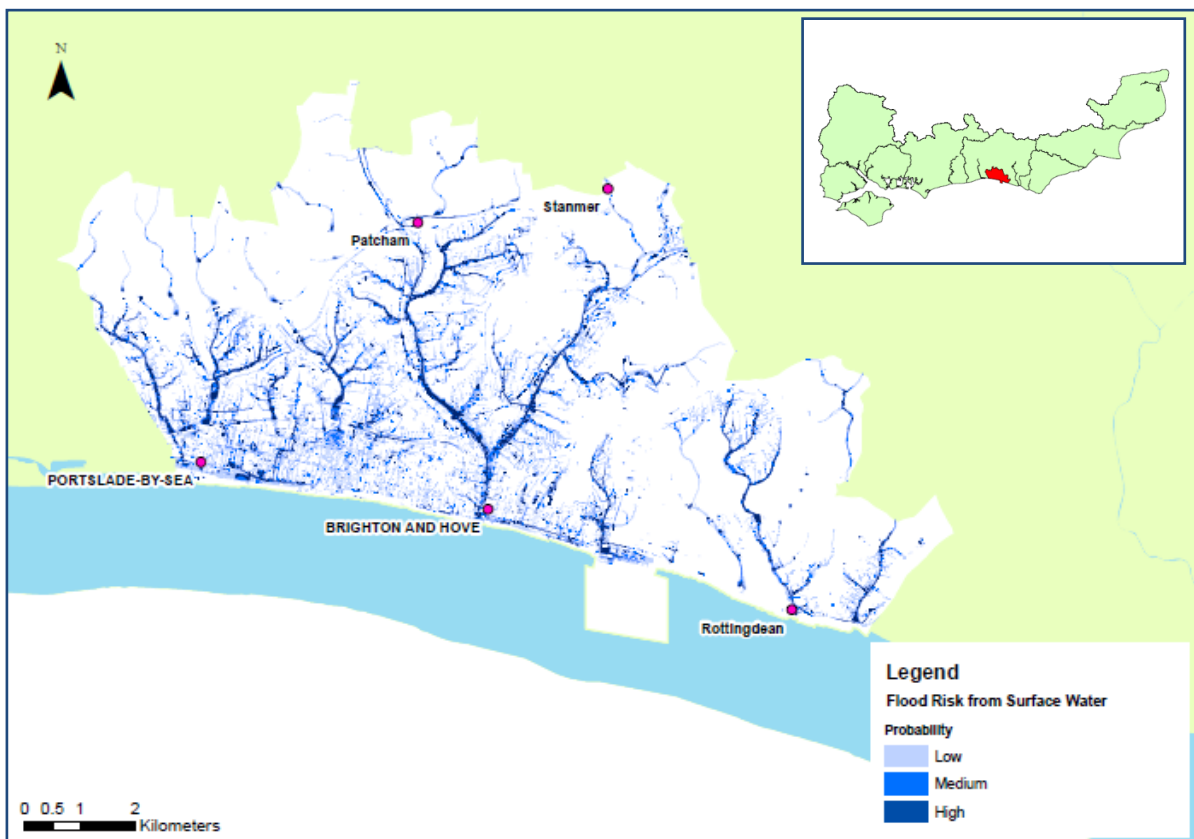


Figure 4: Surface Water Flood Map in the Brighton and Hove Flood Risk Area

Table 2 Summary flood risk from surface water to people, economic activity and the natural and historic environment across the Brighton and Hove Flood Risk Area

Surface Water	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	283,700	3,900	9,000	30,500	0
Number of services:	240	<10	<10	30	0
Risk to economic activity:					
Number of non-residential properties:	12,300	300	500	1,700	0
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	40	<10	<10	<10	0
Length of railway (km):	20	<10	<10	<10	0
Agricultural land (ha):	1,150	<50	<50	50	0
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	2	1	0	0	0
Number of EPR installations within 50m:	0	0	0	0	0
Area of SAC within area (ha):	0	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):	<50	0	0	0	0
Area of Parks and Gardens within area (ha):	300	<50	<50	<50	0
Area of Scheduled Ancient Monument within area (ha):	50	0	0	<50	0
Number of Listed Buildings within area:	1,140	20	20	70	0
Number of Licensed water abstractions within the area:	18	0	0	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Surface Water Flood Risk

Surface water is one of the main sources of flood risk in Brighton and Hove. Surface water flooding happens when rainwater does not drain away through the normal drainage systems or soak into the ground, but lies on or flows over the ground instead. It is of particular concern in urban areas of the city where there is a high proportion of impermeable surfaces, which limit the amount of infiltration that can take place. Surface water flooding can be most severe following heavy rainfall.

The city has suffered from surface water flooding on a number of occasions. The last significant event occurred on the 28 July 2014, where a month's worth of rain fell on the city in less than two hours.

These events are sometimes referred to as 'muddy floods' - surface water runs off the South Downs carrying with it soil and 'muddy' debris. Between September and December 2000, run-off from agricultural land resulted in the 'muddy flooding' of suburbs of Brighton including Bevendean, areas around Woodingdean and Ovingdean. Rottingdean has also suffered from historic 'muddy flooding'.

Sewer flooding can occur when the sewer system becomes overloaded with water and is most likely to happen following storms or if there is a blockage. With heavy rainfall, the system can become surcharged, meaning sewage is unable to drain away but instead emerges at the surface. The capacity of the sewer infrastructure can also be reduced when rising groundwater permeates into the network.

Groundwater Flood Risk

Groundwater is another main source of flood risk in Brighton and Hove, due to the underlying chalk bedrock. Flooding from groundwater can happen when the level of water within the chalk (known as the water table) rises. When this rising groundwater meets the surface, water can start to flow over land. Low-lying land and basement properties are particularly susceptible to this type of flooding.

Brighton and Hove has suffered flooding from high groundwater levels in the past, with records of flooding in the Patcham area dating back to 1877. The most notable and largest events in recent years occurred in 2000 to 2001. The most recent event occurred in February 2014. Places within the Flood Risk Area known to be affected are Patcham and parts of Mill Road south of the A27, the Lewes Road area of Moulescomb and Portslade. The A23 has been recorded as being closed for several days due to groundwater flooding. The Brighton to London rail line has also been adversely affected in the past.

Forecasting the amount and exact location of groundwater flooding is difficult as it is dependent on the amount of rainfall that has already fallen in the area and how wet the ground already is. The complex nature of the chalk bedrock also means it is hard to predict where springs may emerge. Groundwater levels in the chalk are also partly modified by abstraction for public water supply. There is a groundwater Flood Alert Area for Patcham. The Environment Agency work closely with Brighton and Hove City Council and local residents of Patcham in the monitoring of groundwater levels in various locations. When certain thresholds are reached the Environment Agency issues alerts to the community at risk.

Further information on surface water and groundwater flood risk in Brighton and Hove can be found in Brighton and Hove City Council's Local Flood Risk Management Strategy at <http://www.brighton-hove.gov.uk/content/environment/coast-defence-and-flood-management/flood-and-drainage-policies>

Reservoir Flood Risk

There are no reservoirs in Brighton and Hove that meet the requirements of the Reservoirs Act 1975, which are reservoirs that hold at least 25,000 cubic metres of water above ground level.

Conclusions and objectives for the Brighton and Hove Flood Risk Area

The Flood Risk Area of Brighton and Hove is within Brighton and Hove City Council's administrative boundary. It is constrained geographically by the South Downs to the north and the English Channel to the south. There are no watercourses in this Flood Risk Area. The three main sources of flood risk are surface water, groundwater and flooding from the sea.

There are approximately 11,000 properties at risk from surface water flooding in the Flood Risk Area. It is most severe following heavy rainfall, with the most recent event of note in July 2014, when many properties were affected. Some events are referred to as 'muddy floods' if heavy rainfall causes water to run off the South Downs.

The flood risk from groundwater is due to the nature of the underlying chalk bedrock. Rising groundwater levels are a particular concern for low-lying areas and basement properties. When levels reach the surface, water can also flow overland posing additional risks. Complex fractures in the bedrock mean it is also difficult to predict where springs may emerge on the surface. Areas of the city that are particularly susceptible to groundwater flooding are Patcham, the Lewes Road area of Moulescomb and Portslade.

Coastal flooding and erosion also pose risks to the southern parts of the city. The defences along the coast consist largely of shingle beaches, groynes and seawalls. Wave overtopping of the shingle beaches is the main cause of sea flooding along the open coast, and is of particular concern during storms with large waves. Areas to the west of the city are particularly vulnerable and include Western Esplanade and Basin Road. The beach alignment at Kings Esplanade has resulted in a promontory at this section of the frontage with a narrow steep beach which is also susceptible to wave overtopping.

Large parts of Brighton Marina are built on areas of reclaimed land. Two breakwaters surround the complex offering protection from large waves, however, high tide levels coupled with storm surges can lead to some lower areas within the marina being at risk of flooding. Much of the existing development has been built to mitigate against this, but with the threat of rising sea levels in the future, careful management of this risk will be needed. Aspects of this are being considered in the Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy.

Brighton and Hove City Council, along with the Environment Agency and Southern Water Services are actively looking at ways to reduce the risks and impacts associated with all sources of flooding that may affect the area. The climate is changing and this is likely to have an impact on flooding. Sea levels are rising and rainfall events may become more frequent and intense, increasing flood risk in the Brighton and Hove Flood Risk Area. Important measures in managing flood risk now and in the future include: building new defences, sustainable drainage as part of new developments, good land use planning and rural land management.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to coastal management.
3. Promote the consideration of environmental benefits to people (ecosystem services) as part of work to manage flood risk.
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads

Environmental

8. Work with coastal processes to conserve and enhance natural sediment systems and physical features (coastal morphology).
9. Promote sustainable soil and land use management across the catchment
10. Support climate change adaptation by making space for water, both inland and at the coast.

Measures to manage flood risk across the Brighton and Hove Flood Risk Area

In the Brighton and Hove Flood Risk Area there are 9 measures to manage risk from 2015 to 2021. The Environment Agency and Brighton and Hove City Council measures in this Flood Risk Area are all statutory measures. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing Risk:

- Strategic Assessment of Groundwater Flooding and Awareness in Brighton and Hove - to investigate the recurring events and assess options to reduce the risk of flooding from groundwater. It also includes a programme for public communication and education on flood risk matters to identify measures and steps that the public can take to help themselves to increase their flood resilience.
- Complete Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy – this long term strategic assessment of flood and coastal erosion risk across the Brighton frontage will provide the business case and implementation plan for the management of the Brighton Marina to River Adur coastal frontage and Shoreham Lock Section. This report examines the problem, identifies strategic objectives and identifies and appraises options to manage the shoreline.
- Complete Newhaven to Brighton Marina Flood and Coastal Erosion Risk Management Strategy - this long term strategic assessment of flood and coastal erosion risk across the frontages of Brighton and Lewes will provide the business case and implementation plan for the management of the coast between Brighton Marina to Newhaven coastal. This report examines the problem, identifies strategic objectives and identifies and appraises options to manage the shoreline.

Preparing for risk:

- Maintain and improve flood warnings in the Brighton and Hove Area - Where appropriate, maintain and improve current flood warning services for the local communities in Brighton and Hove
- Maintain Multi Agency Flood Plan (MAFP) for Brighton and Hove City Council - Brighton and Hove City Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken. Local Resilience Forum will continue to develop business continuity, emergency and evacuation plans, and review local essential services protection, to inform the MAFP.

Protecting from risk:

- Bevendean Surface Water Scheme - Implementation of a number of highway improvements to protect residential properties in the area. This may include: increasing the kerb height adjacent to the properties, installing raised tables to direct flows, increasing verge heights as well as vehicle crossovers and the construction of an embankment between the playing fields and Bevendean Primary School.
- Patcham Flood Alleviation Scheme - Construct an embankment and basin to the south of the recreation ground adjacent to Patcham Place in order to restrict flow into the Old London Road. Implement property level protection for properties at risk along the Old London Road
- Carden Avenue/ Warmdene Road Surface Water Scheme – Highway alterations at the junction of Carden Avenue and Warmdene Road in addition to the construction of a bypass pipe from the low spot on Warmdene Road into the playing fields at Patcham High School
- Works from Brighton Marina to River Adur Flood and Coastal Erosion Risk Management Strategy – Implement the recommended preferred options from the strategy to reduce flood and coastal erosion risk to the frontage.

Recovery and review of risk: there are no measures by the risk management authorities contributing to this FRMP over and above existing flood risk work.








The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3 Conclusions, objectives and measures to manage flood risk in South East river basin district catchments

The following sections consider the main flood risks and the measures to manage them for each of the following catchments in the South East river basin district:

- ▶ New Forest
- ▶ Isle of Wight
- ▶ Test and Itchen
- ▶ East Hampshire
- ▶ Arun and Western Streams
- ▶ Adur and Ouse
- ▶ Cuckmere and Pevensey Levels
- ▶ Rother and Romney
- ▶ Stour

Table 3: Lead local flood authorities in the South East river basin district

LLFA	Relevant management catchment	Link to further information
 Hampshire County Council	<ul style="list-style-type: none"> • New Forest • Test and Itchen • East Hampshire • Arun and Western Streams 	Hampshire LFRMS
 ISLE of WIGHT COUNCIL	<ul style="list-style-type: none"> • Isle of Wight 	Isle of Wight Council website
 SOUTHAMPTON CITY COUNCIL	<ul style="list-style-type: none"> • Test and Itchen 	Southampton LFRMS
 Portsmouth CITY COUNCIL	<ul style="list-style-type: none"> • East Hampshire 	Portsmouth LFRMS
 west sussex county council	<ul style="list-style-type: none"> • Arun and Western Streams • Adur and Ouse 	West Sussex LFRMS
 East Sussex County Council	<ul style="list-style-type: none"> • Adur and Ouse • Cuckmere and Pevensey Levels 	East Sussex LFRMS
 Kent County Council kent.gov.uk	<ul style="list-style-type: none"> • Rother and Romney • Stour 	Kent LFMRS

3.1 The New Forest catchment

Introduction to the catchment

The New Forest catchment is the most westerly catchment within the South East river basin district. The majority of the catchment lies within the boundaries of New Forest District Council, and nearly all of the catchment is covered by the New Forest National Park. The area is environmentally rich, with protected areas covering around half of the catchment, including 2 Ramsar Sites and Special Protection Areas (SPA), 3 Special Areas of Conservation (SAC) and 14 Sites of Special Scientific Interest (SSSI). Many of these sites support important wetland habitats and species sensitive to changes in water levels and flow.

The New Forest watercourses drain into either the Solent or Southampton Water. The two largest watercourses are the Lymington River and the Beaulieu River, which both flow through largely forested areas. Other watercourses of note include Avon Water, the Bartley Water and the relatively urbanised Danes Stream. Due to the geology and overlying soils, the catchments of the New Forest are considered relatively impermeable, which generally leads to a quick response to rainfall and large fluctuations in river flows.

Many areas of the catchments, particularly in rural areas can flood regularly but without significant risk to life or property. There are however a number of towns within the catchment which are at risk of fluvial flooding notably Brockenhurst, Lymington, Totton and Milford on Sea. Upstream of Milford on Sea, flows in the Danes Stream can be managed and controlled by the Milford Dam. This Environment Agency structure creates an impoundment in an existing valley, helping to protect the town from this source of flooding.

The majority of the settlements are located along rivers or near the sea meaning that most are generally at risk of flooding. In some of the low lying towns such as Lymington the interactions between rivers, sea and surface water from heavy rainfall means the mechanisms of flooding are often complex and interlinked. As with most catchments, development pressure can pose a problem when managing flood risk, each local planning authority therefore (which included the National Park authority) has a strategic flood risk assessment setting out how best to consider flood risk in conjunction with spatial planning.

The coastline of the New Forest is diverse, ranging from sheltered harbours to low cliffs and shingle beaches. This includes internationally important saltmarsh habitats around Keyhaven and Pennington which are a sanctuary for birdlife. Areas such as these are vulnerable to the impacts of sea level rise in the future. Much of the coast is protected from large waves due to the presence of the Isle of Wight, however more exposed frontages like Milford on Sea are vulnerable to storms, as was evident in February 2014 when properties were affected by flooding and storm damage.

Land Use and Management

The New Forest is a mosaic of ancient and ornamental woodland, open heathland and historic villages. Lowland heath once covered much of southern England but the New Forest National Park is now the largest area that remains. There is a mixture of improved grasslands and patches of arable farming as well as areas of set-aside grasslands along parts of the river valleys. The majority of agricultural land is classified as grades 3, 4 and 5 with mostly pasture and some wooded areas towards the National Park.

The New Forest was created due to the deforestation that occurred during the Bronze Age. It is characterised by low shrubbery and the beautiful varied colours of heather when in bloom. In 1079 the New Forest was designated as a 'royal forest', or 'Crown Lands', with the granting of 'common rights' as recompense to those who lived and worked in the forest. Since then the management of the land has been through many changes (summarised well in the New Forest Wetland Management Plan, 2006-2016). In 1924 the management of the Crown Lands passed to the Forestry Commission. This land comprises a total of 26,756 hectares of land, of which approximately 8,500 hectares is woodland in enclosures and over 3,692 hectares is Ancient and Ornamental woodland.

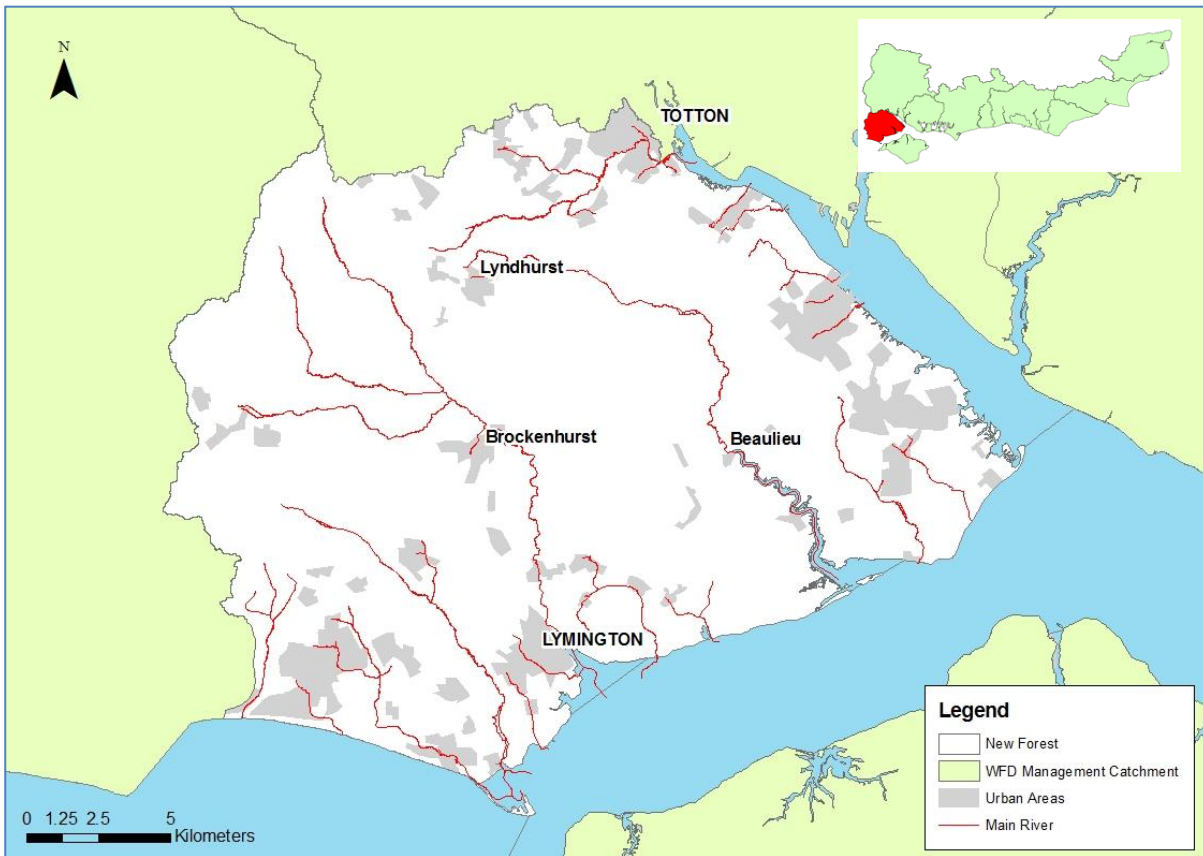


Figure 5: Overview map of the New Forest catchment

Geology

The central area of the New Forest extends across a slightly elevated plateau, sloping gently from north to south towards the Solent coast.

Rivers and streams cutting through the plateau have formed gently sloping valleys between low flat-topped hills and created much of the rolling landscape towards the centre of the Forest. Towards the north the valleys are deeper, whilst near the coast the land is flatter and more open. The whole area is contained within a downfold of the surrounding chalk, forming part of the Hampshire Basin.

Gravel, sand and clay predominate, dating from the time when the entire New Forest area was a shallow sea or large river estuary. On the surface, the New Forest National Park is a mixture of poor soils in flat, gravelly areas, richer clay and loam that is well-drained and water-logged, marshy bogs or mires. The bed of clay a metre or less below the surface is a hard, impervious layer and creates the saturated, spongy earth that is characteristic of large parts of the National Park. Forest soils are generally derived from soft clays and sands, overlain in many areas by deposits of flint, gravels and windblown brickearth.

The geology gives rise to distinctive vegetation: pine, birch, heather, gorse and grasses on the heathland; beech, oak, yew and holly in the woodland areas; and bracken, moss, cotton grass and willow on the boggy ground.

National and International Designations

The New Forest was given National Park status in 2005, making it one of the newer National Parks in England and Wales. It contains many different environments of natural beauty that are of international importance. There are 2 Special Protection Areas which include the Solent and Southampton Water as well as the New Forest itself, 2 Special Areas of Conservation which again

includes the Solent and the New Forest, 2 RAMSAR sites at Keyhaven and Pennington Marshes as well as numerous Sites of Special Scientific Interest. In addition there are numerous historic Grade I and Grade II listed buildings

Partnership Working

Within the New Forest catchment, the Environment Agency is working alongside a number of partners. The catchment is covered by New Forest District Council who maintains large parts of the coast. Hampshire County Council is the lead local flood authority operating within the catchment. The New Forest National Park Authority works in partnership with New Forest District Council and Hampshire County Council in undertaking the strategic planning policy and planning application process within the river basin district.

The Environment Agency works with Local Resilience Forum partners and Hampshire County Council to prepare and improve multi agency response to flooding throughout Hampshire, including the New Forest.

Southern Water Services is both a water and sewerage provider in this catchment and they actively participate in partnership working to identify and address flood risk issues. In addition to Southern Water Services, Portsmouth Water is also a water supplier working in the catchment.

In addition to this, there are a number of other partners who work closely with risk management authorities including: National Farmers Union, Natural England, Marine Management Organisation, and the Hampshire and Isle of Wight Wildlife Trust

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the New Forest catchment are described in the table and figures below.

Flood risk from Rivers and the Sea

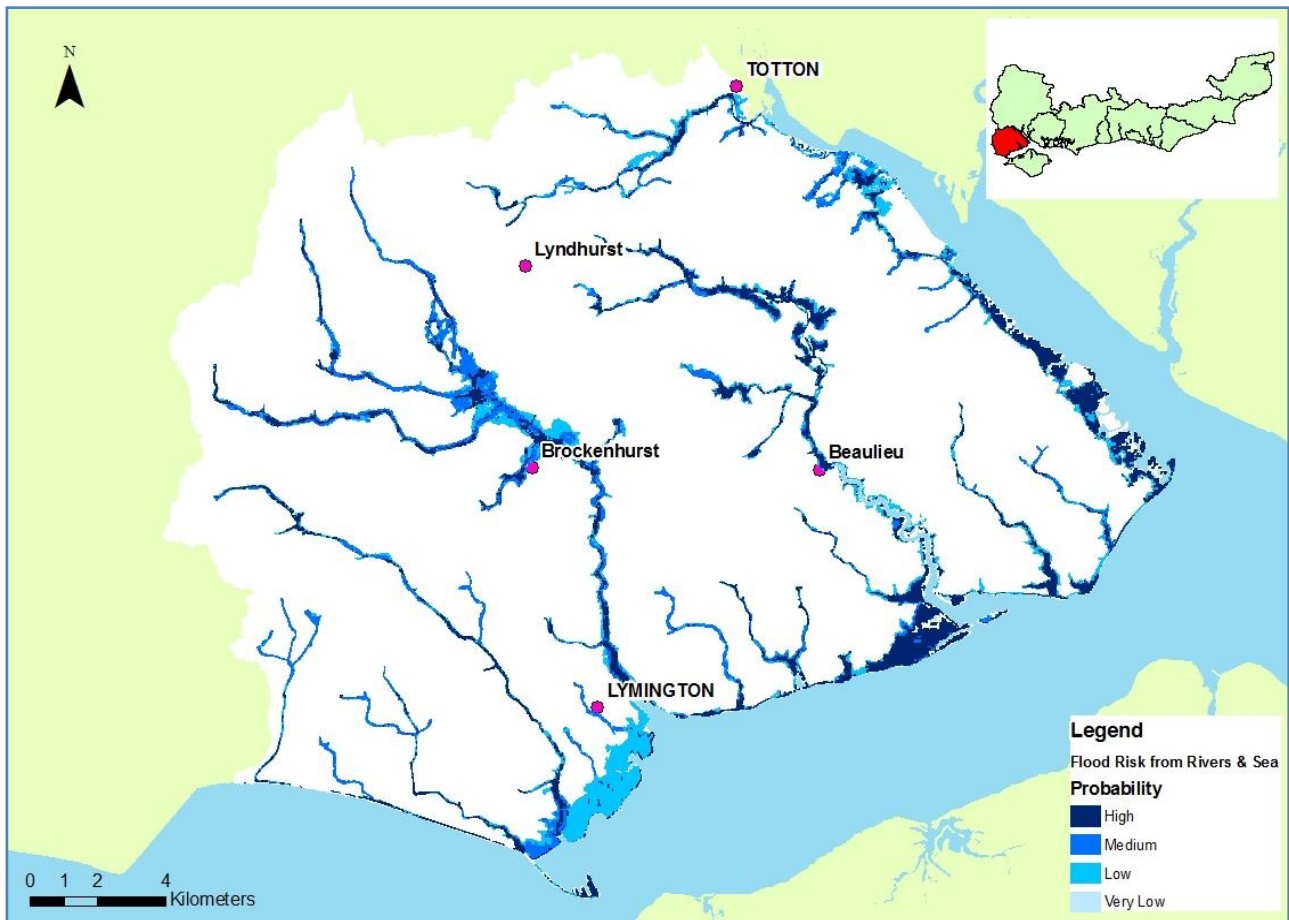


Figure 6: National Flood Risk Assessment (NaFRA) in the New Forest catchment

Table 4: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the New Forest catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	141,400	750	3,800	2,100	<50
Number of services:	240	10	10	0	0
Risk to economic activity:					
Number of non-residential properties:	19,800	450	400	550	0
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	20	0	0	0	0
Length of railway (km):	50	0	0	0	0
Agricultural land (ha):	9,250	150	150	200	0
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	17	0	1	0	0
Area of SAC within area (ha):	20,100	650	400	300	0
Area of SPA within area (ha):	20,300	1,000	450	450	0
Area of RAMSAR site within area (ha):	20,300	1,000	450	450	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	21,650	1,150	500	550	0
Area of Parks and Gardens within area (ha):	500	0	0	0	0
Area of Scheduled Ancient Monument within area (ha):	50	0	0	0	0
Number of Listed Buildings within area:	800	40	20	40	0
Number of Licensed water abstractions within the area:	70	20	10	20	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal and Coastal Flooding

Tidal effects have an important influence on fluvial flooding within the catchment area and have contributed to flooding incidents, both along Southampton Water (including Eling and Marchwood) and the Solent (including Lymington). Milford-on-Sea and Keyhaven are relatively low-lying and the effects of high tides on fluvial flooding have also been known to reach further inland, previously affecting Beaulieu. In recent history the events of February 2014, and of winter 2000 to 2001 were caused by a combination of a tidal surge and prolonged rainfall. In Lymington, the tidal gates are closed during significant high tides to protect people and property in the town.

With significant urban concentration along the coast, the issue of 'tide-locking' of fluvial flows in these areas is an important issue to consider for the future. Along Southampton Water, from Hythe to Totton, there are many small developed watercourses that have shallow gradients and suffer from 'tide-locking'.

Coastal Erosion

Soft cliffs of sand, clay and gravel can be found along the open coast of Christchurch Bay, some protected and some still eroding naturally. The still eroding cliffs provide sediment to the beach and Hurst Spit. Additional sections of cliff can be found in the Solent, but due to the lower wave energy, cliff erosion is less of an issue than on the open coast.

Fluvial flooding

The flooding regime of rivers in this catchment is characterised by relatively rapid run-off from short to medium duration rainfall events, usually in the aftermath of wet winter conditions but occasionally after intense summer storms. At some urban locations within the catchment, such as at Brockenhurst, Totton and Beaulieu, channel capacity deficiencies and restrictions at key structures exert a significant influence on the extent of flooding. In many cases, with several towns located at the mouths of rivers, the interaction of a severe tide condition with peak river flows can have a very significant effect.

Due to the geology and overlying soils, the catchments of the New Forest are considered relatively impermeable, which generally leads to a quick response to rainfall and large fluctuations in river flows. The Danes Stream is the watercourse that responds most quickly to rainfall. Due to the tertiary geology and structure of overlying soils, the catchments of the New Forest in general can be considered as relatively impermeable. This leads to rapid rainfall run-off and large fluctuations in river flows

Many areas of the catchments, particularly rural parts of the main river valleys, may flood regularly but without significant risk to life or property. There are however, a number of towns where flood risk from rivers is concentrated, for example Brockenhurst, Lymington, and Totton.

There is fluvial flood risk in Rushington, Ashurst Bridge, Marchwood and Totton which will worsen over time due to rising tide levels. Flooding from rivers is already a significant concern within parts of the catchment area. Studies have shown it could increase significantly in the future, mainly as a result of climate change through a combination of sea level rise, more intense rainfall and wetter winters.

In general, the river catchments are not particularly steep and there could be opportunities for increased flood plain storage along much of the rivers, especially where the rivers have been straightened in the past. Some river restoration works which increase meanders and flood plain storage have been implemented in the New Forest streams catchments, such as the LIFE 3 project. These provide environmental benefit, for example, improving existing wetlands improvement or wetland creation, as well as reducing downstream flood risk.

Within the catchment the Environment Agency manages a network of water level and flow gauges on main rivers. These systems enable real-time data from rivers to be collected and in conjunction with rainfall data can help predict the response of a given river. This helps inform the Environment Agency's flood warning service.

Flood defences have been constructed in Lymington, Milford on Sea and Brockenhurst. Sections of the Bartley Water have also had some channel improvements or flood embankments constructed, particularly in the lower reaches of the watercourse.

Communities within the New Forest catchment have experienced an increase in both severity and frequency of existing flooding problems and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue.

Surface Water flooding

Surface water flooding is a risk in urban areas across the catchment, with the greatest risk occurring in towns such as New Milton, Totton, Hythe and Marchwood. Ponding in low spots interacting with watercourses and surface water networks can lead to flooding when the system “backs up”, particularly if it occurs in areas which suffer from tide locking.

Surface water flooding can also occur when sewer systems receive more rainwater than they are design to handle and this can cause surcharging. Flooding from surface water is often quite localised and is much more difficult to predict than river or coastal flooding. This means there is often limited advanced notice of this type of flooding. With climate change predicting more frequent high intensity rainfall, surface water flooding may happen more often in the future.

Information on surface water and groundwater in the New Forest Catchment can be found in Hampshire County Council’s Local Flood Risk Management Strategy at <http://www3.hants.gov.uk/flooding/floodriskstrategy.htm>

Groundwater flooding

The New Forest catchment can be considered to be relatively impermeable. There is little baseflow to most of the river systems within the catchment from minor aquifers in the sands and gravel. Flooding caused by groundwater is therefore considered to be a minor issue for the New Forest catchment.

Flood risk from Reservoirs

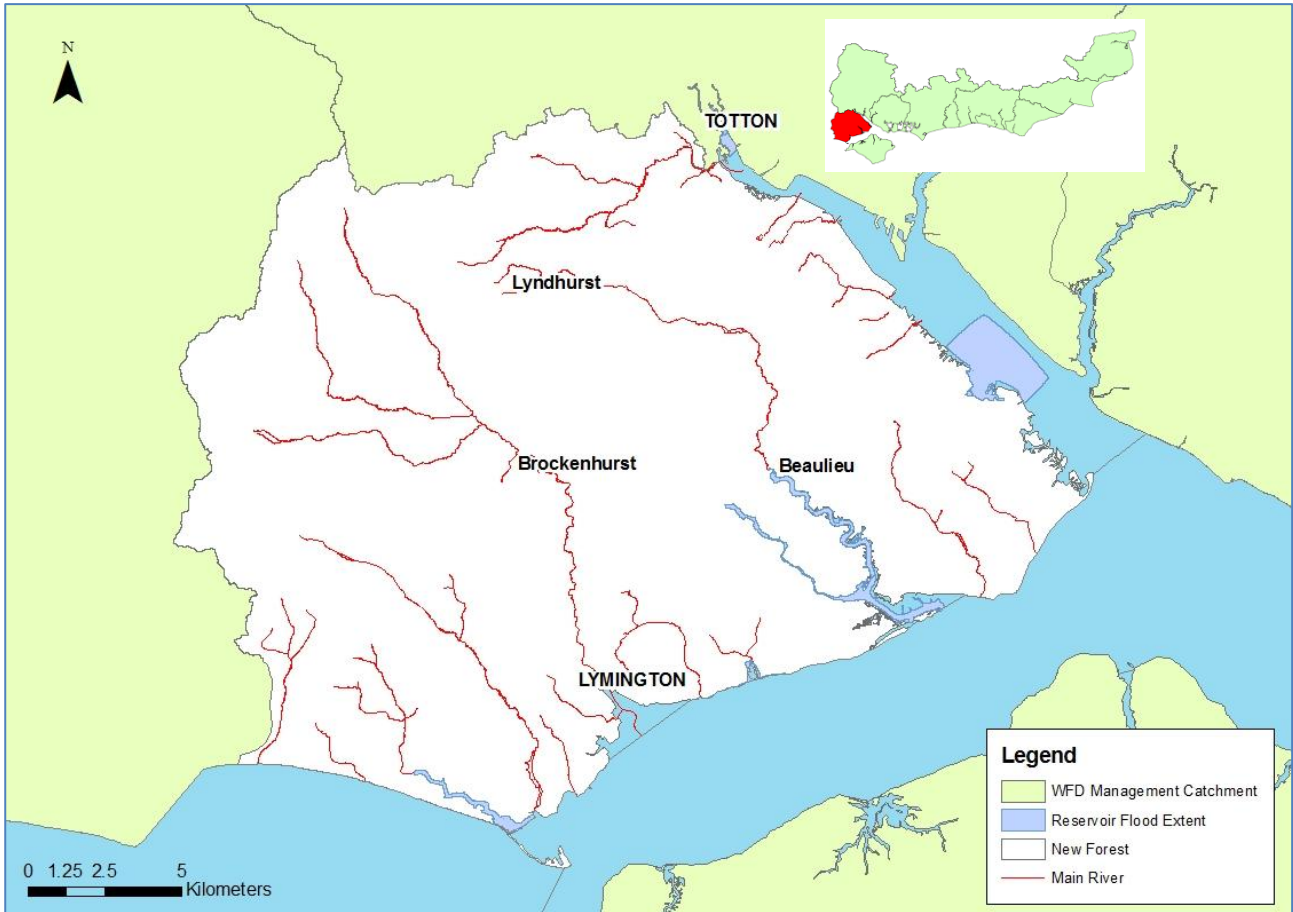


Figure 7: Flood risk from Reservoirs in the New Forest catchment

Reservoir Flooding

Reservoirs can hold large volumes of water above ground level, contained by embankments and dams. Although the safety record for reservoirs is excellent, it is still possible that an embankment or dam could fail which would result in a large volume of water being released very quickly. It may also be the case that a reservoir could overflow and cause a surface water flood risk.

The Environment Agency is responsible for overseeing the safety of reservoirs registered under the Reservoirs Act 1975, which are reservoirs that hold at least 25,000 cubic metres of water above ground level.

Within the New Forest catchment there are several reservoirs that meet the registration criteria, including Blashford Lakes, Milford Dam and Beaulieu Mill Dam.

Table 5: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the New Forest Catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	141,400	650
Number of services:	240	0
Risk to economic activity:		
Number of non-residential properties:	19,800	200
Number of airports:	0	0
Length of trunk roads (km):	20	0
Length of railway (km):	50	<10
Agricultural land (ha):	9,250	100
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	17	0
Area of SAC within area (ha):	20,100	50
Area of SPA within area (ha):	20,300	100
Area of RAMSAR site within area (ha):	20,300	100
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	21,650	100
Area of Parks and Gardens within area (ha):	500	0
Area of Scheduled Ancient Monument within area (ha):	50	0
Number of Listed Buildings within area:	800	20
Number of Licensed water abstractions within the area:	70	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; aquatic weed cutting in main river and tributaries, inspection,

maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the New Forest catchment

Recently completed schemes include major flood defence works in the form of flood gates installed at Lymington. The town of Lymington has a history of flooding with significant fluvial events recorded in 1959, 1989 and 1999. The existing railway embankment performs the role of a low flood barrier because of its location and height. In 2007 a raised defence of steel sheet pile was constructed along the railway, raising the existing standard of protection from defending against a 14% annual probability flood (1 in 7 year) to defending against a 0.5% annual probability flood (1 in 200 year).

There have been 2 flood defence schemes completed at Milford-on-Sea. In 1998 a flood storage reservoir was constructed upstream of the town and 20 years ago, a section of the river bank through the town was strengthened by a steel sheet piled wall. Prior to the completion of the flood alleviation scheme, approximately 30 properties experienced regular internal flooding.

The last major floods in Brokenhurst were in 1960s and 1990 which affected 100 and 23 properties respectively. There have been no further reported incidents of flooding in Brockenhurst since the construction of a flood relief scheme in 1993, where the channel capacity was increased between the access bridge to Woodstock House and Butts Lawn Watersplash. However high water levels have been observed on several occasions.

Tidal flaps have been installed at Keyhaven and sea doors in Bridge Road at the upper end of Lymington estuary. The Lymington sea doors were replaced in 1995/96 and the Keyhaven tidal flaps preventing saline flow into Avon Water outfall were replaced in 2003 to 2004.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads
8. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

9. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
10. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
11. Promote sustainable soil and land use management across the catchment
12. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the New Forest Catchment

In the New Forest catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work across the New Forest catchment there are 16 measures to manage flood risk. Examples of these measures are provided here, and the full list of measures can be found in Part C: Appendices.

The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk:

- Hampshire Coast NaFRA Rerun - to update the Risk of Flooding from Rivers and Sea Maps following the completion of more detailed modelling in 2014.
- Lymington and Keyhaven NaFRA Rerun following the completion of the 2009 model to update the flood map to make it more accurate.

Preparing for risk:

- National Network of Strategic Regional Coastal Monitoring Programme 12/13 -16/17 Phase 1 - Development of strategic coastal monitoring programmes to inform effective and cost effective expenditure on coastal risk management.
- National Network of Strategic Regional Coastal Monitoring Programme 17/18 – 21/22 Phase 2 - Development of strategic coastal monitoring programmes to inform effective and cost effective expenditure on coastal risk management.
- Beaulieu River - new Model and NaFRA run. The New model is required to update the flood map for the Beaulieu River. The Environment Agency has a very low confidence in the existing model which is based purely on modelling. This project will also include collection of survey data required to build the model and a NaFRA rerun once the model is complete.
- Hampshire and Isle of Wight JFLOW - JFLOW reruns are required to create missing flood map along main river and realign the flood map and main river.
- Danes Stream National Flood Risk Assessment (NaFRA) Rerun, to update the Risk of Flooding from Rivers and Sea Maps following the completion of more detailed modelling in 2009.

Protecting from risk:

- Bartley (New Forest) Fluvial Flood Alleviation Scheme - At the upper reaches of the Bartley Water, the preferred option is to construct 3 balancing/flood storage ponds upstream of

Bartley village in the new forest. Provide flood storage and attenuation upstream of the village to provide a 1 in 75 yr standard of protection

- Hythe Coastal Flood Alleviation Scheme. To increase the standard of protections of the 300m length up to the 1 in 200 year standard of protection. Works are likely to consist of a clay core earth embankment with sheet piling.
- Lower Totton Tidal Flood Alleviation Scheme Investigate options for reducing flood risk as defences are old and offer too low a standard of protection. Likely to include a combination of improve, replace and new defences.

Recovery and review of risk: There are no measures from the risk management authorities contributing to this FRMP over and above existing flood risk work

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide Information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.2 The Isle of Wight catchment

Introduction to the catchment

Many of the rivers drain over relatively flat and low lying land to the sea. With the exception of the Chine's streams in the south and the southern sections of the Western Yar, rivers generally flow north before discharging into the Solent on the north coast of the island.

Causes of flooding on the Isle of Wight are diverse and influenced by a range of factors. Fluvial flooding occurs in areas where heavy or prolonged rainfall occurs on less permeable or already saturated land and leads to surface run-off entering the river systems. As the drainage is often poor in these flat areas, they can be prone to waterlogging and are susceptible to surface water flooding when drainage networks back up during high intensity rainfall events.

The permeable chalk geology in the middle of the island influences the baseflow of several of the rivers, although prolonged groundwater flooding has not been known to occur. Surface water flooding can be an issue in urban areas where the drainage capacity is restricted, and the increase of impermeable areas through development increases the run-off. Localised surface water flooding can also occur in rural areas on or adjacent to land that has low permeability.

The south coast of the island is susceptible to coastal erosion where there are steep cliffs present along this coastline. The coastal towns of Yarmouth, Gurnard, Cowes, Ryde, Bembridge, Sandown and Freshwater are all susceptible to coastal or tidal flooding.

A flood risk issue on the island is 'tide-locking' where rivers are prevented from discharging to the sea by high tides or structures designed to prevent the upstream passage of sea water such as tidal outfall flaps. The current pattern of flooding on the Isle of Wight is quite localised, however larger fluvial flood events can still occur.

The presence of underlying chalk geology has an impact on flow of the rivers on the island by increasing the baseflow from the slowly changing groundwater levels. The Lukely Brook and the Thorley Stream are predominately groundwater fed streams whilst the most rapidly responding stream is the Monktonmead Brook which has a steep urbanised lower catchment.

The largest rivers that drain the Isle of Wight catchment are:

- ▶ River Medina
- ▶ Monktonmead Brook
- ▶ Eastern Yar
- ▶ Western Yar

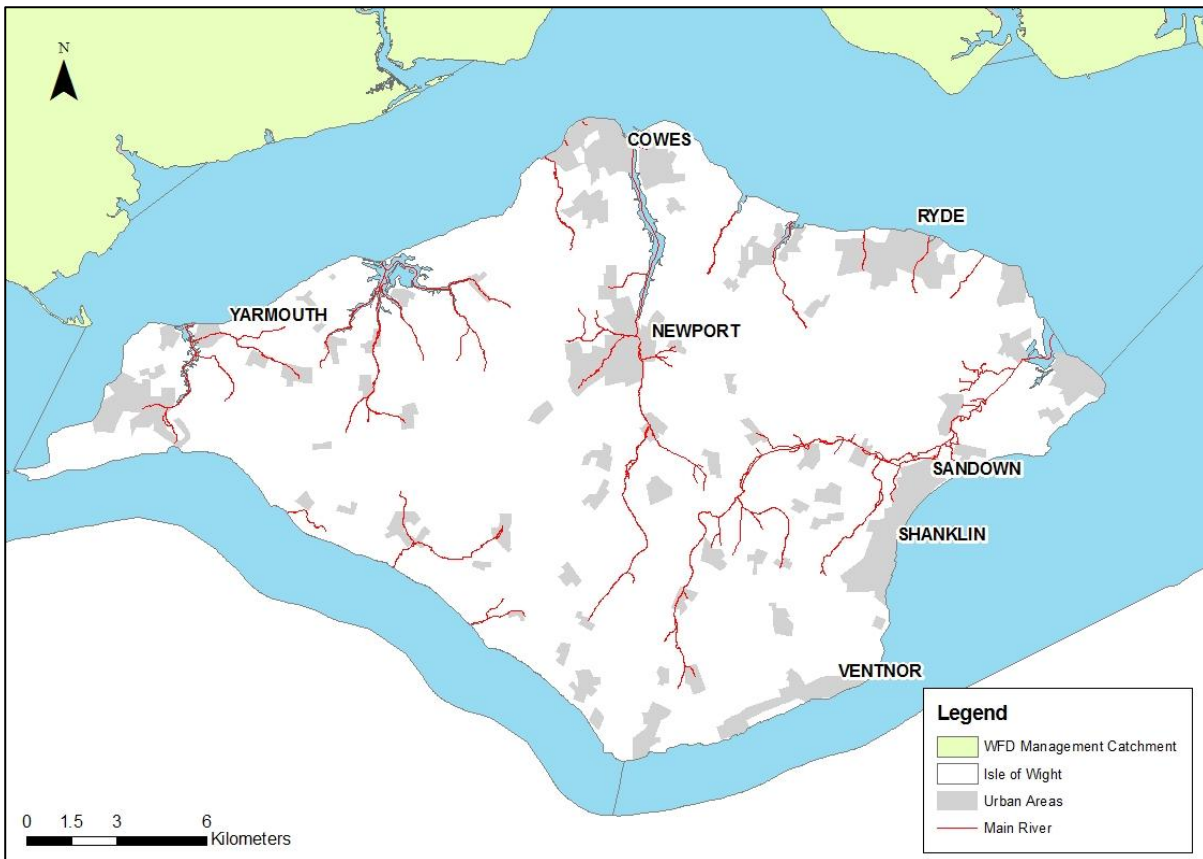


Figure 8: Overview map of the Isle of Wight catchment

Land Use and Management

The largest proportion of land use across the Isle of Wight catchment is for agricultural land (88%), with the majority of this in the central part of the catchment.

Of the agricultural land, approximately 2% is at risk of fluvial flooding. The urban land classification (8%) is concentrated in the seven large towns around the coast and one in the centre of the Isle of Wight. Approximately 0.5% of the urban land classification is at risk of fluvial flooding. The central part of the island is predominately rural, with the population generally dispersed across small towns and villages.

Given that the majority of the towns and villages are located along the coast or adjacent to rivers, they are generally at risk of flooding whether that risk is coastal, fluvial or from surface water.

The Medina, Eastern Yar and smaller rivers on the island flow north into the Solent – except for the unusual chine gullies on the south west coast. Most of the rivers have been deepened and straightened for land drainage to accommodate the railway lines, towns, or to reduce flood risk. Some rivers have become silted-up with soils washed from fields in the catchment and unstable river banks.

In some of the low lying towns such as Ryde and Cowes, the interactions between rivers, sea and surface water from heavy rainfall means the mechanisms of flooding are often complex and interlinked. In recent years there has been increased development across the catchment which has presented challenges to planning authorities and developers to ensure the risk of flooding is not increasing to new or existing communities.

Geology

The geology of the Isle of Wight can be split into 3 areas; a spine of chalk running from the Needles at the west to Whitecliff bay (south of Bembridge) to the east. There is also a smaller area of chalk along the southern coast. To the north of the chalk spine the geology consists primarily of

clays with small areas of sand and in places, layers of stone. To the south of the chalk spine, the geology consists primarily of various types of sands, most notably Upper and Lower Greensands.

National and International Designations

The Isle of Wight catchment contains a number of environmentally designated sites which present both opportunities and constraints to flood risk management.

Almost 50% of the island falls within the Isle of Wight Area of Outstanding Natural Beauty. Around half of the coastline is recognised as Tennyson and Hamstead Heritage Coasts. The island has a range of internationally, nationally and locally important nature conservation sites, including Special Areas of Conservation, Newtown National Nature Reserve, 41 Sites of Special Scientific Interest and 395 Local Wildlife Sites (Sites of Importance for Nature Conservation). These are recognised for their important habitats and species, including maritime cliff and slope, coastal and flood plain grazing marsh, lowland heathland, saline lagoons, intertidal mudflats, coastal sand dunes, intertidal flats and seagrass beds and coastal vegetated shingle. The Solent and Southampton Water is designated as a Ramsar site and as a Special Protection Area, as it supports internationally important numbers of wintering waterfowl and various rare invertebrates and plants.

Partnership Working

Within the Isle of Wight catchment, risk management authorities are working alongside a number of partners. In terms of authority, the catchment is covered solely by the Isle of Wight Council who is also the lead local flood authority and oversees the catchment. The Environment Agency work closely with the Isle of Wight Council to ensure that information and best practice is shared, as well as supporting them in their role as a lead local flood authority.

Southern Water Services is both a water and sewerage provider in this catchment. They actively participate in partnership working to identify and address flood risk issues. For example, they are currently working with the Environment Agency and Isle of Wight Council in Ryde where investigations are ongoing with a view to providing a joined up set of works to manage the risk of flooding.

The Isle of Wight Council is the planning authority and has a Strategic Flood Risk Assessment setting out how best to consider flood risk in conjunction with spatial planning.

The Flood and Water Management Act places a statutory duty on the Isle of Wight Council (as a lead local flood authority) to develop, maintain, implement and monitor a Local Flood Risk Management Strategy (LFRMS) to manage local flood risk in its area. The strategy is currently in progress, and the Environment Agency is supporting the Isle of Wight Council in its development. The purpose of a Local Flood Risk Management Strategy is to help local communities and businesses to better understand and manage flood risk on the island.

The strategy must consider local sources of flood risk, though it will include other sources of flood risk as well, specifically those from tidal and main river sources. By including all sources of flooding within the strategy, the aim is to provide a clear overview of flood risk on the island and set out a co-ordinated approach to managing these risks.

As the majority of the coastline within the Isle of Wight catchment is defended in urban areas, there is a strong emphasis on partnership working in order to provide, maintain or improve coastal protection where it has been identified as a feasible option. The Environment Agency has supported the Isle of Wight Council and will continue to do so in applying for government funding for strategies and schemes to reduce the risk of flooding and coastal erosion for future.

In addition to this, there are a number of other partners who work closely with risk management authorities including: Natural England, National Farmers Union, Marine Management Organisation, Hampshire and Isle of Wight Wildlife Trust, RSPB as well as the various flood action groups and rivers groups.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Isle of Wight catchment are described in the tables and figures below.

Flood risk from Rivers and the Sea

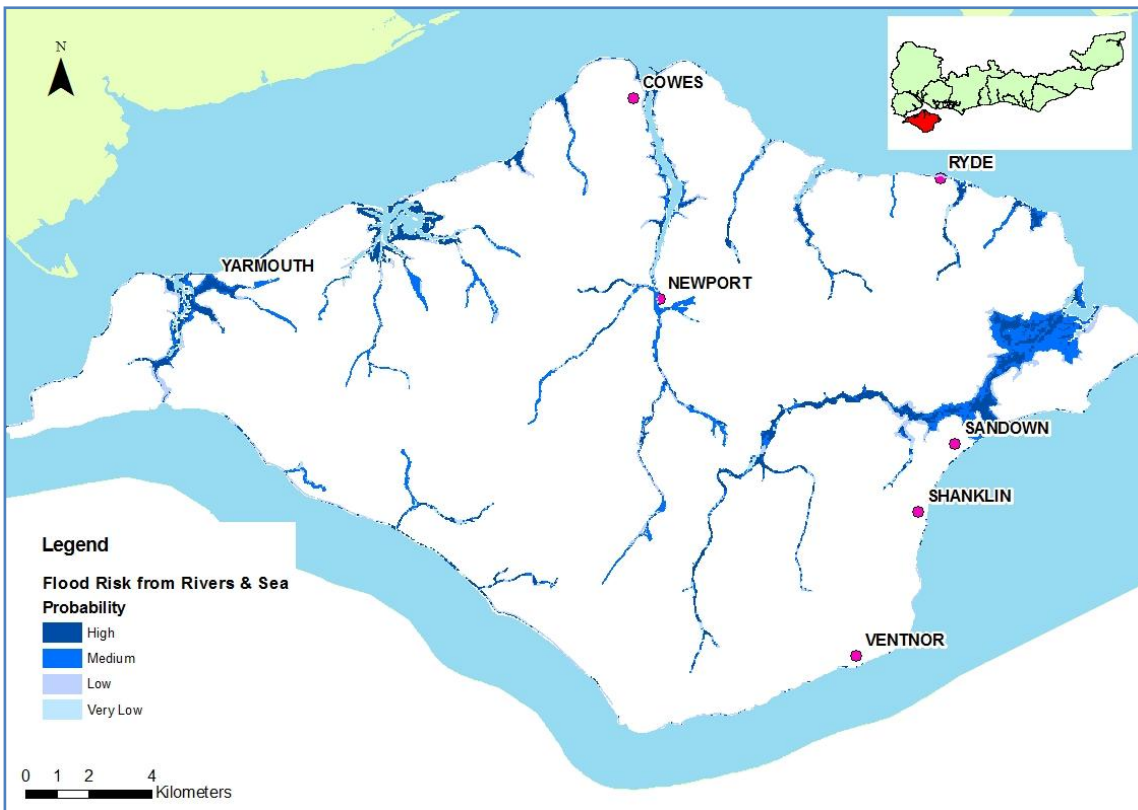


Figure 9: National Flood Risk Assessment (NaFRA) in the Isle of Wight catchment

Table 6: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Isle of Wight catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	158,300	1,950	2,400	800	300
Number of services:	340	20	10	<10	<10
Risk to economic activity:					
Number of non-residential properties:	20,700	550	650	200	50
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	0	0	0	0	0
Length of railway (km):	10	<10	<10	<10	<10
Agricultural land (ha):	22,000	250	250	100	50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	6	5	0	0	0
Number of EPR installations within 50m:	5	0	0	1	0
Area of SAC within area (ha):	1,150	200	<50	50	0
Area of SPA within area (ha):	700	300	200	<50	<50
Area of RAMSAR site within area (ha):	600	300	200	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	3,050	400	200	50	<50
Area of Parks and Gardens within area (ha):	700	<50	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	150	0	0	0	0
Number of Listed Buildings within area:	1,920	70	50	40	10
Number of Licensed water abstractions within the area:	120	30	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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal and Coastal Flooding

Flooding from the sea tends to occur as a result of high tides, surges in sea water and strong winds which raise the sea level above the ground level of the coast or the defences that protect it. Being an island, tidal flooding is a constant risk to the Isle of Wight catchment.

The south coast of the island is susceptible to coastal erosion where there are steep cliffs present. The coastal towns of Yarmouth, Gurnard, Cowes, Ryde, Bembridge, Sandown and Freshwater are all susceptible to coastal or tidal flooding.

Tidal flooding also brings challenges in respect of combined flood risks. For example, watercourses can be affected by the action of 'tide-locking'. This is where drainage outfalls discharging by gravity at the coast become blocked for a period of time by high tides and as a result, the surface water system backs up. If there is insufficient capacity within the watercourses or drainage networks, it may lead to surface flooding when it coincides with an extreme rainfall event. This is an issue which does occur on the island fairly regularly at present and with the predicted effects of sea level rise, it is likely that this form of flooding could increase in the future. This is a particular problem for the coastal towns such as Ryde, Cowes and Yarmouth.

The North East Isle of Wight Coastal Strategy Study (Shrape Breakwater at East Cowes to Culver Cliff) was completed in 2005 by the Isle of Wight Council. Coastal strategies are also planned for the West Wight (East Cowes to Freshwater Bay) and South Wight (Freshwater Bay to Culver Cliff) to be undertaken by the Isle of Wight Council. It is envisaged that these strategies will investigate the various mechanisms of flooding and coastal erosion with a view to suggesting appropriate risk management measures to reduce those risks in the future.

Coastal Erosion

Most of the coastline of the Isle of Wight is characterised by cliffs of varying lithology and varying exposure to waves and thus varying rates of erosion. Most affected is the southern coast where only short stretches have any protection. Parts of the western and south-eastern coast are susceptible to landsliding of the protected cliffs. Cliffs along the Solent coast generally erode much slower than those on the open coast.

Fluvial flooding

Fluvial flooding will occur when the watercourse is unable to contain the volume of water which is draining into it from the surrounding area.

The majority of watercourses are in the northern half of the island and discharge into the Solent. The Isle of Wight's largest river is the Eastern Yar and this discharges into the Solent at Bembridge. The history of flooding is well documented along the lower reaches of this watercourse. As the majority of rivers on the island flow in a northerly direction, the main estuarine environments are on the northern shores of the island. The exception is the Eastern Yar Estuary at Bembridge in the east.

The climate is changing and this is likely to have an impact on flooding. Sea levels are rising and rainfall events may become more frequent and intense. Changes in weather patterns and in particular, more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Communities within the Isle of Wight catchment have experienced an increase in both severity and frequency of existing flooding problems and communities that have not flooded previously have been affected in recent years. It is likely that this pattern will continue.

Surface Water flooding

Surface water flooding results from excessive rainfall being unable to enter the local drainage system, due to blockages or capacity being exceeded or because the rainfall intensity is greater than the infiltration rate of the soils leading to overland flows.

Surface water flooding is more likely in heavily urbanised catchments and in areas with low infiltration potential. Following intense rainfall events, water can flow over the surface from surrounding areas and cause localised flooding. As surface water flooding is often quite localised it

is much more difficult to predict than river or coastal flooding. This means there is often limited advanced notice of this type of flooding.

The occurrence of flooding caused by insufficient capacity of the drainage system is related to the probability of a given rainfall event over a given area. The likelihood of flooding is dependent on the condition of the surface drainage network, as well as the rates of surface water run-off generation. The likelihood of flooding may change over time; due to increases in development, changes in impermeable area, increased frequency of blockages and climate change. As a result, flooding related to surface water drainage may become more frequent in the future. Cowes, Newport, Ryde and Brading all suffer with well documented surface water flooding issues at present although it should be noted that surface water flooding can occur anywhere depending on the conditions.

Groundwater flooding

The ability of surface water to be absorbed into the ground is a function of the permeability of the soils and superficial geology deposits and of the porosity of the solid geology. Chalk and limestone are generally considered to be highly permeable and no flooding is reported to have occurred in the chalk areas, except along the spring line at the boundary between the chalk base and clay formations.

As such, groundwater flooding will generally occur in low-lying areas after prolonged periods of wet weather, when the water levels in the ground rise to a level higher to that of the ground itself. This water will then flow out of the ground in the form of a spring or a groundwater fed watercourse.

Minor incidences of localised groundwater flooding may occur on the island rather than prolonged groundwater flood events.

Flooding from reservoirs

There are currently no reservoirs on the island that meet the requirements of the Reservoirs Act 1975, which are reservoirs that hold at least 25,000 cubic metres of water above ground level. However, there are proposed changes to the Act that will bring the limit down to 10,000 cubic metres. If this is the case, this may need to be re-assessed.

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; aquatic weed cutting in main river and tributaries, inspection, maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the Isle of Wight catchment

The catchment covers a mix of urban and rural areas with different land uses, population densities and types of watercourse. The population in the Isle of Wight catchment is mainly concentrated in the coastal areas with several towns and villages located along rivers in the middle and upper areas of the catchment.

The main sources of risk on the Isle of Wight are tidal, fluvial and surface water. Flood risk for the northern coastline is predominantly tidal, with fluvial and surface water risk becoming more prominent inland. The interaction between the various flood sources can also be problematic, with rivers and surface water infrastructure becoming tide locked and backing up, causing flooding.

Fluvial flooding is predominantly experienced in the towns of Newport, and Ryde and along settlements adjacent to the Eastern Yar. Actions in the flood risk management plan for the catchment include tidal defence improvements at Bembridge and Monkton Mead, together with flood alleviation schemes in Newport on the Gunville Stream and Lukely Brook.

The Environment Agency has established a number of Flood Warning Areas within the Isle of Wight catchment. The purpose of these areas is to provide as much warning of potential flooding as possible to communities. Flood Warning Areas cover coastal communities such as Yarmouth, Gurnard, Cowes, Fishbourne, Ryde, Seaview and Bembridge, and there are fluvial warning areas on the Eastern Yar, Western Yar, Medina and Monktonmead Brook. Work is continuously underway to further improve and refine this service.

Work is being carried out with communities to increase people's awareness of the risk of flooding and the associated actions that they should take, such as promoting the maintenance of watercourses that have riparian ownership. The importance of this work for all relevant parties to improve and maintain the watercourses and various defences is demonstrated in that it reduces the likelihood of these communities experiencing flooding in the future.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Raise community awareness and understanding of all sources of flooding and coastal erosion and support community preparedness and resilience
5. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

6. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
7. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
8. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads
9. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

10. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
11. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
12. Promote sustainable soil and land use management across the catchment
13. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the Isle of Wight catchment

In the Isle of Wight catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work on the Isle of Wight there are 8 measures to manage risk. More details on the actions can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk:

- Gunville Stream (Isle of Wight) Flood Alleviation Scheme - the proposed option is to provide Property Level Protection.
- River Medina (Newport) Flood Alleviation scheme – the proposed option is to provide property level protection

Preparing for risk:

- Maintain and improve flood warnings on the Isle of Wight - Where appropriate, maintain and improve current flood warning services for the local communities on the island
- Hampshire and Isle of Wight JFLOW - JFLOW reruns are required to create missing flood map along main river and realign the flood map and main river.
- Develop Multi Agency Flood Plan for Hampshire and the Isle of Wight - Hampshire County Council, Portsmouth and Southampton and Isle of Wight work collaboratively to produce a Multi Agency Flood Plan for Hampshire and the Isle of Wight
- Isle of Wight coastal National Flood Risk Assessment (NaFRA) re-run. This will be commenced following completion of the 2014 Isle of Wight Coastal Model

Protecting from risk:

- Monktonmead Brook pumping station and outfall improvements. This will Investigate and implement option to reduce ongoing blockage of outfall.
- Lukely Brook (Isle of Wight) Flood Alleviation Scheme. The Environment Agency will investigate and implement options include flood storage, raised defences and Property Level Protection

Recovery and review of risk: There are no measures from the risk management authorities contributing to this FRMP over and above existing flood risk work

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide Information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.3 The Test and Itchen catchment

Introduction to the catchment

The catchments of the Test and Itchen rivers cover approximately 1,760 square kilometres.

The rivers are regarded as two of the finest chalk streams in the world with their crystal clear waters supporting a rich diversity of mammal, bird, fish, invertebrates and plant communities. Both main rivers are important sites of nature conservation and as such are designated as Sites of Special Scientific Interest (SSSI). The River Itchen is further designated as a Special Area of Conservation (SAC) under European legislation. They are both internationally famous for their trout and salmon fishing.

The geology in the north of the catchment is dominated by chalk. Groundwater in the chalk feeds both the River Test and River Itchen and provides the rivers with constant flows of water, though the response of river levels to rainfall is slow. The major urban locations in this area are Andover, Romsey and Winchester.

In contrast, the geology of the southern part of the catchment is dominated by clay. The river levels in these locations respond much quicker to rainfall. Major urban areas here are Eastleigh, and those concentrated along the coast, such as Southampton and its conurbation and Netley. The Test and Itchen rivers are heavily modified, with many structures and multiple or artificially braided channels along their lengths. They support a number of commercial fisheries which benefit from the high water quality. Historically, mills, navigation and water meadows have also led to alterations in the flow of watercourses.

The following streams and rivers drain the Test and Itchen catchment:

- ▶ the River Test (tributaries include Bourne Rivulet, River Anton, River Dever, Wallop Brook, River Dun, River Blackwater, Cadnam River, Tadburn Lake)
- ▶ the River Itchen (tributaries include Candover Stream, River Alre, Cheriton Stream, Bow Lake, Monk's Brook)

Land Use and Management

The upper and middle Test and Itchen catchment is predominantly rural. With the exception of Andover, Romsey and Winchester, the population is generally dispersed across small towns and villages. This comprises a varied landscape consisting of a mixture of improved grasslands and arable farming, combined with a significant patchwork of woodland areas (mostly mixed and broad-leaved) and some set-aside grasslands along parts of the river valleys. In the lower portions of the Test and Itchen catchment, the population is concentrated in large conurbations along Southampton Water, and also along the M3 - M27 (Southampton / Eastleigh) corridor.

The overall character of the Test and Itchen catchment has been significantly influenced by human intervention over several hundred years. Channels were controlled and re-routed, and additional channels, weirs and sluices were constructed, for the purpose of navigation which required seasonal regulation of river levels and flows. The braided channel networks are a legacy of milling operations and water meadow systems, both of which are redundant. There has also been a long history of growing watercress. In more recent times, fish-farming has developed. Both of these industries continue to be important economic activities. Some riparian owners undertake regular weed cutting which mainly serves to improve the river for fishing activities, though it also helps to maintain river levels.

Upstream of Winchester, the Itchen is regarded as one of the best examples of chalk streams in Europe. The Test and Itchen both have high water quality status, as a direct result of being fed by groundwater. This water arises both from valley springs and through the channel bed. This high water quality also supports the watercress industry and important water-dependant habitats for species such as white-clawed crayfish, brook lamprey, water crowfoot and otters. The aquifers

underlying these rivers are important sources for much of the water used in Hampshire. The balance between public water supply needs and the needs of the aquatic environment is a growing challenge.



Figure 10: Overview map of the Test and Itchen catchment

Geology

More than 80% of the Test and Itchen catchment lies on an outcrop of permeable chalk, extending south of Winchester to Colden Common on the Itchen, and to the River Dun confluence, north of Romsey on the Test. The coastal strip between these southern boundaries of the chalk and the coast is made up of much less permeable clay which runs roughly parallel to the coast. Several of the sub-catchments in the lower reaches, for example Monks Brook on the Itchen, and the River Cadnam and Tanners Brook on the Test, are wholly or partially underlain by these clay, sand and silt Tertiary deposits.

National and International Designations

The Rivers Test and Itchen are classic chalk rivers with high water quality along their entire lengths. Fed by groundwater, they support a rich diversity of mammals, birds, fish, invertebrates and plants. The Itchen is designated a Site of Special Scientific Interest (SSSI) and a Special Area of Conservation (SAC) for its internationally important wildlife. It supports an abundant and exceptionally rich aquatic flora and fauna. The Test is designated as a SSSI, and the lower part of the Test is characterised by a wide flood plain and tidal marshes between Testwood and Red Bridge.

Partnership Working

Within the Test and Itchen catchment, risk management authorities are working alongside a number of partners. The catchment is covered by a number of local councils: Hampshire County

Council, Wiltshire Council and Southampton City Council are all lead local flood authorities operating within the catchment. There are also the District and Borough Councils of New Forest, Test Valley, Winchester, Basingstoke and Deane, and Eastleigh who the Environment Agency has active partnerships with.

Southern Water Services is both a water and sewerage provider in this catchment and they actively participate in partnership working to identify and address flood risk issues. In addition to Southern Water Services, Portsmouth Water is also a water supplier working in the catchment.

In addition to this, there are a number of other partners who work closely with risk management authorities including: National Farmers Union, Natural England, Marine Management Organisation, and the Hampshire and Isle of Wight Wildlife Trust.

As the majority of the coastline within the Test and Itchen catchment is managed by local councils, there is a strong emphasis on partnership working in order to provide coastal protection. Southampton City Council and Eastleigh Borough Council are both coastal authorities who have worked with the Environment Agency to produce strategies to inform the management of the coastline.

Following on from the significant flooding experienced within the Test and Itchen catchment during winter 2013 to 2014, considerable partnership working has progressed through the formation of the Test and Itchen Pilot Studies Group. This group is made up of all the relevant authorities within the catchment. The aim is to set out a clear multi-agency strategy, together with policies and a priority action plan to implement a suite of realistic measures to manage the risk of flooding from all sources in key communities. This will be achieved through reviewing evidence from various sources, engage with communities to fully understand the key issues and identify measures (short, medium and long term) that are to be implemented, although this is funding dependant.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Test and Itchen catchment are described in the table and figures below.

Flood risk from Rivers and the Sea

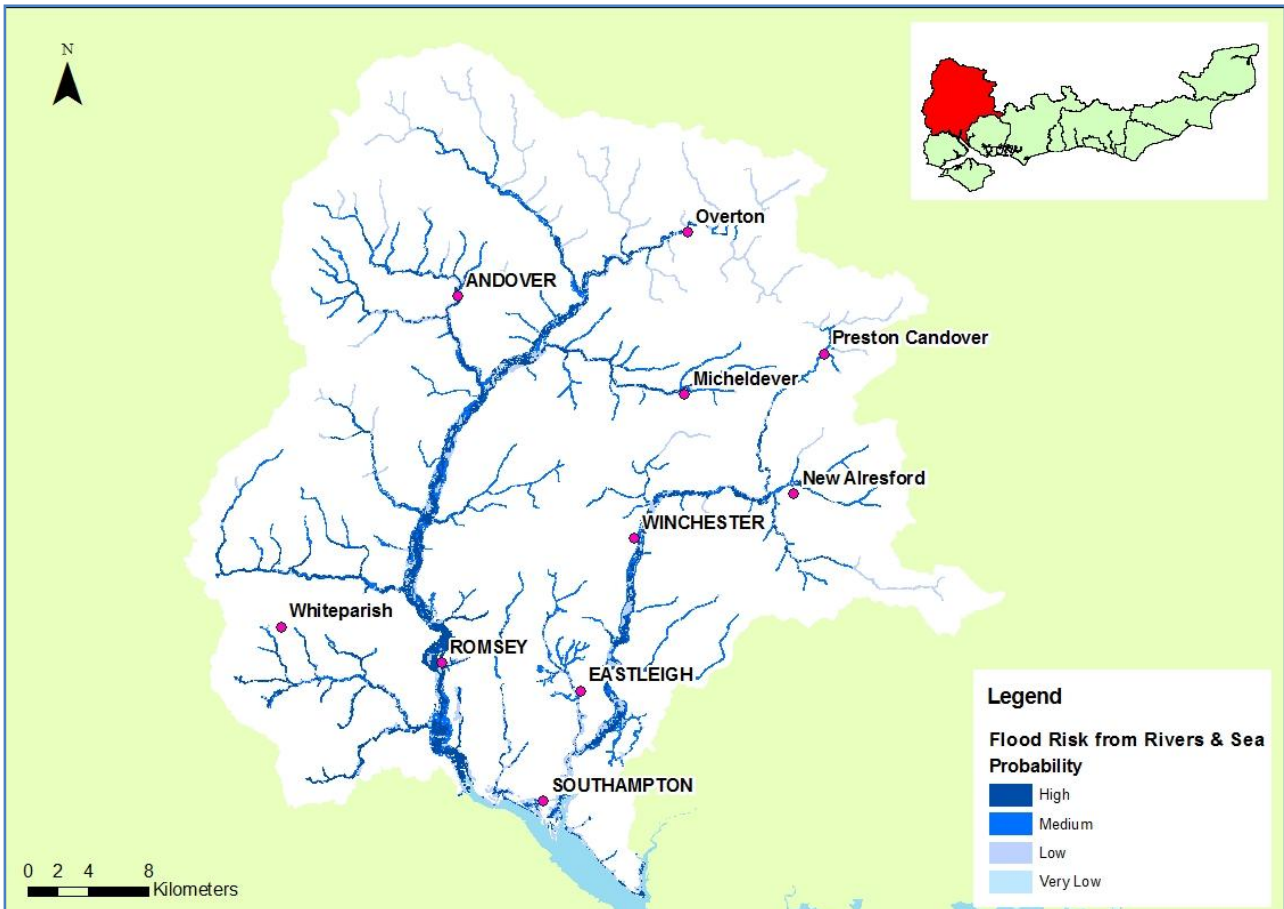


Figure 11: National Flood Risk Assessment (NaFRA) in the Test and Itchen catchment

Table 7: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Test and Itchen catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	578,450	3,950	8,300	9,750	<50
Number of services:	1,070	20	40	50	<10
Risk to economic activity:					
Number of non-residential properties:	63,850	850	1,750	1,850	<50
Number of airports:	1	0	0	0	0
Length of trunk roads (km):	380	<10	<10	<10	0
Length of railway (km):	160	<10	<10	<10	0
Agricultural land (ha):	132,500	450	1,250	750	<50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	0	0	0	0	0
Number of EPR installations within 50m:	27	2	1	0	0
Area of SAC within area (ha):	4,000	250	50	50	0
Area of SPA within area (ha):	3,050	100	<50	<50	0
Area of RAMSAR site within area (ha):	2,250	100	<50	<50	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	7,000	800	300	350	<50
Area of Parks and Gardens within area (ha):	2,200	50	50	50	<50
Area of Scheduled Ancient Monument within area (ha):	1,100	<50	<50	<50	0
Number of Listed Buildings within area:	5,000	130	250	220	<10
Number of Licensed water abstractions within the area:	580	100	50	30	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal and Coastal Flooding

The coastal boundary of the Test and Itchen catchment is within the sheltered Southampton Water, reducing the effect of wave action on the coastline. The tidal reaches of the Test and Itchen catchment area are affected by a combination of the dominant base flow from the upper sub-catchments and 'flashy' flows from the lower tributaries, together with tidal effects. The tidal limits are Redbridge for the River Test and Woodmill for the River Itchen. Tidal flooding is not the predominant source of flood risk in this area, although in the lower reaches flooding can also be influenced by tidal conditions due to a combination of fluvial and tidal factors.

The land alongside the west bank of the River Itchen is the area most at risk from tidal flooding within the catchment, particularly as parts of this area have undergone land reclamation for industry, and there are areas below sea level.

It is thought that climate change will bring higher sea levels, increased storminess, larger waves and changes in tidal currents. Loss of intertidal habitats is a particular concern. Increasing development in the coastal zone must be managed extremely carefully to prevent unsustainable practice that may place future generations at greater risk of coastal flooding and erosion.

Coastal Erosion

Some short stretches of soft cliffs composed of sand, clay and gravel can be found in Southampton Water. Their erosion contributes sediment to beaches.

Fluvial Flooding

The Test and Itchen are mainly dominated by groundwater base flow from the permeable chalk aquifers. These aquifers are unconfined and produce many streams rising as springs at the margins of the North and South Downs. These streams tend to respond slowly to increasing volumes of rainfall over a prolonged period of time. Maximum flows within the watercourses normally occur after prolonged winter rainfall.

As these rivers are dominated by groundwater, the onset of flooding is generally gradual in nature, however when this occurs, floods are often prolonged.

In the south of the catchment, where the land is less permeable, smaller watercourses are dominated by surface water run-off. These tributaries respond to short duration rainfall and have little (if any) base flow. Maximum annual flows generally occur during the winter after a few days of moderate or heavy rainfall. Shorter duration, intense summer rainfall can also generate high flows which is often flashy in nature. High tide conditions can exacerbate flooding in the tidal reaches.

Urban areas at risk of fluvial flooding include Winchester, Romsey, Andover and along the Monks Brook in Eastleigh. Where urban centres were built at significant river crossing points, artificial constrictions and reduced flood plain capacity are the main causes of flooding.

For the low peak, high volume flood events experienced within the chalk sub-catchments, flood storage solutions are generally ineffective. Therefore where flooding occurs as a result of inadequate flow capacity, flood risk management needs to consider management of river levels and conveyance, flood warning, flood proofing and development control measures.

In the rural settlements on the chalk, where the high water table causes flooding, flood risk management is more difficult. For these locations, flood resilience measures combined with flood warning are likely to be the preferred options to consider. Where excess run-off from poorly managed rural land is causing 'muddy flooding', better land management can alleviate this problem.

In the sub-catchments further downstream, such as the Monks Brook, shorter duration, high peak, 'flashy' flood events can occur. In these cases increased flood storage should be considered. Flood warning, channel maintenance, improved conveyance to lower water levels, or raised defences to contain high water levels are also likely to be flood management options.

Surface Water flooding

Surface water flooding is known to occur in urban areas across the catchment, with the greatest risk occurring in Eastleigh, Southampton and Romsey. Ponding in low spots, coupled with various watercourse and surface water networks interacting can also lead to flooding when the system “backs up” particularly if it occurs in areas which suffer from ‘tide-locking’.

Surface water can occur when sewer systems receive more rainwater than they are designed to handle and this can cause surcharging. Also in areas affected by groundwater, sewer capacity can be reduced when the water infiltrates into the network, which can again cause flooding.

Flooding from surface water is localised and is more difficult to predict than river or coastal flooding. This means there is often limited advanced notice of this type of flooding.

During the 2013 to 2014 flood event, surface water had significant impacts with several key roads around urbanised areas being closed for periods of time. Surface water also caused flooding to several properties and businesses especially in Romsey.

It is likely that surface water will become more of an issue in the future within the urbanised catchments as the climate changes and the catchment experiences more frequent high intensity rainfall.

Further information on surface water and groundwater in the Test and Itchen catchment can be found in the following Local Flood Risk Management Strategies:

- ▶ Hampshire County Council's Local Flood Risk Management Strategy
<http://www3.hants.gov.uk/flooding/floodriskstrategy.htm>
- ▶ Southampton City Council's Local Flood Risk Management Strategy
<http://www.southampton.gov.uk/environmental-issues/flooding/managing-flood-risk/local-flood-risk-strategy.aspx>

Groundwater flooding

The groundwater flood risk in Hampshire follows the underlying geology, with villages at risk from groundwater flooding predominantly in the north and east of Hampshire.

Normally, the chalk rock has the capacity to store excess rainfall given its porosity. However in wet winters this capacity is exceeded and flooding can be experienced for days or weeks after the rainfall. Many traditional methods of flood protection, such as sandbags, may not be effective against flooding from groundwater. This is because water can come up through the floor and remain high for a long time. Also, rising groundwater levels can affect the sewage network, leading to foul sewers flooding.

Flood risk from Reservoirs



Figure 12: Flood Risk from reservoirs in the Test and Itchen Catchment

Reservoir Flooding

Reservoirs can hold large volumes of water above ground level, contained by embankments/dams. Although the safety record for reservoirs is excellent, it is still possible that an embankment/dam could fail which would result in a large volume of water being released very quickly. It may also be the case that a reservoir could overflow and cause a surface water flood risk.

The Environment Agency is responsible for overseeing the safety of reservoirs registered under the Reservoirs Act 1975, which are reservoirs that hold at least 25,000 cubic metres of water above ground level.

Within the Test and Itchen catchment there are several reservoirs that meet the registration criteria, including Alresford Pond, Awbridge Lake, Kentford Lakes and Stoneham Park Pond.

Table 8: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Test and Itchen catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	578,450	2,650
Number of services:	1,070	10
Risk to economic activity:		
Number of non-residential properties:	63,850	350
Number of airports:	1	0
Length of trunk roads (km):	380	<10
Length of railway (km):	160	<10
Agricultural land (ha):	132,500	100
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	27	0
Area of SAC within area (ha):	4,000	50
Area of SPA within area (ha):	3,050	<50
Area of RAMSAR site within area (ha):	2,250	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	7,000	200
Area of Parks and Gardens within area (ha):	2,200	<50
Area of Scheduled Ancient Monument within area (ha):	1,110	0
Number of Listed Buildings within area:	5,000	20
Number of Licensed water abstractions within the area:	580	20

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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; aquatic weed cutting in main river and tributaries, inspection,

maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the Test and Itchen Catchment

The sources of flood risk in the Test and Itchen area include river, sea, surface and ground water flooding. Flood risk is concentrated within the urban areas such as Southampton, Romsey, Winchester and Andover, although there are villages within the catchment also at flood risk. Actions in the flood risk management plan for the catchment are the implementation of the coastal and erosion strategy in Southampton, implementation of surface water management schemes in Southampton, Calmore Canal Fluvial Flood Alleviation Scheme, Winchester Fluvial Flood Alleviation Scheme, and Romsey Fluvial Flood Alleviation Scheme. These schemes all aim to reduce flood risk to properties in the area and where feasible, enhance the environment.

Work is being carried out with communities to increase people's awareness of the risk of flooding and the associated actions that they should take. The Environment Agency needs to continue to contribute to this by working with other partners. The importance of this work to improve and maintain the defences is demonstrated in that it reduces the likelihood of these communities flooding.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads
8. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

9. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
10. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
11. Promote sustainable soil and land use management across the catchment
12. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the Test and Itchen catchment

In the Test and Itchen catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to this ongoing maintenance work, in the Test and Itchen catchment there are 40 measures to manage flood risk. Examples of these measures are provided here and the full list of measures can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk:

- St Mary Bourne Flood Alleviation Scheme - Groundwater derived flooding in St Mary Bourne resulted in the Environment Agency deploying pumps and temporary defences. The Environment Agency is now proposing a more permanent and cost effective approach to reducing flood risk at St Mary Bourne.
- Improve the knowledge and understanding of flood risk in Southampton (Southampton City Council) - Improve our knowledge and understanding of flood risk, in particular groundwater through the establishment of groundwater monitoring stations, and ordinary watercourses through the identification of opportunities to monitor flow for further modelling. Improve the recording of flood incidents to help build a better understanding of flood issues being experienced within the city.
- Improve existing drainage infrastructure and rivers/watercourses with available resources (Southampton City Council) - Prioritise drainage works (cleansing, maintenance and improvement) at hotspot flood risk locations throughout the city, and identify opportunities for improving rivers/watercourses where funding is available.
- Property level protection schemes in Southampton (Southampton City Council) - Where residential properties are at significant risk of flooding, or have suffered internal flooding in their property in the past, and are unlikely to benefit from a wider flood alleviation scheme SCC will work with the homeowners/residents to implement a property level protection scheme, where national grants can be attracted to finance delivery.
- Spatial and land use planning (Southampton). Use a range of policies (new and existing) to ensure new developments take account of flood risk, provide appropriate mitigation measures on the immediate site, does not increase flood risk elsewhere and reduces flood risk where opportunities exist. It will be a requirement for new developments to meet set standards in relation to surface water run-off from the site to minimise the potential impacts from climate change.

Preparing for risk:

- Create new groundwater flood warning service for Kings Worthy and Sutton Scotney and Chilbolton
- Work with the National Flood Forum to support communities setting up flood action groups as part of recovery in Romsey and in the Bourne Valley
- Telemetry Improvement Project - The Installation of new telemetry sites to improve warning, forecasting and modelling capability in the Test and Itchen catchment
- Support the establishment of local community flood groups in Southampton (Southampton City Council) - If local residents express an interest in establishing local community flood groups, SCC will support their establishment through the provision of advice, guidance and flood risk information and attendance at group meetings as requested.
- Joint working and duty to co-operate in Southampton (Southampton City Council) - Continue to work with others (neighbouring authorities, external organisations and internal SCC departments) to provide a co-ordinated approach to managing flood risk within the

City and across our boundary, mainly through the Southampton Flood Board meetings and Hampshire Strategic Flood Group.

Protecting from risk:

- Implement the Coastal Flood and Erosion Risk Management Strategy in Southampton (Southampton City Council) - Take forward the River Itchen Flood Alleviation Scheme to reduce flood risk through the implementation of an interim height flood wall along the west bank of the River Itchen from Ocean Village to Mount Pleasant Industrial Estate. Take forward the Upper Itchen/St Denys property level protection scheme to reduce potential damages through implementation of measures to prevent water entering properties in the area at significant risk
- Romsey (River Test) Fluvial Flood Alleviation Scheme - Protection of Romsey from fluvial flooding using temporary and permanent defences
- Test and Itchen Pilot study - This project covers all of the categories 'recovery and review', 'prepare', 'prevention' and 'protection'. The aim is that the pilot studies will set out a clear multi-agency strategy, together with policies and a priority action plan to implement a suite of realistic measures to manage the risk of flooding from all sources in key communities. See 'Partnership Working' section for more info.
- Calmore Canal (Totton) Flood Alleviation Scheme – investigate options to increase the capacity of the open watercourses, and to include property level protection for properties
- Winchester (R. Itchen) Fluvial Flood Alleviation Scheme – Protection of Winchester from fluvial flooding using temporary and permanent defences

Recovery and review of risk:

- Investigate flood incidents in Southampton (Southampton City Council) - On becoming aware of a flood, the Flood Risk Manager will use the SCC developed guidance and protocol to determine whether an investigation is necessary and if so, how the investigation will be carried out. The Flood Risk Manager will notify the relevant organisation or authority responsible for the flood.

Other:

- Manor Farm, River Test (Regional Habitat Creation Programme) – investigate options to create compensatory freshwater grazing marsh

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.4 The East Hampshire catchment

Introduction to the catchment

The rivers of the East Hampshire catchment have shallow gradients, mostly emerging from the permeable chalk downs in the north as seasonal streams. The rivers then flow over clay and gravels entering the sea in Southampton Water, the Solent, Portsmouth Harbour and Langstone Harbour. Most urban development is located in the south of the catchment, with major conurbations between Portsmouth and Southampton along the route of the M27 motorway. Agriculture takes up 78% of the land in the catchment with the remainder being mostly urban.

Causes of flooding are diverse and strongly influenced by the underlying geology. Groundwater flooding occurs in the chalk catchments, fluvial flooding occurs in the areas that lie on clays and gravels and surface water flooding is an issue in the urban areas where natural drainage has been modified. The history of flooding in the catchment suggests that there are generally small numbers of properties flooded in a relatively large number of locations. However, particular exceptions to this include Wickham, Wallington, Hambledon, Rowlands Castle and Portsmouth, where more than 20 properties have flooded in each of these places during a single flood event.

Tidal flooding is an issue in coastal and estuary areas within the catchment. High astronomical tides coupled with storm surges can lead to properties and infrastructure flooding. Along more exposed areas of this coast, wave action can cause flooding when coupled with high sea levels; Southsea and Hayling Island are notable locations where waves can overtop coastal defences.

The internationally designated wetland sites within the catchment include the Solent Maritime SAC, Solent and Southampton SPA/Ramsar, Chichester and Langstone SPA/Ramsar, Portsmouth Harbour SPA/Ramsar, and Solent and Isle of Wight Lagoons SAC. These are important wetland habitats that support species sensitive to changes in water levels, quantity and quality.

The main streams and rivers draining the East Hampshire catchment are:

- ▶ The River Wallington
- ▶ The Hermitage Stream
- ▶ The Lavant Stream
- ▶ The River Hamble
- ▶ The River Meon

Land Use and Management

Land use within the East Hampshire catchment is 78% agricultural with the remainder being mostly urban.

The northern part of the catchment is mainly rural, with the population generally dispersed across small towns and villages. The northern agricultural land is a mixture of arable and grassland, together with a significant patchwork of woodland areas. The type of agricultural land use can impact on run-off and consequently the nature of flood risk.

There are significant urban developments stretching from Portsmouth along the M27 to the west and along the A3 (M) to the north. Urban development can have a notable effect on flood risk, with changes to the drainage network and impermeable surfaces leading to surface water entering the watercourses more quickly. This results in flashy flood events with higher flood peaks of shorter duration. Urban areas may also be at risk of flooding from inadequate drainage systems and high groundwater levels (which are unable to drain away). Portsmouth, Havant, Gosport and Hedge End are all densely populated urban areas that are particularly at risk from the drainage networks being overwhelmed.

Development in the flood plain can significantly increase flood risks. As considerable urban development is planned for this catchment, careful consideration of the flood risks will be required and future development should accord with the National Planning Policy Framework.

Portsmouth is home to the Royal Navy and provides important maintenance and ship building facilities. Tidal flooding is a significant risk to these economic activities and will become increasingly so with predicted climate change and sea level rise.

The rural areas to the north and in particular within the South Downs National Park provide important recreational and tourist related facilities. Southampton Water and the Solent are also world renowned for water sports which provide an important economic boost to the area.

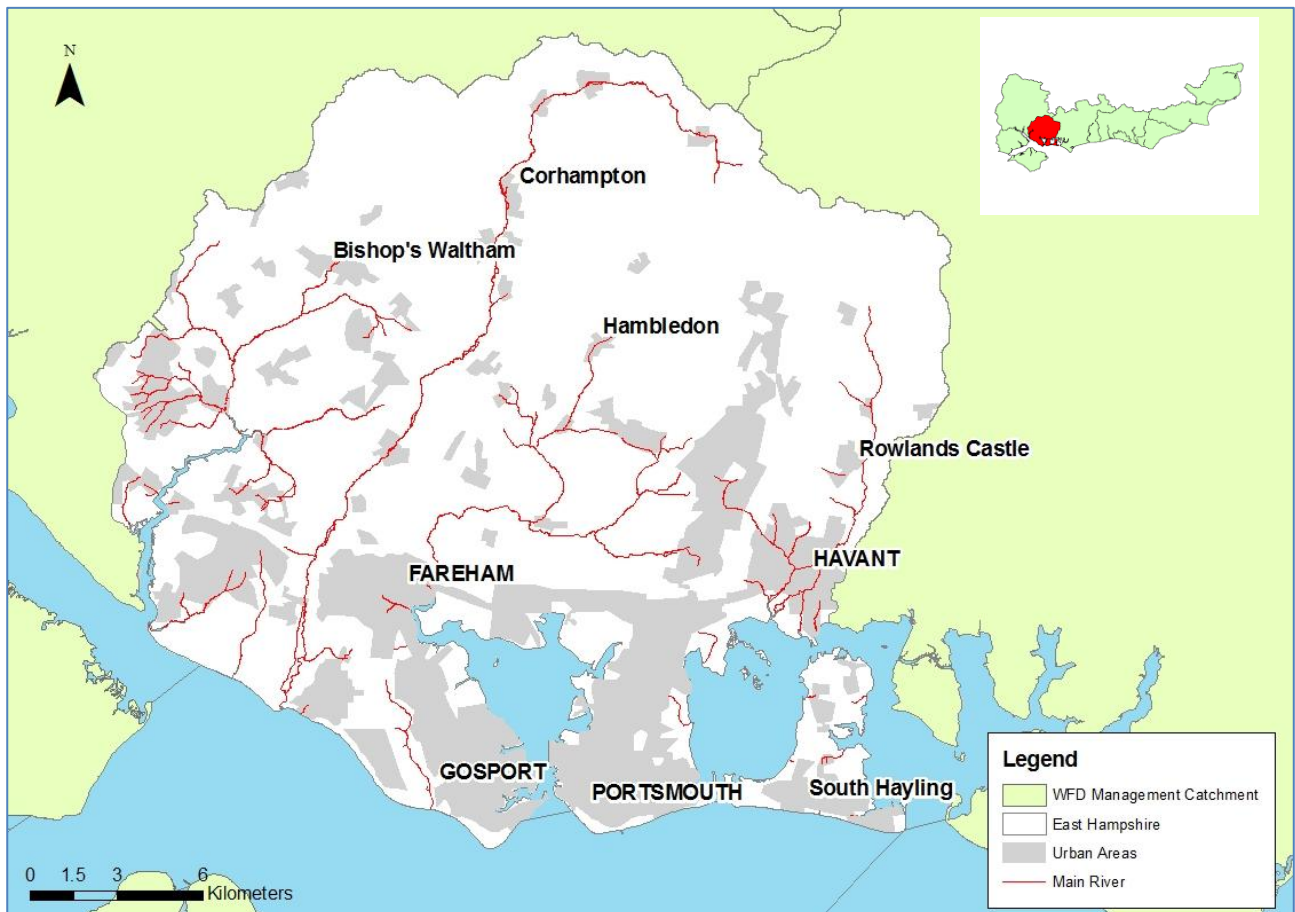


Figure 13: Overview of the East Hampshire catchment

Geology

The northern part of the catchment is chalk, whilst the southern part of the catchment mostly consists of less permeable clays. The River Meon flows over chalk bedrock for approximately half its length. Tributaries of the other large sub-catchments, Hamble, Wallington, Hermitage and Lavant also flow over chalk but are ephemeral streams that only appear when groundwater levels are higher. The underlying geology has a significant impact on the hydrology of the area, with rivers responding differently to rainfall. Rainfall falling on chalk areas tends to soak into the ground, recharging groundwater stores. Water levels in the chalk areas will rise and fall over a period of days or weeks and consequently river flows respond relatively slowly to rainfall events

The majority of the remaining river network in the southern part of the catchment flows mostly over the clay, which is less permeable and produces more surface run-off, which flows directly into watercourses. Water levels in these areas respond more rapidly to rainfall, with large volumes of water moving through the river network quickly, causing rivers to rise and fall in a matter of hours.

This variation in the response of river flows to rainfall events, dependent upon the geology, has significant implications for flood risk management

National and International Designations

The East Hampshire catchment contains a range of nature conservation, landscape and coastal heritage designated sites. Some of these sites are recognised as internationally important and include Ramsar, Special Protection Areas (SPA) and Special Areas of Conservation (SAC) sites.

- ▶ SAC sites – Solent Maritime, Solent and Isle of Wight Lagoons, Butser Hill
- ▶ SPA/Ramsar sites – Chichester and Langstone Harbours, Solent and Southampton Water, Portsmouth Harbour

Within the catchment there are also features of national importance, including Sites of Special Scientific Interest (SSSI) and National Nature Reserves (NNR) sites. There are also locally important sites designated as Sites of Importance for Nature Conservation (SINC), Local Nature Reserves (LNR) and Geological Sites.

A significant part of the catchment falls within the South Downs National Park. The heritage features within the catchment include scheduled monuments and structures associated with mill operations and water meadows.

The environment and heritage within the East Hampshire catchment present both opportunities for and constraints to flood risk management. Understanding the location and nature of the protected sites will play an important role in developing options to manage flood risk in a sustainable and integrated way. Any options identified for flood risk management will need to take account of Water Framework Directive requirements identified within the river basin management plan.

Partnership Working

Within the East Hampshire catchment risk management authorities are working alongside a number of partners. Hampshire County Council and Portsmouth City Council are both lead local flood authorities operating within the catchment. There are also the District and Borough Councils of Eastleigh, Winchester, Fareham, Gosport, Havant and East Hampshire with whom the Environment Agency have active partnerships.

Southern Water Services is both a water and sewerage provider in this catchment and they actively participate in partnership working to identify and address flood risk issues. In addition to Southern Water Services, Portsmouth Water is also a water supplier working in the catchment.

There are a number of other partners who work closely with risk management authorities including: National Farmers Union, Natural England, Marine Management Organisation, Sussex Wildlife Trust, Hampshire Wildlife Trust, Wildfowl and Wetlands Trust, Partnership for Urban South Hampshire (PUSH) and the South Downs National Park.

As much of the coastline within the East Hampshire catchment is defended in urban areas, there is a strong emphasis on partnership working in order to provide coastal protection. The Eastern Solent Coastal Partnership (ESCP) provide a coastal management service to the four coastal authorities of Portsmouth, Gosport, Havant and Fareham. The Environment Agency works closely with the Eastern Solent Coastal Partnership on both the development of flood risk strategies and the implementation of coastal protection schemes within these areas.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the East Hampshire catchment are described in the tables and figures below.

Flood risk from Rivers and the Sea

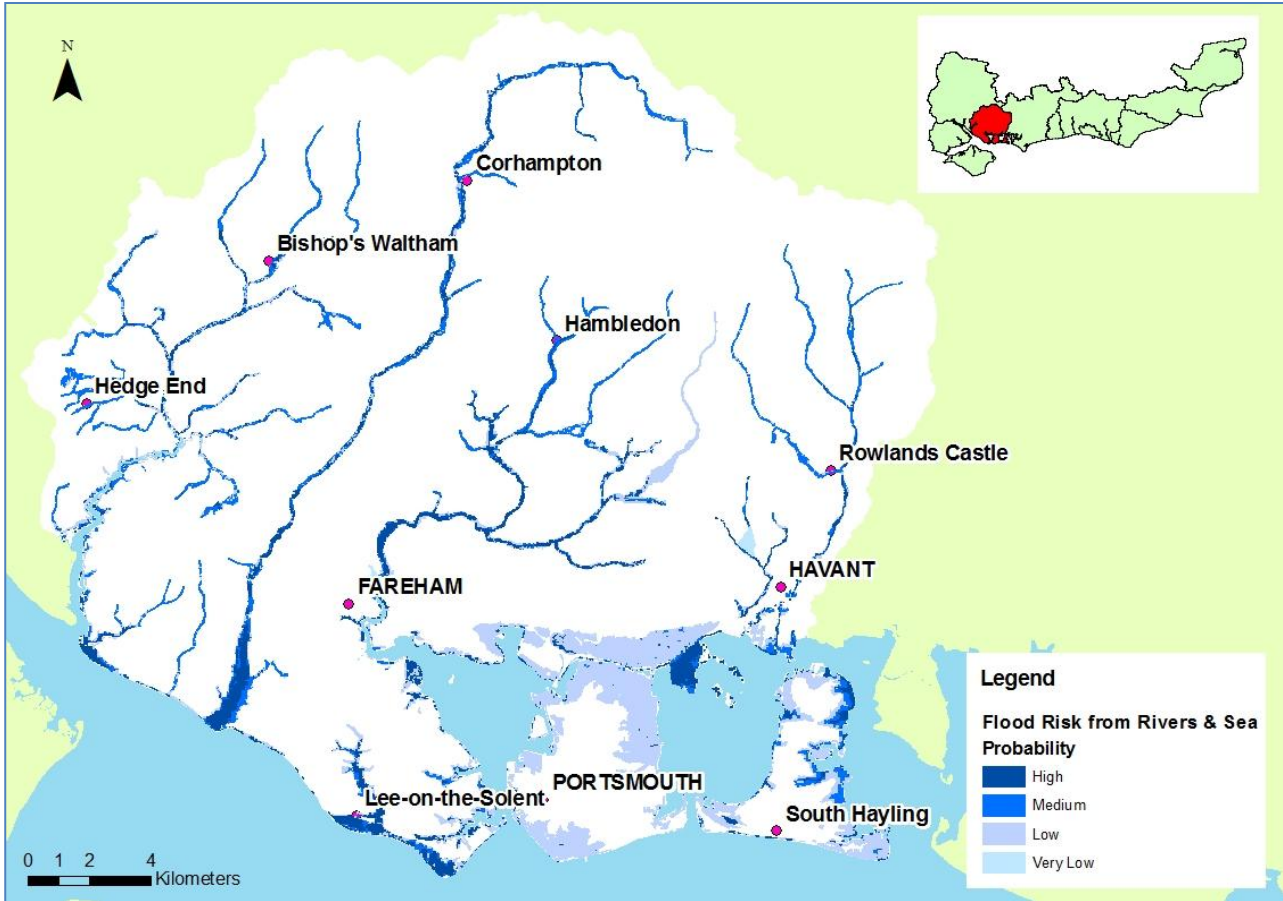


Figure 14: National Flood Risk Assessment (NaFRA) in the East Hampshire

Table 9: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the East Hampshire catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	614,500	1,750	5,000	47,950	1,700
Number of services:	720	10	20	60	<10
Risk to economic activity:					
Number of non-residential properties:	47,150	350	850	4,250	<50
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	130	0	0	<10	0
Length of railway (km):	70	0	2	10	0
Agricultural land (ha):	27,600	300	500	300	<50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	2	2	0	0	0
Number of EPR installations within 50m:	13	0	0	3	0
Area of SAC within area (ha):	350	50	50	50	0
Area of SPA within area (ha):	700	300	150	100	0
Area of RAMSAR site within area (ha):	700	300	150	100	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	1,800	400	150	150	0
Area of Parks and Gardens within area (ha):	400	<50	<50	50	0
Area of Scheduled Ancient Monument within area (ha):	300	<50	<50	50	0
Number of Listed Buildings within area:	2,120	30	120	170	0
Number of Licensed water abstractions within the area:	100	20	10	<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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Coastal and Tidal Flooding

Low-lying coastal areas including Portsea Island (Portsmouth), Hayling Island, Gosport and the River Hamble Estuary are all close to or below sea level and are at risk of coastal and tidal flooding.

Flooding in the lower reaches of the River Hamble, Wallington River, Hermitage, Lavant and West Brook Streams can be made worse when fluvial flood events and high tides coincide. This is a significant risk to places such as Wallington and Havant.

High tides can also have significant impacts upon the drainage systems within urbanised coastal areas. If drainage systems are unable to drain freely due to high tide levels this can lead to serious flooding.

A large proportion of the coastal frontage in the East Hampshire catchment is protected by defences. These defences are largely owned and maintained by local councils, the Ministry of Defence and private landowners. The North Solent shoreline management plan has identified a hold the line policy for most of the frontages associated with the urbanised areas. An area of No Active Intervention has been identified for the policy unit Hurst Spit to Stubbington.

The following coastal strategies cover the majority of the East Hampshire catchment area and have been developed to identify flood defence requirements in this area:

- ▶ Portchester Castle to Emsworth Strategy
- ▶ Portsea Island Coastal Strategy
- ▶ River Hamble to Portchester Strategy (currently out to consultation)

Current tidal schemes in the East Hampshire area include:

- ▶ Wallington River wall (tidal, fluvial and surface water scheme)
- ▶ Lee-on-the-Solent Beach Recharge
- ▶ Eastoke Point Coastal Defence Scheme (now complete)
- ▶ Southsea and North Portsea Island flood cells defence improvements

The Eastern Solent Coastal Partnership are currently producing the River Hamble to Portchester Strategy and leading on the Portsmouth flood cells defence works, supported by the Environment Agency.

Coastal Erosion

Much of the coastline is low lying with more notable soft cliffs only along Southampton Water where the erosion contributes to the beaches. Only short lengths of the cliffs are protected.

Fluvial Flooding

Fluvial flooding in the East Hampshire catchment results from surface run-off generated events in the impermeable catchment and from high baseflow events in the chalk catchment. The former results in short duration, high discharge events, whilst the latter results in lower peak flow but longer duration and greater overall flood volume events.

Flooding on the River Meon tends to be a response to high groundwater levels and base flows. Flooding on the Wallington, Hermitage and Lavant Streams tends to be a more complex mix of both groundwater derived high flows, particularly in the upper catchment areas, and rapid response to rainfall events in the lower catchment where the rivers run through urbanised areas and less permeable geology.

Notable flood events occurred both in 2000 to 2001 and 2013 to 2014 causing significant disruption and flooding of properties in the villages of Hambledon, Finchdean and Rowlands Castle. Restrictions caused by some structures within watercourses can also have an impact upon channel capacity and conveyance, which can increase flood risk.

Surface Water Flooding

Surface water flooding happens as a result of excess overland flow rather than watercourses overtopping. It is usually caused by intense, short duration storms that overwhelm drainage systems and sewer networks. However, the effect can happen after more prolonged rain, such as occurred at several places during winter 2000 to 2001. Blockages and poor maintenance of existing drainage systems and in-filling of roadside storm water relief ditches were believed to be contributory factors in flooding experienced in many rural locations within the catchment.

Flooding from surface water often lasts a short time and can be relatively shallow (less than 0.5m) unless combined with flooding from other sources such as groundwater, fluvial or tidal. As surface water flooding is closely linked to the nature of the local drainage system it is often difficult to predict exactly where and when it may occur.

Flooding from sewage systems can also occur if the system is overwhelmed either by surface water or groundwater entering the network.

Further information on surface water and groundwater in the East Hampshire catchment can be found in the following Local Flood Risk Management Strategies:

- ▶ Hampshire County Council's Local Flood Risk Management Strategy
<http://www3.hants.gov.uk/flooding/floodriskstrategy.htm>
- ▶ Portsmouth City Council's Local Flood Risk Management Strategy
<https://www.portsmouth.gov.uk/ext/community-and-environment/environment/flood-protection-policies.aspx>

Groundwater Flooding

High groundwater levels and emerging springs are a major source of flooding within the catchment, particularly in the northern part that lies on chalk. Whilst the chalk aquifer may take several months to become saturated, once the groundwater table has reached the surface, property flooding, run-off from fields and high baseflow in rivers can all last for a long time.

Groundwater flooding is widespread across the catchment. The flooding that occurred during the winters of 2000 to 2001 and 2013 to 2014 affected numerous villages. Groundwater flooding is experienced in the River Meon valley in particular, with significant groundwater flooding also experienced in Hambledon and Rowlands Castle. The location of flooding within villages depends on where springs emerged and where groundwater levels exceeded property thresholds.

The consequences of groundwater flooding are different to those of surface water flooding due to the prolonged nature of high groundwater levels. This can often mean that people have to move out of their property for some time while they wait for the flood water to subside.

Flood risk from Reservoirs

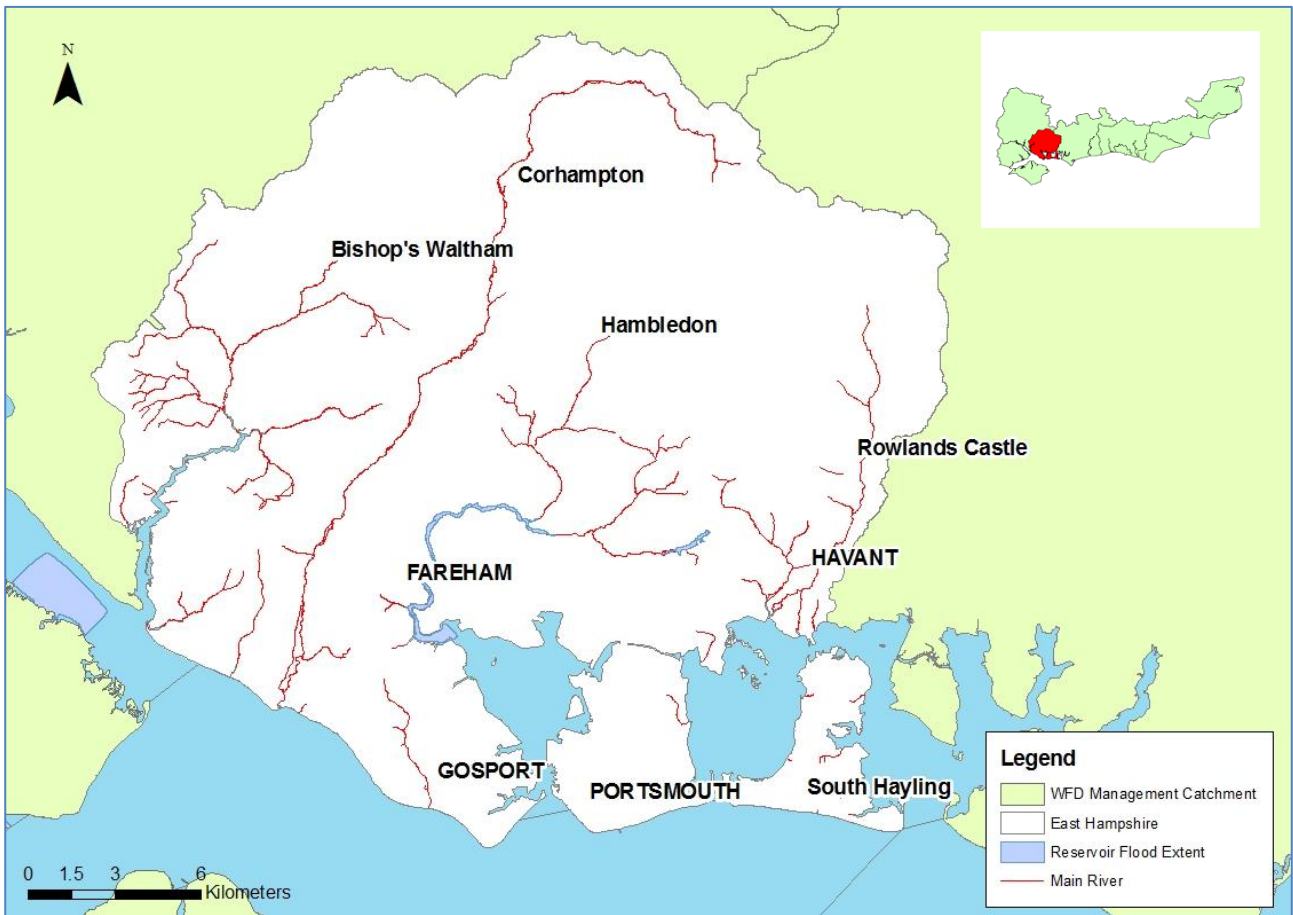


Figure 15: Reservoir flood risk map for the East Hampshire catchment

Reservoir Flooding

Two reservoirs are located within the East Hampshire catchment. Southwick Park Lake consists of a large online impoundment (dam), situated on the River Wallington. The reservoir flood risk map shows the flood risk area to extend down the valley and through Wallington Village. Southwick Park Lake is under private ownership and is used for angling purposes.

A smaller reservoir (Purbrook regulating reservoir) is located in Purbrook and is operated by Southern Water Services.

Table 10: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the East Hampshire catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	614,500	700
Number of services:	720	<10
Risk to economic activity:		
Number of non-residential properties:	47,150	100
Number of airports:	0	0
Length of trunk roads (km):	130	0
Length of railway (km):	70	0
Agricultural land (ha):	27,600	50
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	2	0
Number of EPR installations within 50m:	13	0
Area of SAC within area (ha):	350	0
Area of SPA within area (ha):	700	<50
Area of RAMSAR site within area (ha):	700	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	1,800	<50
Area of Parks and Gardens within area (ha):	400	0
Area of Scheduled Ancient Monument within area (ha):	300	0
Number of Listed Buildings within area:	2,120	<10
Number of Licensed water abstractions within the area:	100	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; aquatic weed cutting in main river and tributaries, inspection,

maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the East Hampshire catchment

The East Hampshire catchment is mainly rural to the north, with settlements consisting mostly of small villages. Large densely populated urban areas are located to the south along the coast, Portsmouth, Fareham, Gosport, Havant and Hayling Island being the main towns and cities.

Groundwater and surface water flooding are the main sources of flood risk in the rural areas. A number of settlements within the catchment were severely affected by flooding during 2000 to 2001 and again in 2013 to 2014. Fluvial flooding is also experienced when groundwater levels are high for a prolonged period and when large rainfall events occur over the less permeable areas in the southern half of the catchment. Hampshire County Council as the lead local flood authority lead on managing flooding from groundwater and surface water sources, but works in partnership with the Environment Agency, District and Borough Councils and local community or action groups.

Large parts of the urban areas along the coast are at risk of tidal flooding. Predicted sea level rise and climate change will mean that there will be an increasing level of risk for these areas in the future. Risk management authorities have been developing strategies and schemes to identify and bring forward improvements to the standard of protection afforded to these coastal areas.

Work is being carried out to increase community awareness of the risk of flooding and the associated actions that they should take to increase resilience and minimise the impacts of flooding. The Environment Agency has established a number of Flood Warning areas within the East Hampshire catchment. The purpose of these areas is to provide as much warning as possible to communities of potential flooding. Flood Warning Areas cover coastal communities such as Hayling Island, Havant, Portsmouth, Gosport, Fareham and Hamble and there are fluvial warning areas on the Hamble, Meon, Wallington, Hermitage, Lavant and West Brook. Groundwater level information is also provided to certain communities that are at risk of this type of flooding. Work is continuously underway to further improve and refine this service.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads

8. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

9. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
10. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
11. Promote sustainable soil and land use management across the catchment
12. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the East Hampshire catchment

In the East Hampshire catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work across the East Hampshire catchment there are 22 measures to manage flood risk. Examples of measures are provided here and the full list can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk:

- Hermitage and Lavant - NaFRA model reruns - Required following the completion of the 2010 model. Defended model runs are also required to enable suitable Quality Assessment of NaFRA.
- Portchester Paulsgrove NaFRA rerun - NaFRA rerun following completion of a new capital scheme to take into account the new defences
- River Hamble - new model and NaFRA - New model to update the flood map for the River Hamble. The Environment Agency has a very low confidence in the existing model which is based purely on modelling. Project will also include collection of survey data required to build the model and a NaFRA rerun once the model is complete.
- Wallington National Flood Risk Assessment (NaFRA) model rerun following completion of the 2011 Model and following completion of new capital scheme. This will help update the flood risk map to make it more accurate
- Hampshire Coast NaFRA Rerun - NaFRA rerun following completion of the 2014 Model
- Pier Road, Little Morass – groundwater investigation recommended from surface water management plan

Preparing for risk:

- Maintain and improve flood warnings, East Hampshire - Where appropriate, maintain and improve current flood warning services for the local communities in the East Hampshire catchment
- Encourage communities to produce/test/review/improve community emergency/flood plans – working with local resilience forum partners
- Develop Multi Agency Flood Plan for Hampshire and the Isle of Wight - Hampshire County Council, Portsmouth and Southampton and Isle of Wight work collaboratively to produce a Multi Agency Flood Plan for Hampshire and the Isle of Wight

- Farlington Marshes - The sea wall surrounding the marshes is nearing the end of its design life which the Eastern Solent Coastal Partnership are addressing with the Environment Agency through a feasibility study.
- Anchorage Park - The area is flagged as having high flood risk due to its low topography. The risk is further increased by the estate having a combined drainage system. Any surface water separation scheme would be very costly to implement. Recommended for groundwater investigation.

Protecting from risk

- Southsea Coastal Flood and Erosion Risk Management Scheme - Reducing tidal flood risk from existing 5% Annual Exceedance Probability to 0.5% Annual Exceedance Probability by improving coastal defences
- North Portsea Island Coastal Flood and Erosion Risk Management Scheme - Reduce tidal flood risk from (existing) 10% Annual Exceedance Probability to 0.5% Annual Exceedance Probability by adapting to keep pace with sea level rise at North Portsea Island
- Tidal Defence Improvements, Wallington Shore Road - Construct embankment and walls required to reduce the flooding and flap valves on surface water drainage outlets need to be installed
- Investigation into potential Farlington Marshes tidal defence improvements and realignment – options to carry out the recommendations of the Portchester to Emsworth strategy of tidal defence realignment and improvements at Farlington Marshes. This is following completion of the high roost study being carried out by the Eastern Solent Coastal Partnership
- Portchester Castle to Paulsgrove Tidal Defence - For the Portchester Castle to Paulsgrove frontage, improve and upgrade the standard of protection against flooding to the existing community, and the A27. In conjunction with this scheme, the Trafalgar Wharf development will provide defences on-site.

Recovery and review of risk: there are no measures from the risk management authorities contributing to this FRMP over and above existing flood risk work

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide Information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.5 The Arun and Western Streams catchment

Introduction to the catchment

The Arun and Western Streams catchment covers a large part of West Sussex as well as small areas of East Hampshire and parts of Waverley and Mole Valley in Surrey. The landscape in the catchment varies from the hills of the South Downs and the Low Weald and the wide Arun valley flood plain south of Pulborough. In addition to these features, there are the internationally important natural harbours of Chichester and Pagham and the flat coastal plain south of the downs.

The tide has a significant influence on the River Arun and this affects the character of the lower reaches of the river all the way up to its tidal limit at Pallingham weir. The Western Rother is a major tributary which joins the Arun near Pulborough. The Rother starts in East Hampshire north of Liss and flows easterly to its confluence with the Arun at Hardham. Much of the Rother flows through the South Downs National Park and as a catchment, has differing characteristics from the Arun. This can lead to varying responses to flooding around Pulborough depending on which river is in flood.

The Western Streams are primarily chalk rivers which are fed from groundwater rising out of the downs. The Ems and Lavant are both examples of this. During the summer months and through dry winters their headwaters can often have no flow as groundwater levels are low, but in particularly wet winters they can keep rising and cause disruption to travel infrastructure as well as flooding to properties and business in rural areas.

The south of the catchment sits upon the flat coastal plain and the rivers in this area are characterised as being slow moving and often heavily modified to serve as land drainage features. This is particularly the case on the Manhood Peninsula south of Chichester and in the Aldingbourne Rife catchment further to the east. As the drainage is often poor in these flat areas, they can be prone to waterlogging in wet conditions and are susceptible to surface water flooding when the various drainage networks “back up” during high intensity rainfall events.

The area has a diverse coastline ranging from sheltered harbours like Chichester and Pagham, to south westerly facing beaches which can bear the brunt of winter storms. The majority of the open coast consists of managed shingle beaches, which are an effective form of flood defence given their ability to dissipate wave energy. Beaches are often managed in conjunction with other structures such as sea walls or rock armour. In the tidally influenced harbours, which don't have to contend with the waves experienced on the coast, earth embankments and bunds are often sufficient to deal with high levels and surges.

The main streams and rivers that drain the Arun and Western Streams catchment are:

- ▶ River Arun
- ▶ Western Rother (major tributary of the River Arun)
- ▶ River Ems
- ▶ River Lavant
- ▶ Aldingbourne Rife

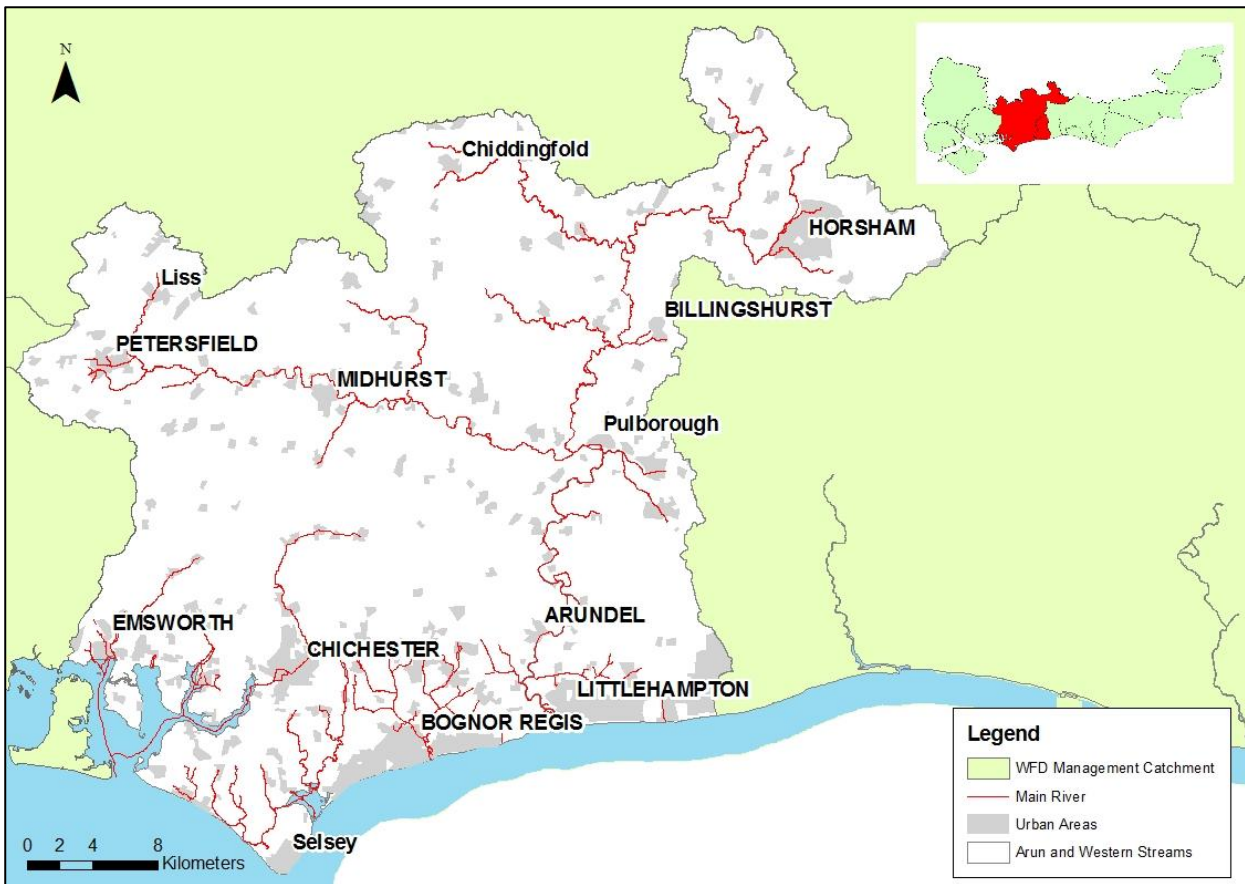


Figure 16: Overview of the Arun and Western Streams catchment

Land Use and Management

The land use across the Arun and Western Streams is diverse. Much of the catchment is rural and made up of small towns and villages. The main urban centres are located along the coastal plain with a few larger towns like Midhurst, Horsham and Petersfield located along the River Arun and Rother. Where major towns are located along rivers or near the sea, they are generally at risk of flooding. In some of the low lying towns such as Bognor Regis and Littlehampton, the interactions between rivers, sea and surface water from heavy rainfall means the causes of flooding are often complex and interlinked. In recent years there has been increased development across the catchment which has presented challenges to planning authorities and developers to ensure there is not increased risk of flooding to new or existing communities. Each local planning authority has a Strategic Flood Risk Assessment setting out how best to consider flood risk in conjunction with spatial planning.

The natural landscape of the Arun and Western Streams catchment is nationally recognised for its beauty and unique habitats. The South Downs, which sits across the middle of the catchment, became England and Wales newest National Park in 2011. There are areas of ancient woodland, managed forestry, wetlands, lowland heath and saltmarsh all adding to the natural character of the area.

With the downs and coast in close proximity, the Arun and Western Streams catchment is a popular tourist destination. There are Blue Flag beaches at West Wittering and Littlehampton. The South Downs Way, Serpents Trail, Downs Link and Monarchs Way are all notable long distance paths which provide amenity and recreation opportunities within the catchment.

Angling is popular on both the Rother and the Arun, with both rivers experiencing a good run of Sea Trout as well as supporting populations of native Brown Trout.

Geology

The geology of the headwaters vary for each watercourse within the catchment. The River Ems, Lavant and Bosham Stream all rise in the chalk of the South Downs and are characterised by groundwater levels in the porous rock. The network of rifes and ditches in the south of the Arun and Western Streams catchment typically drain clays and silts whereas the River Arun itself and Western Rother begin over sandstone before flowing over a variety of other soil and rock types.

National and International Designations

The Arun and Western Streams catchment contains a number of environmentally designated sites and historical monuments which present constraints to flood risk management. The South Downs is a National Park and Chichester Harbour is an Area of Outstanding Natural Beauty. There is a National Nature Reserve at Kingley Vale which is famed for its ancient Yew trees. There are numerous Sites of Special Scientific Interest across the catchment as well as internationally designated Ramsar sites in Pagham and Chichester Harbours as well as Pulborough and Amberley Brooks. The latter are also classed as Special Protection Areas. There are numerous listed buildings and structures and sites of archaeological interest in the catchment which includes Arundel Castle, Bignor Roman Villa and Fishbourne Palace.

Partnership Working

Within the Arun and Western Streams catchment, risk management authorities are working alongside a number of partners. The catchment is covered by a number of local councils: West Sussex County Council, Surrey County Council and Hampshire County Council who are all lead local flood authorities operating within the catchment. There are also the district and borough Councils of Chichester, East Hampshire, Mole Valley, Waverley, Horsham and Arun with whom the Environment Agency maintain active partnerships.

Southern Water Services is both a water and sewerage provider in this catchment as well as actively participating in partnership working to identify and address flood risk issues. Portsmouth Water is an additional water supplier working in the catchment.

There are a number of other partners who work closely with risk management authorities including: National Farmers Union, Natural England, Marine Management Organisation, Sussex Wildlife Trust, Hampshire Wildlife Trust, Wildfowl and Wetlands Trust, as well as the Arun and Rother Rivers Trust.

As the majority of the coastline within the Arun and Western Streams catchment is defended in urban areas, there is a strong emphasis on partnership working in order to provide coastal protection. As an example, The Environment Agency has jointly produced strategies for the coastline with both Chichester and Arun District Councils who are both coastal authorities.

The West Sussex Flood Risk Management Group is responsible for looking at the management of flood and erosion risk across this area it is chaired by West Sussex County Council as the lead local flood authority with input from all the active risk management authorities.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Arun and Western Streams catchment are described in the tables and figures below.

Flood risk from Rivers and the Sea

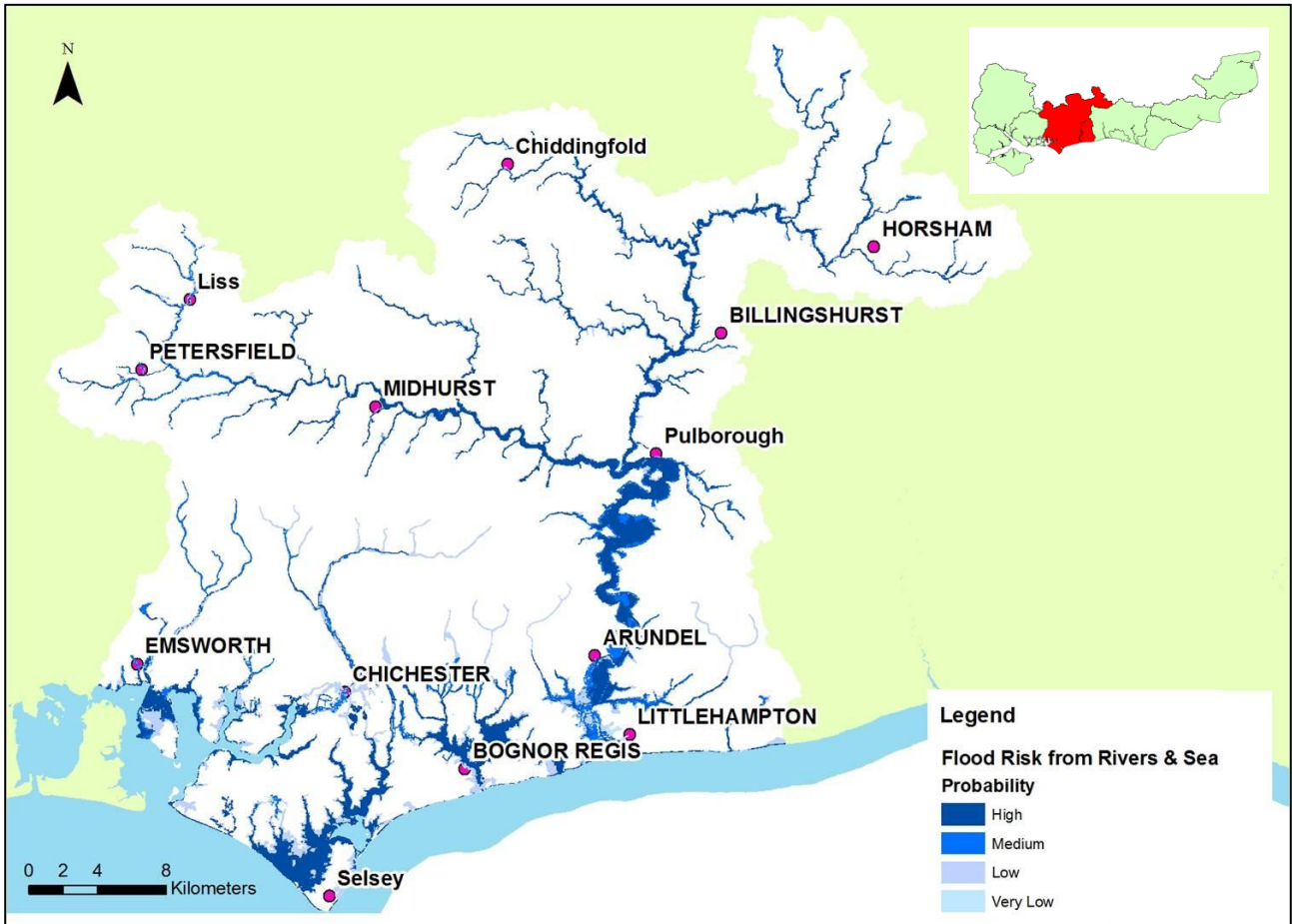


Figure 17: National Flood Risk Assessment (NaFRA) in the Arun and Western Streams catchment

Table 11; Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Arun and Western Streams catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	460,750	3,600	7,150	19,200	1,750
Number of services:	970	30	20	50	<10
Risk to economic activity:					
Number of non-residential properties:	61,200	1,450	950	2,450	300
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	220	<10	<10	10	0
Length of railway (km):	120	<10	<10	<10	0
Agricultural land (ha):	89,000	4,100	1,400	1,950	<50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	2	2	0	0	0
Number of EPR installations within 50m:	15	3	0	0	1
Area of SAC within area (ha):	1,400	50	<50	<50	0
Area of SPA within area (ha):	1,450	900	50	50	0
Area of RAMSAR site within area (ha):	1,200	900	50	50	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	5,850	1,050	50	100	0
Area of Parks and Gardens within area (ha):	3,550	50	<50	<50	0
Area of Scheduled Ancient Monument within area (ha):	500	<50	<50	<50	0
Number of Listed Buildings within area:	6,010	120	110	280	10
Number of Licensed water abstractions within the area:	410	140	20	20	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal and Coastal Flooding

The main risk of tidal flooding exists within Chichester Harbour, Pagham Harbour and the River Arun from Littlehampton to Arundel. Raised embankments exist on the Arun to mitigate against this risk and improvements have been carried out on the East bank of Littlehampton to offer greater protection to the town. Pagham Harbour currently has new flood defences being constructed within the harbour itself and further plans are proposed for improvements near Sidlesham.

Although large areas of Chichester Harbour are at risk of tidal flooding, there are very few properties at direct risk. The Harbour has an assortment of slipways, walls and earth embankment. The town of Emsworth and village of Bosham are two locations where tidal flooding is commonplace and residents currently use a combination of the Environment Agency's Flood Warning service and property level protection to mitigate against the risk. West Wittering has recently had a new flood defence bank constructed as a result of an effective partnership between the Environment Agency and local residents.

The risk of coastal flooding exists as a result of high sea levels and wave overtopping. Much of this risk is well understood and already managed to varying degrees. Towns like Littlehampton, Bognor Regis and Selsey all have defences designed to protect against coastal flooding.

At Medmerry, one of the largest coastal realignments in the UK has taken place at a cost of £28 million. In addition to protecting over 350 properties in the town of Selsey the scheme has also created over 180ha of important new habitat.

Climate change means that waves and the number of storm surges could increase. Changes to the currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposition and erosion. This could expose new risks from coastal flooding, lead to a greater risk of coastal defences failing and increase the need for maintenance work on defences and more extensive warning systems.

Coastal Erosion

The coastline is dominated by the coastal plain which in many locations terminates in very low soft cliffs, located mostly behind shingle beaches. Cliffs of a few metres height can be found around Selsey Bill where the majority of them are protected from erosion.

Fluvial flooding

The main sources of fluvial flooding within the Arun and Western Streams catchment comes from the Arun, Western Rother, Aldingbourne Rife, Ems and Lavant. Lesser flooding is associated with some of the smaller watercourses

The River Lavant in Chichester caused widespread flooding during 1993 to 1994 with a further incident in 2000. Significant improvements were carried out during and after the 2000 floods resulting in a flood alleviation scheme in the form of a bypass channel, taking peak flows away from the city.

A strategy exists for the Lower Tidal Arun, outlining the approach to managing the catchment, both now and into the future.

The climate is changing and this is likely to have an impact on flooding. Sea levels are rising and winter rainfall may become more intense. Changes in weather patterns and in particular more torrential rainfall is likely to increase flood risk from surface water and ordinary watercourses as well as rivers. Communities within the Arun and Western Streams catchment have experienced an increase in both severity and frequency of existing flooding problems and communities that have not previously been flooded have been affected in recent years. It is likely that this pattern will continue.

Surface Water flooding

Surface water flooding is known to occur in urban areas across the catchment, with the greatest risk being in the flatter, coastal areas, where drainage can be poor. Ponding in low spots coupled with various watercourse and surface water networks interacting can also lead to flooding when the system "backs up", particularly if it occurs in areas which suffer from 'tide-locking'.

Surface water can occur when sewer systems receive more rainwater than they are designed to handle and this can cause surcharging. Also in areas affected by groundwater, sewer capacity can be reduced when the water infiltrates into the network, which can again result in flooding.

Surface water flooding is a known issue across the Aldingbourne Rife catchment, in parts of Chichester, Angmering and Littlehampton.

Further information on surface water and groundwater in the Arun and Western Streams catchment can be found in the following Local Flood Risk Management Strategies:

- ▶ Hampshire County Council's Local Flood Risk Management Strategy at <http://www3.hants.gov.uk/flooding/floodriskstrategy.htm>
- ▶ West Sussex County Council's Local Flood Risk Management Strategy <http://www.westsussex.gov.uk/default.aspx?page=36272>

Groundwater flooding

Groundwater flooding is both complex and commonplace in the areas underlain by chalk across the catchment. When the porous rock becomes saturated, water rises to the surface and can then start flowing above ground causing a risk to properties and infrastructure. Groundwater can also rise up through basements and the foundations of properties in susceptible areas, making it particularly hard to mitigate against.

The upper River Ems and Lavant valleys around Stoughton, Walderton, East Dean, Chilgrove and Singleton are all especially susceptible to this source of flooding.

A groundwater flood alert area covers the River Lavant valley and the Environment Agency issues alerts when water levels rise in monitored boreholes.

West Sussex County Council, as one of the lead local flood authorities, is currently developing a management plan for groundwater in the River Lavant valley.

Flood risk from Reservoirs

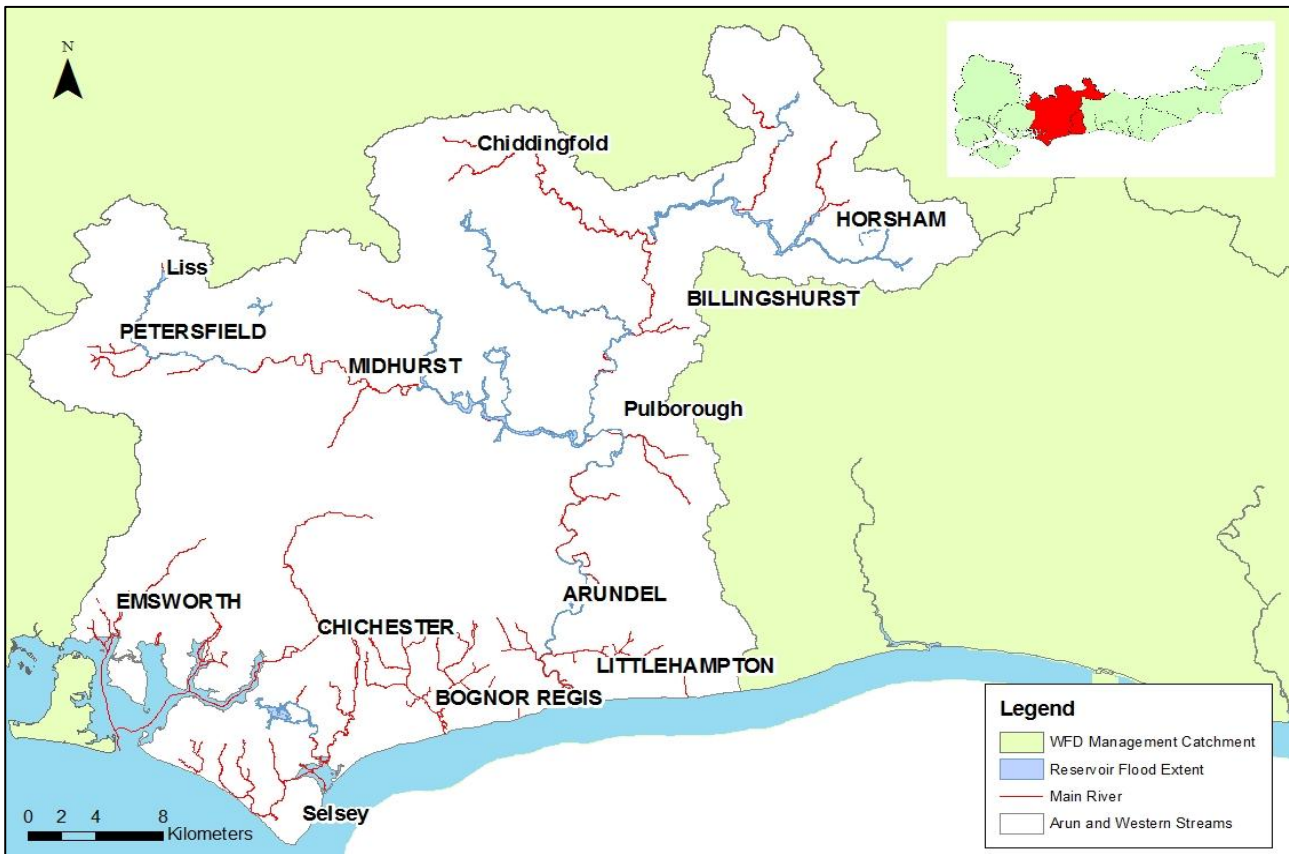


Figure 18: Reservoir flood risk in the Arun and Western Streams catchment

Reservoir Flooding

There are very few reservoirs in the catchment and subsequently property numbers at risk proportionately low. The reservoirs in the catchment are not generally used for water supply, but tend to be large lakes managed for amenity or on private estates.

Table 12: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Arun and Western Streams catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	460,750	1,550
Number of services:	970	10
Risk to economic activity:		
Number of non-residential properties:	61,200	200
Number of airports:	0	0
Length of trunk roads (km):	220	<10
Length of railway (km):	120	<10
Agricultural land (ha):	89,000	450
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	2	0
Number of EPR installations within 50m:	15	0
Area of SAC within area (ha):	1,400	<50
Area of SPA within area (ha):	1,450	<50
Area of RAMSAR site within area (ha):	1,200	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	5,850	50
Area of Parks and Gardens within area (ha):	3,600	<50
Area of Scheduled Ancient Monument within area (ha):	500	<50
Number of Listed Buildings within area:	6,010	30
Number of Licensed water abstractions within the area:	410	40

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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; aquatic weed cutting in main river and tributaries, inspection,

maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the Arun and Western Streams catchment

The catchment covers a mix of urban and rural areas, with different land uses, population densities and types of watercourse. The population in the Arun and Western Streams is mainly concentrated in the coastal areas with several towns and villages also located close to the river in the middle and upper areas of the catchment.

Of the 31,500 people at risk of fluvial or coastal flooding, over 19,000 are indicated as being at low risk. This is largely as a result of existing defences and measures currently in place to reduce risk, however it should be noted that defences can fail or be overtopped.

Work is being carried out to increase community awareness of the risk of flooding and the associated actions that they should take to increase resilience and minimise the impacts of flooding. Improved mapping and modelling is one of the most effective means of communicating and illustrating flood risk. Across the catchment there is an ongoing programme of modelling to ensure that risk from a variety of sources is better understood.

June 2012 saw one of the biggest flood events in recent memory in the southern part of the catchment with in excess of 700 properties flooding from both fluvial and surface water sources. 1993 to 1994, 2000 and the winter of 2013 to 2014 also saw widespread flooding across the catchment but with fewer properties flooded. 2008 saw a significant coastal flood event around Selsey and since the completion of Medmerry, this risk has dropped considerably with the benefits being seen during the 2013 to 2014 winter storms.

Surface water and groundwater flooding are both common in the catchment. West Sussex County Council as the lead local flood authority lead on managing flooding from these sources, but this is very much done in partnership with the Environment Agency and District and Borough Councils. Partnership working is happening in the Lavant Valley and Lancing to look at groundwater and surface water risk and across the Manhood Peninsula, Chichester and the Aldingbourne Rife catchment to look at Surface Water.

The Environment Agency has established a number of Flood Warning areas within the Arun and Western Streams catchment. The purpose of these areas is to provide as much warning of potential flooding to communities as possible. Flood Warning Areas cover coastal communities such as Emsworth, Pagham, Bognor and Littlehampton, and there are fluvial warning areas on the Lavant, Ems, Aldingbourne Rife, Arun and Rother. Work is continuously underway to further improve and refine this service.

Flooding from reservoirs and sewers continue to be a source of risk in this catchment. There has been reported sewer flooding incidents in recent years, leading to studies like the Lidsey Wastewater Treatment Works Surface Water Management Plan being developed to investigate this risk in greater detail.

The Pagham to East Head and Arun to Pagham Coastal Defence strategies set out how coastal risk can best be managed now and over the next 100 years. The Pagham to East Head strategy is approved and completed, whilst Arun to Pagham was consulted on in late 2014.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads
8. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

9. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
10. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
11. Promote sustainable soil and land use management across the catchment
12. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the Arun and Western Streams catchment

In the Arun and Western Streams catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work across the Arun and Western Streams catchment there are 33 measures to manage flood risk. Examples of these measures are provided here and the full list of measures can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk:

- Riparian flood awareness campaign – Work with local communities to promote awareness of riparian roles and responsibilities to managing watercourses

Preparing for risk:

- Maintain and improve flood warnings – Arun and Western Streams. Where appropriate, maintain and improve current flood warning services for the local communities in the Arun and Western Streams
- Work with West Sussex County Council and the National Flood Forum to support communities setting up flood action groups as part of recovery. West Sussex County Council Local Flood Risk Management Strategy Objective 4 Put communities at the heart of what we do and help West Sussex residents during flood events, and recover as quickly as possible after incidents
- Maintain Multi Agency Flood Plan for Arun, Chichester and Horsham District Councils - Councils will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Lidsey Waste Water Treatment Works Surface Water Management Plan - Finalise surface water management plan and develop a programme of works based on recommendations
- Pagham Beach Erosion Management Option – Beach management works to manage the erosion risk along Pagham Beach frontage

Protecting from risk:

- Development and implementation of the Selsey, Bracklesham and East Wittering Beach Management Plan - maintain beach condition and width
- Pagham Harbour Inland Banks Flood Alleviation Scheme – develop and implement proposals to improve standard of protection on the eastern side of Pagham Harbour
- Nore Farm, Emsworth – identify viable solutions to reduce flood risk to properties in Emsworth
- Lower Tidal River Arun Strategy Implementation - Investigation into options for implementation of the Lower Tidal River Arun FRM Strategy, including changing maintenance regimes in some locations
- Aldingbourne Rife Integrated Flood Risk Management Plan and Works - Construct new flood defences and look at land use management to reduce flood risk

Recovery and review of risk: there are no measures by the risk management authorities contributing to this FRMP over and above existing flood risk work.

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide Information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.6 The Adur and Ouse catchment

Introduction to the catchment

The Adur and Ouse catchment is situated within the counties of West and East Sussex. Although the catchments are geographically close, they are notably different in character.

The River Adur neighbours the Arun catchment to the west and starts its course as 2 different branches which confluence near Henfield. The western branch of the River Adur starts just outside the village of Coolham in West Sussex, rising over a clay and mudstone bedrock. The upper reaches of the Western Adur are typically rural with a sparse population. The land use is mainly agricultural and includes the large estate of Knepp Castle. An area of river restoration has taken place on the Knepp Castle estate reconnecting the river to its flood plain, ensuring a more natural and healthy river system develops.

The eastern branch begins just north of the South Downs outside the town of Burgess Hill. The upper reaches share similar mudstone geology to the west. From its source at Wintons Lakes, the Eastern Adur flows north through Burgess Hill where it then heads west and is met by 2 of its tributaries, the Herrings Stream and Pookbourne Stream. The eastern branch, although still largely rural, does have a greater population with notable settlements including Burgess Hill and Hassocks.

The river is tidally influenced as far upstream as the confluence between the 2 branches, typically the tidal limit is defined as Chates and Merrions Weirs. South of Henfield, the flood plain widens. Although the flood plain between Henfield and Upper Beeding is an important local habitat, it has no significant environmental designations unlike the Arun valley, and the flood plain is typically used for livestock grazing. The river continues to head south through the South Downs, passing through the historic village of Bramber which was formally a port until medieval times when the river became too silted for it to be viable. As the river heads south towards its mouth at Shoreham, the local landmark of Beeding Cement Works signifies a change in the geology as the river passes over the chalk of the South Downs. The Downs Link is also a prominent feature at this point, formerly a railway line linking the coast to Surrey, which was decommissioned as part of the Beeching report, but later restored as a popular cycle and footpath joining the South and North Downs.

The port of Shoreham by Sea sits at the mouth of the River Adur with a large canal basin to the east which forms the functional area of the port. The river itself is not extensively used for industry, although there is some along the A259. The port is a thriving import/export hub for timber, metal and aggregates and also has a large fishing fleet.

The River Ouse catchment shares more in common with the River Arun than the Adur with regards to its head waters. The river rises in the sandstone near St Leonards Forest and continues to flow east under the A23 before turning south easterly near Haywards Heath. Haywards Heath itself is drained by the Scrasebridge and West Common Streams, both of which have a known history of flooding and have had improvement works carried out to mitigate against this. The River Ouse then starts moving through rural pastures away from Haywards Heath where the flood plain starts to widen as the topography changes. The River Uck is a significant tributary of the Ouse, with its headwaters again starting over sandstone. It has similar characteristics to the Ouse in terms of flood response. The Uck passes through the town of Uckfield, which in 2000, like much of the Ouse valley, experienced a significant flood event leading to widespread residential and commercial flooding. From Uckfield, the river flows south to its confluence with the Ouse just outside the village of Isfield. These middle reaches of the Ouse have been subject to improvements and restoration to a more natural state as part of the Middle Ouse Restoration Project (MORPH) and examples of this can be seen near Sheffield Park.

Downstream of Isfield the River Ouse flows towards Barcombe Mills, this forms the tidal limit. This large set of weir and gate structures is operated and maintained by the Environment Agency and provides a popular amenity and recreation spot. The tidal flood plain widens considerably and raised earth embankments line the river offering protection to farmland from regular inundation.

The historic county town of Lewes sits between a narrow gap in the downs through which the Ouse passes. The town is a popular visitor destination famous for its Harveys Brewery, castle, historic buildings and large bonfire celebrations each year. As with Uckfield, Lewes experienced significant flooding in the autumn of 2000 and also in the winter of 1960 leading to hundreds of properties flooding and the area receiving high media interest.

The river continues to flow south to its mouth at Newhaven. Newhaven itself is a port with various industry and businesses operating from it including a large energy recovery facility and a ferry terminal with links to the French town of Dieppe.

Although the Adur and Ouse are the principle watercourses within this catchment, east of the Adur two smaller rivers form their own catchments and discharge into the sea. To the west of Worthing, the Ferring Rife flows through the residential area of Durrington before passing through the village of Ferring where it drains via a flapped outfall on the beach. The river is principally fed from groundwater rising from the chalk and surface water inflows from the urban area. As the river discharges via a flapped outfall, it can mean that when the tide is high, the river cannot drain and becomes 'tide-locked' for a period of time.

To the east of the Ferring Rife is the Teville Stream. Much like the Ferring Rife, the river is fed by groundwater in the chalk and urban inflows from the town of Worthing. The river is culverted for much of its length although it does flow as an open channel in places, including where it joins Brooklands Lake. Brooklands Lake is the point where the stream joins the sea via a series of penstock valves and a flapped outfall. Brooklands Lake is managed by the local council and is a popular amenity space with a model railway, boating and play areas.

The coastline in the catchment is primarily made up of shingle beaches in the east and beyond Brighton, the coastline rises up and chalk cliffs dominate to Newhaven. The shingle beaches are actively managed and form a vital part of the coastal flood defences in the area. The shingle is effective at dissipating wave energy meaning that the risk of structures overtopping is reduced. Most of the beaches are managed in conjunction with sea walls or banks of some description. The chalk cliffs are prone to erosion and landslips. A notable example of this is around Brighton Marina where regular slips have closed paths and in 2001 a significant landslide caused damage to a supermarket situated there.

The main streams and rivers that drain the Adur and Ouse catchment are:

- ▶ River Adur (West and East branches and tributaries)
- ▶ River Ouse
- ▶ River Uck (major tributary of the River Ouse)
- ▶ Scrasebridge Stream
- ▶ West Common Stream
- ▶ Ferring Rife
- ▶ Teville Stream

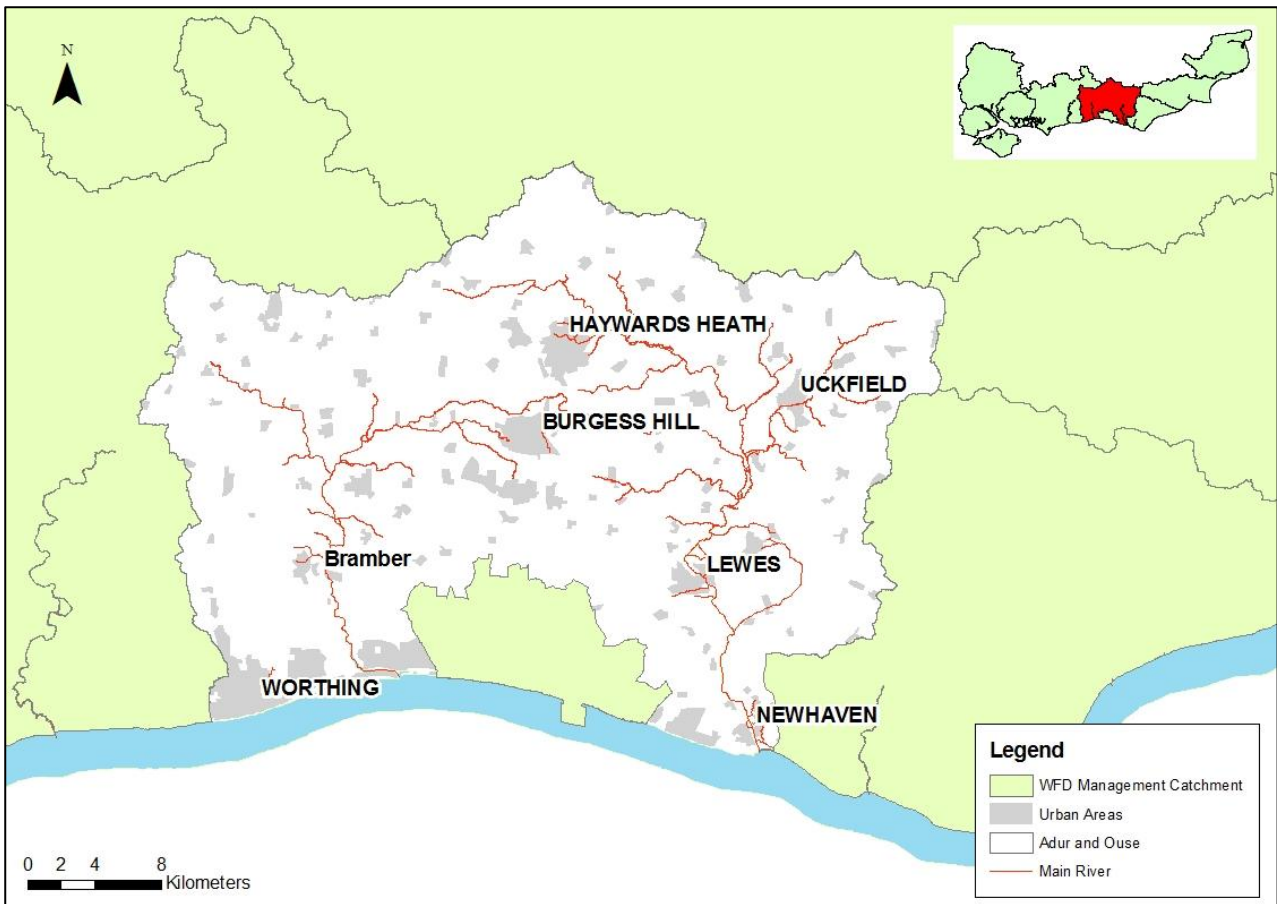


Figure 19: Overview of the Adur and Ouse catchment

Land Use and Management

The land use across the Adur and Ouse catchment is diverse. Much of the catchment is rural and made up of small towns and villages. The main urban centres like Worthing, Shoreham and Newhaven are located along the coastal plain with a few larger towns like Lewes, Haywards Heath, Burgess Hill and Uckfield located inland. As the majority of the major towns are located along rivers or near the sea they are generally at risk of flooding. In many of these towns such as Lewes and Haywards Heath, the interactions between rivers and surface water from heavy rainfall means the causes of flooding are often complex and interlinked. In recent years there has been an increase in development across the catchment which has presented challenges to planning authorities and developers to ensure the risk of flooding is not increasing to new or existing communities. Each local planning authority has a Strategic Flood Risk Assessment setting out how best to consider flood risk in conjunction with spatial planning

In 2011 the South Downs which sit across the middle of the catchment became the most recent National Park in England and Wales. In 2013 the area between Brighton and Lewes was designated a UNESCO Biosphere. The Brighton and Lewes Downs Biosphere covers around 390 square kilometres of land and sea in Sussex, between the Rivers Adur and Ouse and lies partly within the South Downs National Park. Extending two nautical miles out to sea, it also includes part of one of the first Marine Conservation Zones.

With the downs and coast in close proximity, many areas in the Adur and Ouse catchment are popular tourist destinations. The beaches along Worthing and Shoreham are popular for a range of watersport activities, including kite surfing, kayaking and sailing. Whilst inland, The South Downs Way, Downs Link and Monarchs Way are all notable long distance paths which provide amenity and recreation opportunities within the catchment.

Angling is popular on both the Adur and Ouse with both rivers experiencing a good run of Sea Trout as well as supporting populations of native Brown Trout.

Geology

The geology of the headwaters vary for each watercourse within the catchment. The River Adur generally drains areas of clay and mudstone in its upper reaches before flowing south through the chalk of the South Downs. The River Ouse starts in the free draining sandstone of St Leonards Forest before flowing over a variety of sandstone, mudstone and finally chalk bedrock near its mouth. The underlying geology can have a notable bearing on rivers' response to rainfall, particularly in winter months when the ground can be saturated. In addition to the chalk fed streams of the Teville and Ferring Rife, the Lewes Winterbourne Stream (a tributary of the Ouse) is a typical ephemeral chalk stream which will either run dry or have steady baseflow depending on the groundwater levels within the chalk aquifer which feeds it.

National and International Designations

The Adur and Ouse catchment contains a few water dependent environmentally designated sites - a notable one being the Site of Special Scientific Interest (SSSI) at Lewes Brooks. The South Downs National Park and Brighton to Lewes UNESCO Biosphere make up 2 significant designations, with the latter being internationally recognised. A Marine Conservation Zone (MCZ) also exists along the cliffs between Brighton and Newhaven.

Partnership Working

Within the Adur and Ouse catchment, risk management authorities are working alongside a number of partners. West Sussex County Council and East Sussex County Council are both lead local flood authorities operating within the catchment. There are also the district and borough councils of Horsham, Adur and Worthing, Mid Sussex, Lewes and Wealden who work in partnership with the Environment Agency.

Southern Water Services is both a water and sewerage provider in this catchment and they actively participate in partnership working to identify and address flood risk issues. In addition to Southern Water Services, South East Water is also a water supplier working in the catchment.

There are a number of other partners who work closely with risk management authorities including: National Farmers Union, Natural England, Marine Management Organisation, Sussex Wildlife Trust, Hampshire Wildlife Trust, Wildfowl and Wetlands Trust, as well as the Adur and Ouse Rivers Trust.

In 2011 The Adur and Ouse Catchment Delivery Partnership was established with support from a number of organisations. The Partnership has developed over time and comprises a broad membership of organisations and individuals representing a range of interests throughout the Adur and Ouse catchment, including the coast. The Partnership is 'hosted' by the Environment Agency and was one of ten Defra-led pilot catchments.

As the majority of the coastline within the Adur and Ouse catchment is defended in urban areas, there is a strong emphasis on partnership working in order to provide coastal protection. The Environment Agency actively works with the local councils, who under the Coast Protection Act have a role in managing coastal erosion. As a result several strategies have been jointly produced for the coastline in this catchment.

Two Local Enterprise Partnerships (LEPs) sit within the Adur and Ouse catchment: the Coast to Capital Local Enterprise Partnership and South East Local Enterprise Partnership. Their objectives are to promote economic growth and employment. They have a particular interest in developing an Environmental Technologies Growth Centre at Shoreham and a Clean Tech Growth Hub at Newhaven. The LEPs are making significant contributions from their Local Growth Funds to flood defence improvements in Shoreham and Newhaven

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Adur and Ouse catchment are described in the tables and figures below.

Flood risk from Rivers and the Sea

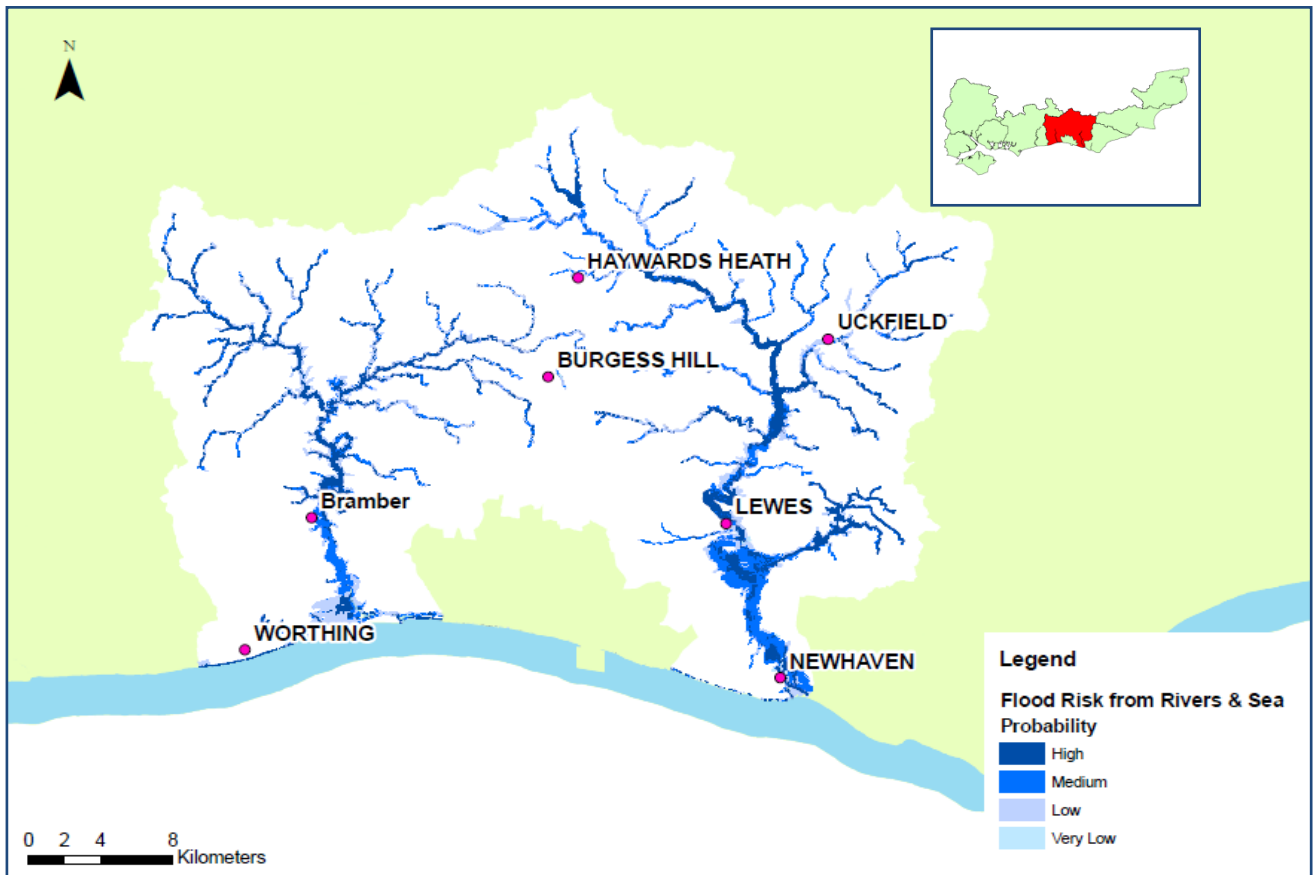


Figure 20: National Flood Risk Assessment (NaFRA) in the Adur and Ouse catchment

Table 13: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Adur and Ouse catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	686,750	1,050	3,050	11,650	200
Number of services:	930	20	20	20	<10
Risk to economic activity:					
Number of non-residential properties:	60,600	550	650	1,500	50
Number of airports:	1	1	0	0	0
Length of trunk roads (km):	300	<10	10	10	0
Length of railway (km):	110	10	10	10	0
Agricultural land (ha):	74,150	1,100	1,150	800	<50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	4	4	0	0	0
Number of EPR installations within 50m:	11	1	0	1	1
Area of SAC within area (ha):	850	0	0	0	0
Area of SPA within area (ha):	600	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):	3,350	150	250	<50	0
Area of Parks and Gardens within area (ha):	1,900	50	<50	<50	0
Area of Scheduled Ancient Monument within area (ha):	400	<50	<50	<50	0
Number of Listed Buildings within area:	4,950	10	30	120	10
Number of Licensed water abstractions within the area:	160	30	<10	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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal and Coastal Flooding

The main risk of tidal flooding exists within the harbour areas of Shoreham and Newhaven. High astronomical tides coupled with storm surges means the water levels in these areas can become elevated and overtop existing defences. Strategies have recommended improvements to existing flood defences in both locations which are currently being progressed.

The winter of 2013 to 2014 saw property and infrastructure flooding as a result of storm surges in both Shoreham and Newhaven. Lewes is also susceptible to tidal flooding, but this is generally only when it coincides with times of high river levels in the Ouse. Significant improvements completed at Malling Brooks and Cliffe in Lewes have helped reduce this risk. There are also raised embankments on both the Adur and Ouse along their tidal reaches.

The urban areas along the coast currently benefit from the Environment Agency's Flood Warning service and in conjunction with property level protection can help further reduce the impacts of flooding.

The risk of coastal flooding exists as a result of high sea levels and wave overtopping. Much of this risk is well understood and already managed to varying degrees. Worthing, Lancing, Shoreham and Seaford all have managed beaches and coastal defences offering a good standard of protection against this risk. Coastal strategies exist for the coastline between the Arun and Adur as well as Newhaven to Seaford Head. These outline the management of flood risk both now and into the future.

Climate change means that waves and the number of storm surges could increase. Changes to the currents acting on the coast could also lead to changes in the movement of coastal sediments, affecting both coastal deposition and erosion. This could expose new risks from coastal flooding, lead to a greater risk of coastal defences failing, increase the need for maintenance work on defences and require more extensive warning systems to be put in place.

Coastal Erosion

The coastline changes from the coastal plain in the west to chalk cliffs in the east. Most of the Chalk cliffs are protected by seawalls at the base of the cliff with only short stretches of natural cliffs. Erosion of these cliffs still contributes a small amount of flint gravel to the beaches.

Fluvial flooding

The main sources of fluvial flooding within the Adur and Ouse catchment comes from the Rivers Adur, Ouse and Uck. There is also flood risk associated with other watercourses such as the Ferring Rife and Scrasebridge Stream.

Much of the fluvial flooding seen in 2000 has led to significant investment in flood defences in the towns of Uckfield and Lewes. Subsequently parts of these communities are now protected to a much higher standard than they were before this event.

Flooding does still occur most winters within rural flood plain areas. The wide, low lying valleys of the Rivers Adur and Ouse can often remain under water for prolonged periods in the winter and can have an impact on rural road networks. Individual isolated properties throughout the catchments may also be susceptible to flooding and can become cut off; this can include properties around Barcombe Mills on the River Ouse and Mock Bridge on the River Adur.

The Scrasebridge Stream in Haywards Heath can respond quickly to intense rainfall events. Within the town there are several weedcreens on culverts which require close monitoring during such events as they are prone to blockages which can lead to flooding.

Surface Water flooding

Surface water flooding is known to occur in urban areas across the catchment. Ponding in low spots, coupled with various watercourse and surface water networks interacting can also lead to flooding when the system "backs up". This is particularly an issue if it occurs in areas which suffer from 'tide-locking'.

Surface water flooding can occur when sewer systems receive more rainwater than they are designed to handle which can cause surcharging. In areas affected by groundwater, sewer capacity can be reduced when the water infiltrates into the network increasing the risk of flooding.

Surface water flooding is an issue in parts of Burgess Hill, Uckfield, Lancing, Lewes, Hassocks, Haywards Heath and Worthing.

Further information on surface water and groundwater in the Adur and Ouse catchment can be found in the following Local Flood Risk Management Strategies:

- ▶ West Sussex County Council's Local Flood Risk Management Strategy
<http://www.westsussex.gov.uk/default.aspx?page=36272>
- ▶ East Sussex County Council's Local Flood Risk Management Strategy
<http://www.eastsussex.gov.uk/environment/flooding/localfloodriskmanagementstrategy>

Groundwater flooding

Groundwater flooding is both complex and commonplace in the areas underlain by chalk across the catchment. When the porous rocks become saturated, water rises to the surface and can then start flowing above ground causing a risk to properties and infrastructure. Groundwater can also rise up through basements and the foundations of properties in susceptible areas, making it particularly hard to mitigate against

The Lewes Winterbourne Stream is actively monitored to ensure appropriate action is taken when groundwater reaches a certain level indicating the stream will start flowing. A flood warning area covers the Winterbourne and the Environment Agency issues alerts when water levels rise in monitored boreholes.

Flood risk from Reservoirs

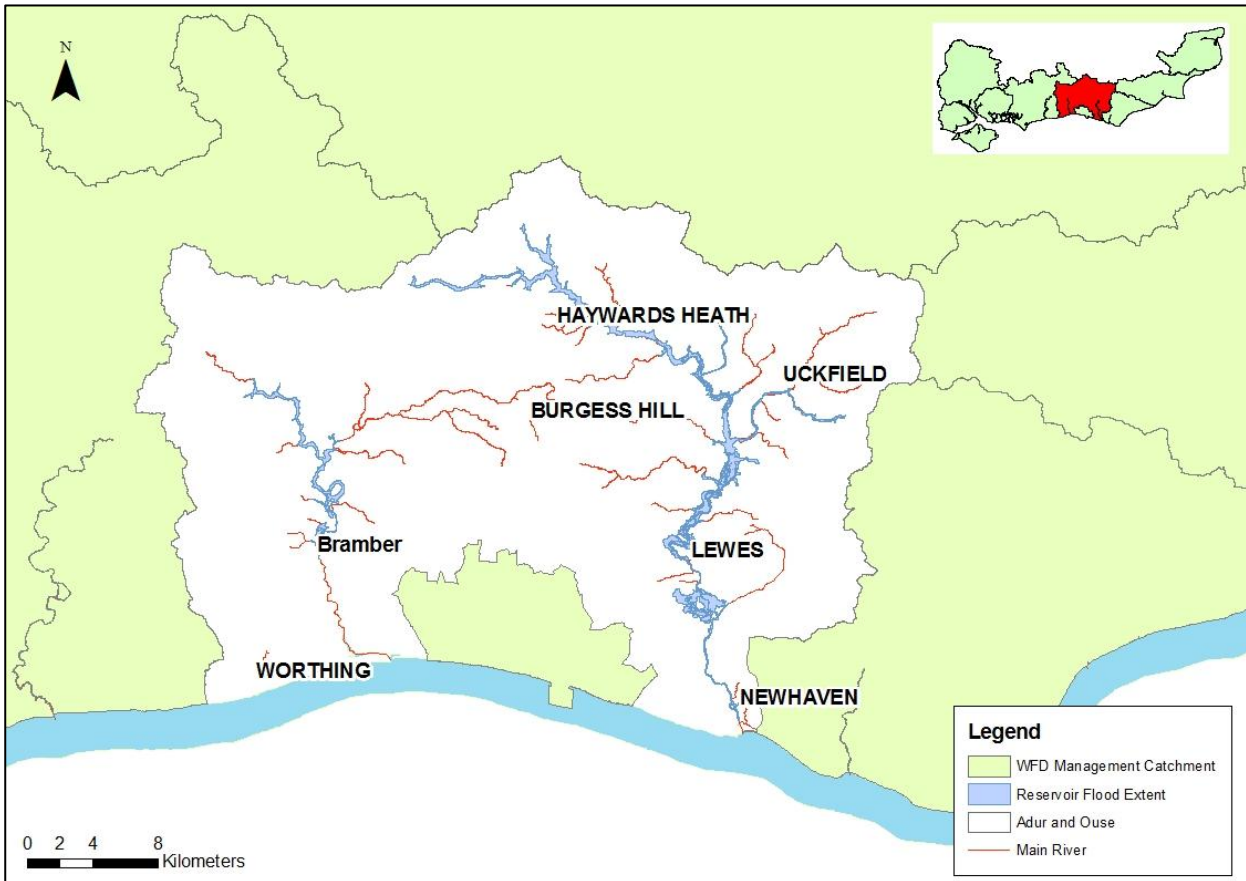


Figure 21: Reservoir flood risk in the Adur and Ouse catchment

Reservoir Flooding

There are 2 notable reservoirs used for water supply within the catchment; Ardingly and Barcombe which are both on the River Ouse. Ardingly is a popular amenity and recreation venue providing walks, angling and watersports. Other reservoirs within the catchment are generally private lakes or impoundments such as the mill pond at Knepp Castle.

Table 14: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Adur and Ouse catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	686,750	200
Number of services:	930	<10
Risk to economic activity:		
Number of non-residential properties:	60,600	350
Number of airports:	1	0
Length of trunk roads (km):	300	<10
Length of railway (km):	110	<10
Agricultural land (ha):	74,150	750
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	4	0
Number of EPR installations within 50m:	11	0
Area of SAC within area (ha):	850	0
Area of SPA within area (ha):	600	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):	3,350	150
Area of Parks and Gardens within area (ha):	1,900	<50
Area of Scheduled Ancient Monument within area (ha):	400	<50
Number of Listed Buildings within area:	4,950	20
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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; aquatic weed cutting in main river and tributaries, inspection,

maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the Adur and Ouse catchment

The catchment covers a mix of urban and rural areas, with different land uses, population densities and types of watercourse. The population in the catchment is mainly concentrated in the coastal areas with several towns and villages located close to the river in the middle and upper areas of the catchment.

Of the 16,000 people at risk of fluvial or coastal flooding, over 11,000 are indicated as being at low risk. This is largely as a result of existing defences and measures currently in place to reduce risk.

Work is being carried out to increase community awareness of the risk of flooding and the associated actions that they should take to increase resilience and minimise the impacts of flooding. Improved mapping and modelling is one of the most effective means of communicating and illustrating flood risk. Across the catchment there is an ongoing programme of modelling to ensure that risk from a variety of sources is better understood. Modelling has already been completed along much of the coast, on some of the Adur and also the Ouse, the outputs of which are being used to inform decision making processes.

Whilst flooding does occur in these catchments, it has not been as severe as the fluvial flood event of autumn 2000. This event led to significant improvements in flood defences in Lewes and Uckfield. The storm surge that occurred in winter 2013 to 2014 highlighted the risk from the sea when the airport at Shoreham was flooded and the railway line at Newhaven was also inundated.

Surface water and groundwater flooding both exist in the catchment. West and East Sussex County Councils as the lead local flood authorities lead on managing flooding from these sources. This is done in partnership with the Environment Agency and district and borough councils.

The Environment Agency has established a number of Flood Warning areas within the catchment. The purpose of these areas is to provide as much warning as possible to communities of potential flooding. Flood Warning Areas cover coastal communities such as Worthing, Lancing, Ferring Shoreham and Newhaven as well as fluvial warning areas on the Ferring Rife, Adur, Scrasebridge Stream, Ouse and Uck. Work is continuously underway to further improve and refine this service.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks

7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads
8. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

9. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
10. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
11. Promote sustainable soil and land use management across the catchment
12. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the Adur and Ouse catchment

In the Adur and Ouse catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work across the Adur and Ouse catchment there are 20 measures to manage flood risk. Examples of these measures are included here and the full list of measures can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 – 2021.

Preventing risk:

- Brighton Marina to River Adur FCERM Strategy – complete long term assessment of flood and coastal erosion risk
- Saltdean to Newhaven Cliff Monitoring, Analysis and Management – monitoring of cliffs to inform erosion risk for Brighton frontage
- Lower Tidal River Adur Strategy. Develop strategy to assess long term options for managing catchment

Preparing for risk:

- Maintain and improve flood warnings – Adur and Ouse. Where appropriate, maintain and improve current flood warning services for the local communities in the Adur and Ouse
- Maintain Multi Agency Flood Plan for Sussex Resilience Forum. West Sussex County Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken
- Maintain Multi Agency Flood Plan for Mid Sussex District Council. Mid Sussex District Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Maintain Multi Agency Flood Plan for Lewes District Council. Lewes District Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Work with West Sussex County Council and the National Flood Forum to support communities setting up flood action groups as part of recovery in Adur District. West Sussex County Council Local Flood Risk Management Strategy Objective 4 Put

communities at the heart of what we do and help West Sussex residents during flood events, and recover as quickly as possible after incidents

Protecting from risk:

- Newhaven Flood alleviation scheme. Implement new flood risk management programme actions
- Seaford beach management. Continue management of existing beach to provide flood protection
- Shoreham and Lancing Coastal Defences Beach Management Plan. Plan to maintain beach condition and width
- Shoreham Adur Tidal Walls Scheme. Implement new flood risk management programme actions
- Worthing – Development, delivery and construction of replacement groynes

Recovery and review of risk: there are no measures by the risk management authorities contributing to this FRMP over and above existing flood risk work.

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.7 The Cuckmere and Pevensey Levels catchment

Introduction to the catchment

The Cuckmere and Pevensey Levels catchment is entirely within the county of East Sussex. The largely rural landscape of the High and Low Weald contains many small villages, the fast growing town of Hailsham and the coastal towns of Seaford, Eastbourne, Bexhill and Hastings.

In the west of the catchment the Cuckmere River rises near Heathfield and joins with its principal tributary, the Bull River at the village of Hellingly. The Knockhatch Stream starts in the heart of Hailsham and flows westward to join the Cuckmere north of Michelham Priory. In the south of the catchment the Cuckmere River passes through the Chalk Downs and the flood plain is relatively narrow and constrained.

There are no significant flood defences along the non-tidal Cuckmere River network and so out of bank flows happen fairly often, causing inundation of the natural flood plain. The flood plain is quite broad and flat in places but with a clearly defined edge where the slope rises abruptly to higher ground. Once the river overtops its banks, flooding can be extensive but is generally shallow and slow moving.

Flooding in the lower reaches of the Cuckmere River can be exacerbated by high tides, and as the valley widens significantly below Alfriston, the extent of flooding can be considerable. Tidal and fluvial flooding in this area is mitigated by earth embankments. However groundwater and surface water flooding can occur as water behind the defences cannot drain freely into the Cuckmere whilst the river level is high.

To the east of the Cuckmere valley lies the Pevensey Levels, a lowland grazing marsh covering 4,300 hectares situated between Eastbourne and Bexhill-on-Sea. Two main watercourses feed the Levels – the Pevensey Haven and Wallers Haven. The Pevensey Haven is fed from streams to the west and north of the Levels and flows down to Pevensey Bay where it enters the sea through outfalls. In summer months the Wallers Haven acts as a reservoir for public water supply. High water levels are needed in the Wallers Haven and other embanked rivers to ensure outlying ditches and streams are kept topped up to support the resident wildlife.

Water moves through the Pevensey Levels by a complex network of ditches. Water levels in the ditches are controlled by a series of pumping stations and sluices operated by the Environment Agency.

The Pevensey Levels is one of the most environmentally important wetland areas in southern England, being of national and international importance for its biological diversity, including the Fen Raft spider. It is designated as a Site of Special Scientific Interest (SSSI), a Ramsar site and a Special Area of Conservation (SAC).

The coast between Eastbourne and Bexhill-on-Sea is protected by the Pevensey Bay Sea Defence scheme. It was the first coastal defence scheme anywhere in the world to be funded as a Public Finance Initiative. In committing to a 25 year contract, local residents and the internationally designated sites are guaranteed a consistent standard of defence until at least 2025.

To the east of the catchment is the Combe Haven. The rural upper reaches of the Powdermill and Watermill Streams drain to the Combe Haven, with the Hollington Stream merging just before it discharges to the sea. The Alexandra Park Stream and Egerton Park Stream flow through Hastings and Bexhill-on-Sea before discharging to the English Channel.

In some of the low lying towns such as Polegate, Bulverhythe and Bexhill, the interactions between rivers, sea and surface water from heavy rainfall means the causes of flooding are often complex and interlinked.

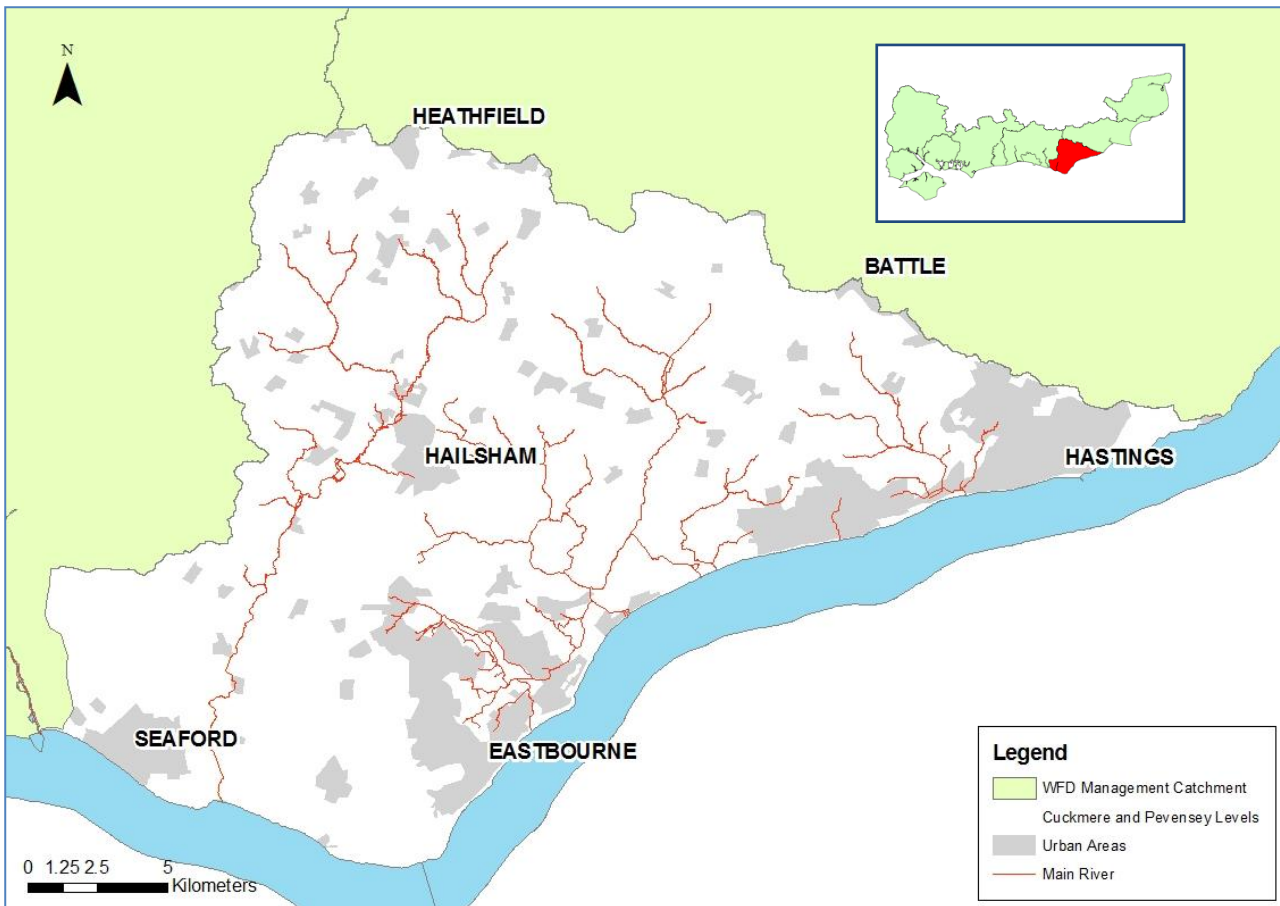


Figure 22: Overview of the Cuckmere and Pevensey Levels catchment

Land Use and Management

This is a mainly rural area with just 12% of the land area classified as urban, with the remaining land coverage being agricultural land moderate to good quality. The area is also home to approximately 370,000 people with urban centres mainly located on the coast including Eastbourne, Bexhill and Hastings.

Geology

The catchment is characterised by relatively impermeable geology within the upper catchments, which contributes to the flashy nature of the High Weald streams, as well as resulting in a strong seasonal variation due to relatively low base-flow. Run-off can be rapid, and the onset of flooding in the upper and middle parts of the Cuckmere catchment and the upper tributaries of the Combe Haven can occur with little warning.

The permeable chalk geology in parts of the lower catchment results in more complex groundwater flooding and surface water drainage problems. During extended wet periods, springs emerge along the base of the South Downs, causing localised flooding. This can be a particular problem around Alfriston where the Cuckmere River cuts through the South Downs.

Although the principal underlying geology on the Pevensey and Willingdon Levels area of the catchment is Tunbridge Wells sandstone, the overlying drift geology is marine alluvial silts and clay, which are relatively impermeable. Combined with the very flat and low-lying nature of the topography, the poor drainage of the soils in the area can result in lengthy periods of standing surface water on the land and the need for an extensive artificial drainage network.

Flow characteristics of the rivers tend to be dominated by topography, with fast flowing streams emerging from the Upper Weald area to the north, flowing into the low-lying coastal plain where the

gradient is less and the river flows are much slower. The steep slopes and impermeable soils of the upper catchment result in rapid run-off.

National and International Designations

Much of the area is designated as being of local or national interest in terms of conservation and landscape quality. The Cuckmere valley south of the A27 is part of the South Downs National Park. The Pevensey Levels are designated as a Special Area of Conservation (SAC) and Ramsar Site, and as a Site of Special Scientific Interest (SSSI). There are 17 other SSSIs across the catchment. A Marine Conservation Zone (MCZ) also exists along the cliffs between Seaford and Beachy Head, which includes the mouth of the river Cuckmere.

Partnership Working

The Environment Agency is working with Local Resilience Forum partners and East Sussex County Council to prepare and improve multi agency response to flooding throughout the Pevensey and Cuckmere catchment.

Within the Pevensey and Cuckmere catchment, the Environment Agency is working alongside a number of partners. The catchment is covered by more than one local council; the district and borough councils of Hastings, Wealden and Rother all of which the Environment Agency has active partnerships with. East Sussex County Council is the lead local flood authority operating within the catchment

Southern Water Services is both a water and sewerage provider in this catchment and they actively participate in partnership working to identify and address flood risk issues. In addition to Southern Water Services, South East Water is also a water supplier working in the catchment.

Three catchment partnership groups exist; The Cuckmere, The Pevensey Levels and the Combe Haven. There are other partners in these groups including: National Farmers Union, Natural England, Sussex Wildlife Trust, local land owners, angling groups and voluntary action groups. These groups meet to discuss a range of issues including flood risk and Water Framework Directive actions.

Many of the same groups are involved in the Pevensey Advisory Group, which was set up specifically to look into issues and ideas concerning the management of the Pevensey Levels SSSI.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Cuckmere and Pevensey Levels catchment are described in the table and figures below.

Flood risk from Rivers and the Sea

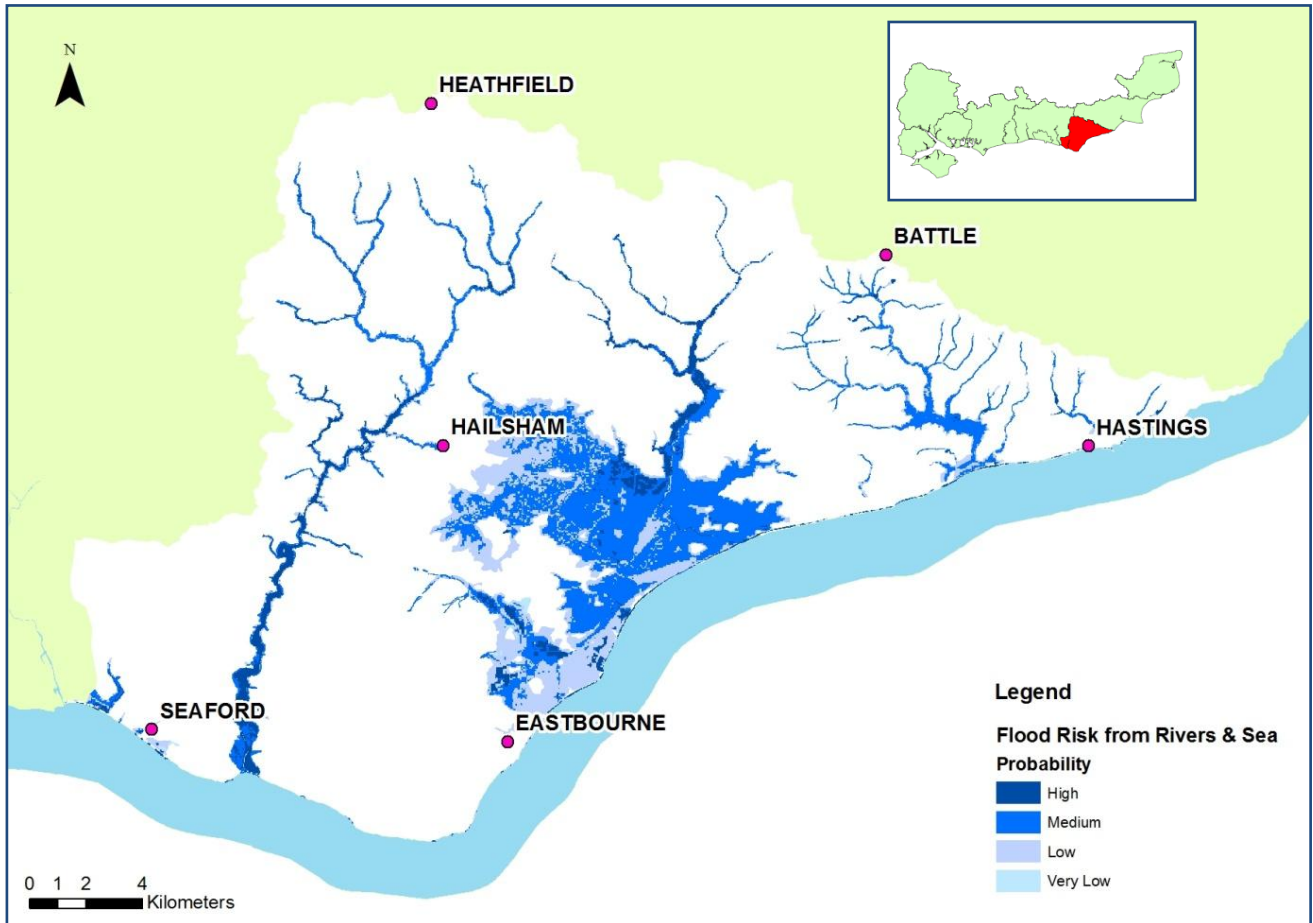


Figure 23 : National Flood Risk Assessment (NaFRA) in the Cuckmere and Pevensey Levels catchment.

Table 15: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Cuckmere and Pevensey Levels catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	370,150	300	4,200	43,950	1,850
Number of services:	470	10	20	50	<10
Risk to economic activity:					
Number of non-residential properties:	29,650	50	700	2,350	50
Number of airports:	0	0	0	0	0
Length of trunk roads (km):	80	<10	<10	10	0
Length of railway (km):	50	0	10	10	0
Agricultural land (ha):	32,800	650	3,200	1,500	<50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	4	4	0	0	0
Number of EPR installations within 50m:	6	0	0	0	0
Area of SAC within area (ha):	150	<50	<50	<50	0
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	3,600	250	2,400	800	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	5,650	450	2,600	800	0
Area of Parks and Gardens within area (ha):	850	<50	<50	<50	0
Area of Scheduled Ancient Monument within area (ha):	150	<50	<50	<50	0
Number of Listed Buildings within area:	1,910	<20	10	40	<10
Number of Licensed water abstractions within the area:	60	10	10	<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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal and Coastal Flooding

The risk of tidal flooding is restricted to the lower Cuckmere River, where tidal surges may overtop the existing tidal defences. The Cuckmere Estuary Strategy recommends no active intervention on the tidal embankments south of the A259, so the risk of flooding there is likely to rise over time, although no residential properties are at risk.

The coastal areas between Eastbourne and Hastings are generally low-lying and reliant on storage for fluvial flows within the watercourses during 'tide-locked' conditions. The whole of this length of coastline is reliant on gravity drainage during low tides and there are no pumped systems currently in place.

The urban areas along the coast currently benefit from the Environment Agency's Flood Warning service and this is used in conjunction with property level protection to help reduce the impacts of flooding.

The risk of coastal flooding exists as a result of high sea levels and wave overtopping. Much of this risk is well understood and already managed to varying degrees. Eastbourne, Pevensey Bay, Bexhill and Hastings all have managed beaches and coastal defences.

Coastal Erosion

The catchment is prone to the natural erosion of the Chalk cliffs in the west that provide a small but natural addition of flint to the beaches fronting the cliffs and to the east. Cliffs composed of sand and mudstone can be found in the eastern part, providing sand to the beaches in Rye Bay to the east. Longshore transport of beach material from west to east can lead to a loss of beach (erosion) in one location. However, this material leads to a gain of beach to the east and the natural movement is counterbalanced by moving the beach material back through beach management (recycling).

Fluvial flooding

The main location of fluvial flooding within the Cuckmere catchment is restricted to the natural flood plain downstream of Hailsham, although flooding is experienced within the Upper Horsebridge area to the east of Hailsham.

Fluvial flooding occurs regularly in the Combe Haven valley when the channel capacity is exceeded and water overtops onto the flood plain. Flooding can occur rapidly in Crowhurst, which is often compounded by surface water run-off, however the floodwater recedes quite quickly. Lower down the valley, the floodwater can remain for many days, discharging to sea as the tidal conditions allow.

The watercourses draining into the remainder of the area are generally steep and flashy draining onto the low lying levels where flooding is relatively shallow. On the levels, fluvial flooding can be exacerbated when combined with groundwater, surface water and 'tide-locked' conditions.

Surface Water flooding

The low-lying nature of the levels makes it particularly susceptible to surface water flooding, especially during 'tide-locked' conditions. In addition to this, within the built up areas in the upper catchments, particularly Bexhill and Hastings, surface water drainage systems can be overloaded during extreme events, resulting in surcharging and overland flood flows. Overland flows in urban areas can be obstructed by obstacles, such as railway and road embankments, resulting in the backing up of the surface water to a considerable depth.

Surface water flooding would be a significant issue within Eastbourne and the surrounding area if it was not for the Eastbourne Flood Storage Park, which is maintained and managed by Eastbourne Borough Council.

Further information on surface water and groundwater in the Cuckmere and Pevensey Levels catchment can be found East Sussex County Council's Local Flood Risk Management Strategy: <http://www.eastsussex.gov.uk/environment/flooding/localfloodriskmanagementstrategy>

Groundwater flooding

Groundwater flooding is both complex and commonplace in the areas underlain by chalk across the catchment. When the porous rocks become saturated, water rises to the surface and can then start flowing above ground causing a risk to properties and infrastructure. It affects the low lying levels, including parts of Eastbourne, and can also be a problem where springs emerge along the base of the South Downs. This causes localised flooding in places such as Alfriston. Groundwater can also rise up through basements and the foundations of properties in susceptible areas, making it particularly hard to mitigate against.

Flood risk from Reservoirs

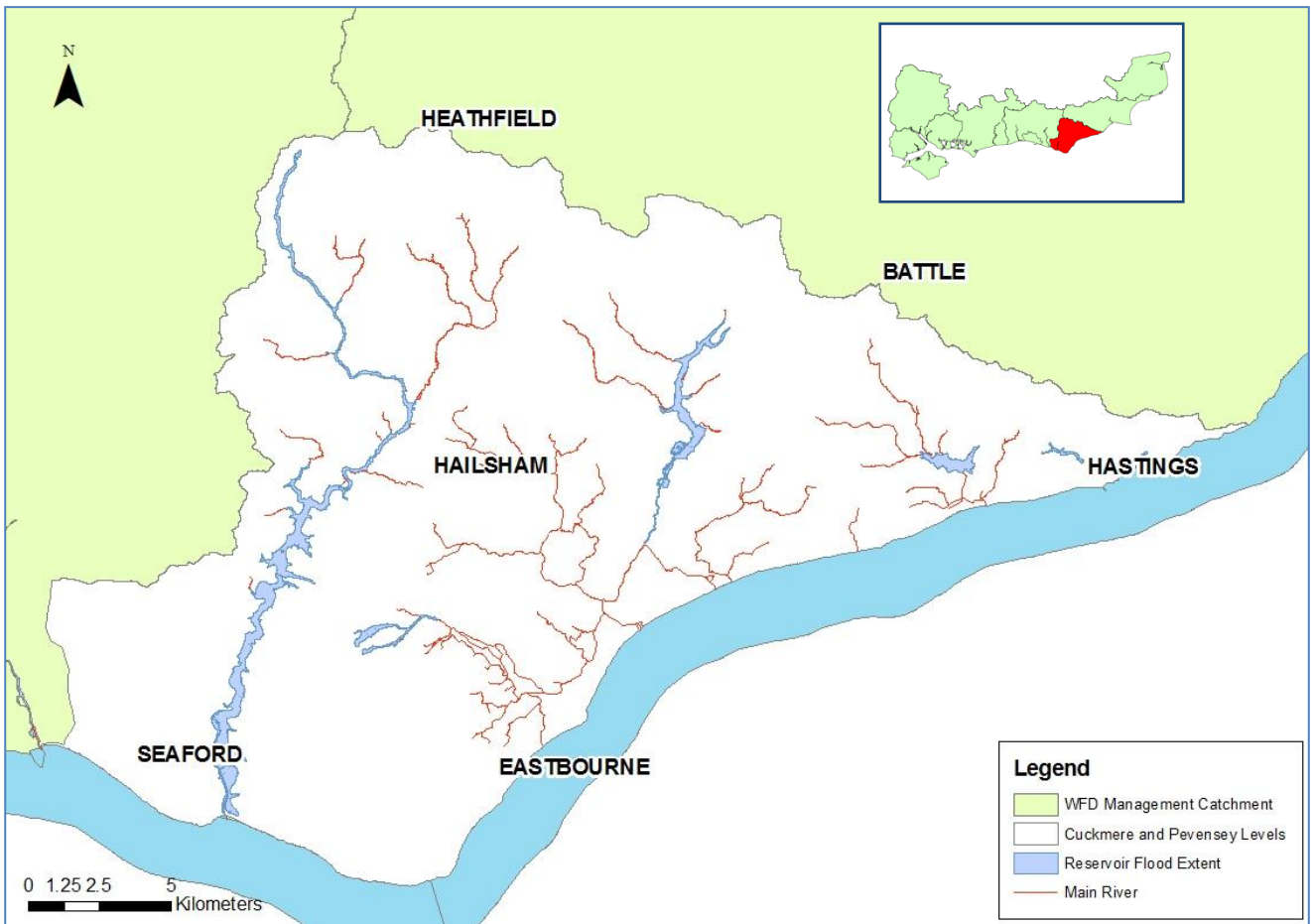


Figure 24: Reservoir flood risk in the Cuckmere and Pevensey Levels catchment

Table 16: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Cuckmere and Pevensey Levels catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	370,150	850
Number of services:	470	10
Risk to economic activity:		
Number of non-residential properties:	29,650	150
Number of airports:	0	0
Length of trunk roads (km):	80	<10
Length of railway (km):	50	0
Agricultural land (ha):	32,800	450
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	4	1
Number of EPR installations within 50m:	6	0
Area of SAC within area (ha):	150	<50
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	3,600	100
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	5,650	400
Area of Parks and Gardens within area (ha):	850	50
Area of Scheduled Ancient Monument within area (ha):	150	<50
Number of Listed Buildings within area:	1,910	20
Number of Licensed water abstractions within the area:	60	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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Reservoir Flooding

Reservoirs can hold large volumes of water above ground level, contained by embankments/dams. Although the safety record for reservoirs is excellent, it is still possible that an embankment/dam could fail which would result in a large volume of water being released very quickly. It may also be the case that a reservoir could overflow and cause a surface water flood risk. The main reservoir in this catchment is at Arlington which is an offline public water supply storage reservoir on the River Cuckmere.

Maintenance Activities

Maintenance activities are carefully targeted to sections of rivers and the coast that derive the optimum benefit to people and property, and maintain the ecological status of rivers within the system.

Every catchment is different so the most suitable maintenance procedure is chosen for each stretch of river or defence. The aim is to provide a sustainable way of managing flood risk, whilst minimising the environmental impact of maintenance operations. These activities often include some or all of the following; inspections, aquatic weed cutting in main rivers, maintenance and clearing of sluices and weed screens, routine grass cutting and various minor and emergency works as required.

Conclusions and objectives for the Cuckmere and Pevensey Levels catchment

The catchment covers a mix of urban and rural areas, with different land uses, population densities and types of watercourse. The population in the catchment is mainly concentrated in the coastal areas of Eastbourne, Bexhill and Hastings with several towns and villages located close to the rivers in the middle and upper areas of the catchment.

Of the approximately 51,300 people at risk of fluvial or coastal flooding, over 46,000 are indicated as being at low or very low risk. This is largely as a result of existing defences currently in place to reduce risk.

Fluvial flooding occurs regularly from the Cuckmere, mainly affecting agricultural land, although it can also affect a small number of properties in Hellingly, Horsebridge, Alfriston and West Dean.

Tidal flooding in the catchment is limited to the lower Cuckmere, where raised embankments are in place to reduce the risk to the adjacent land and properties in West Dean, Littleington and Alfriston. The combination of tidal and fluvial events can lead to these being overtopped.

All the other rivers in this catchment discharge into the sea via outfalls which have tidal gates in place to prevent high tides moving up the rivers. However this may result in the rivers becoming 'tide-locked' which can increase the risk of fluvial flooding.

The coast is well defended between Eastbourne and Hastings with coastal defences providing critical protection to people, property and infrastructure.

Work is being carried out to increase community awareness of the risk of flooding and the associated actions that they should take to increase resilience and minimise the impacts of flooding. Improved mapping and modelling is one of the most effective means of communicating and illustrating flood risk. Across the catchment there is an ongoing programme of modelling to ensure that risk from a variety of sources is better understood. Modelling has already been completed along the coast between Eastbourne and Hastings, the outputs from which are being used by a variety of partners to inform decision making processes.

Surface water and groundwater flooding both exist in the catchment and East Sussex County Council as the lead local flood authority, lead on managing flooding from these sources. They work in partnership with the Environment Agency and district and borough councils. There are a number of Surface Water Management Plans complete or underway in the catchment such as Eastbourne/Polegate/Willingdon, Bexhill, Hailsham, Heathfield and Hastings.

The Environment Agency has established a number of Flood Warning areas within the catchment. The purpose of these areas is to provide as much warning as possible to communities of potential flooding. Flood Warning Areas cover coastal communities such as Eastbourne, Bexhill and Hastings as well as fluvial warning areas on the Cuckmere and Combe Haven. Work is continuously underway to further improve and refine this service.

Objectives

Social

1. Minimise impact to people, property and to critical infrastructure and services from all sources of flooding and coastal erosion
2. Protect and enhance sustainable recreational and amenity opportunities where appropriate, recognising the important contribution of income from these activities to river and coastal management.
3. Promote the consideration of environmental benefits (ecosystem services) to people as part of work to manage flood risk
4. Protect and enhance the landscape character values of the catchment alongside sites of cultural, archaeological and historical value from flooding

Economic

5. Minimise flood risk impact to the local economy, and seek opportunities to promote economic growth, regeneration and partnership funding
6. Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks
7. Minimise the risk of flooding to key transport links within the catchment, such as railway lines, motorways and primary roads
8. Ensure development in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible

Environmental

9. Contribute to achieving Water Framework Directive objectives, working with natural river, estuarine and coastal processes wherever possible to manage flood risk through protecting and enhancing the natural function of the catchment, rivers and flood plains
10. Conserve and enhance biodiversity, internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk
11. Promote sustainable soil and land use management across the catchment
12. Support climate change adaptation by making space for water, both inland and at the coast

Measures to manage risk across the Cuckmere and Pevensy Levels catchment

In the Cuckmere and Pevensy Levels catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work in the Cuckmere and Pevensy Levels catchment there are 28 measures to manage risk. Examples of these measures are included here and the full list can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk:

- Assess options for future coastal defence works Eastbourne to Bexhill following the end of the Pevensey coastal Contract
- Appraise capacity of Combe Haven sea outfall (Bexhill)
- Hailsham Surface Water Management Plan - Investigate surface water issues and identify opportunities to reduce the risk of surface water flooding in Hailsham
- Heathfield Surface Water Management Plan - Investigate surface water issues and identify opportunities to reduce the risk of surface water flooding in Heathfield
- Pevensey Levels desilting – Desilting key watercourses on the Pevensey Levels to improve conveyance, improve the SSSI and tackle invasive plant problems

Preparing for risk:

- Maintain Multi Agency Flood Plan for Sussex Resilience Forum - East Sussex Resilience and Emergencies Partnership will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Maintain Multi Agency Flood Plan for Wealden District Council - Wealden District Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Maintain Multi Agency Flood Plan for Eastbourne Borough Council - Eastbourne Borough Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Maintain Multi Agency Flood Plan for Rother District Council - Rother District Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.
- Maintain Multi Agency Flood Plan for Hastings Borough Council - Hastings Borough Council will work with the local resilience forum (LRF) to review and update the multi-agency flood plan (MAFP) and disseminate outputs of any studies undertaken.

Protecting from risk:

- Bulverhythe Capital Maintenance – The beach is monitored regularly and shingle recycling is carried out as required to maintain the standard of protection
- Eastbourne Beach Management - Ongoing coastal defence works in Eastbourne
- Hastings Coastal Defence Works Stage 2 – Defence works from the Pier to the Harbour Arm
- Pevensey Bay Sea Defences - Ongoing coastal defence scheme from Sovereign Harbour to Cooden (Bexhill)
- Polegate Flood Alleviation Scheme – Investigate flow restrictions and identify solutions to reduce flood risk

Recovery and review of risk: there are no measures from the risk management authorities contributing to this FRMP over and above existing flood risk work

The measures above represent the catchment specific flood risk management measures. Please refer to Part A: Background and River Basin District wide information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.8 The Rother and Romney catchment

Introduction to the catchment

The Rother and Romney catchment covers approximately 970km² with a population of approximately 180,000 people. There are a number of towns within the catchment including Rye, Tenterden, Hythe, Dymchurch, Lydd, Robertsbridge and New Romney with the major towns of Hastings and Folkestone at the edge of the catchment. The Channel Tunnel Rail Link and a section of the M20, both nationally important transport links, pass through the catchment area. The area falls within the administrative area of the East Sussex and Kent County Councils (both of whom are lead local flood authorities) and covers six local authorities.

The area includes the Romney and Walland Marshes, the Royal Military Canal and associated pumping stations and the river Rother and its tributaries: the River Dudwell, River Darwell, River Brede and River Tillingham, as well as some small streams in Folkestone and Hythe, which include the Brockhill, Saltwood, Mill Leese and Seabrook Streams. It also covers the Pent stream which runs through Folkestone. The total main river length (including tidal lengths) is approximately 330 km.

The River Rother rises in the High Weald, which is comprised of sands, silt and clay ridges dissected by incised river valleys, with the Rivers Tillingham and Brede joining the Rother estuary at Rye. The Walland and Romney Marshes, which lie to the east of the catchment, consist of wetlands of international conservation significance. The Marshes are characterised by a complex drainage system based upon a series of private ditches flowing to a network of Internal Drainage Board (IDB) sewers and main rivers, the most important being the Royal Military Canal (RMC).

Flooding can occur from a number of sources. The main source of flood risk within the Rother and Romney area is from the sea. The future planning for tidal flood risk management for this area is covered by the South Foreland to Beachy Head shoreline management plan (SMP), and the SMP policy for the Rother and Romney shoreline is 'Hold the line' where all urban areas meet the coastline (Normans Bay, Camber Sands, Rye, Bexhill, Cooden), and 'no active intervention' in other areas (Fairlight Cove).

The main sources of non-tidal flooding within the Rother and Romney are fluvial flooding along the Rother (Robertsbridge and Etchingham), a combination of fluvial, groundwater and surface water flooding in Hamstreet, a combination of fluvial and tidal flooding in the lower catchment, around Rye and in the Marshes. The Walland and Romney Marshes are very low lying and there is a network of channels, drains, and structures which together with the Royal Military canal combine to drain the area for agricultural use. There are also a number of small steep urban catchments in Folkestone and Hythe which have experienced both fluvial and surface water flooding during heavy rainfall. The Mill Leese stream has a flood storage area that protects central areas of Hythe.

The Environment Agency currently maintain flood defences on the main rivers, this includes keeping flood walls and embankments up to standard, maintaining flood gates, and undertaking channel maintenance such as clearing culverts, weed clearance and maintaining the sea defences along the coast.

The lower lying coastal areas of the catchment are primarily formed of reclaimed land which was created over a period of several hundred years. This coastal flood cell stretches for 49km from Cliff End to Folkestone covering communities between Rye and Cliff End and the entire Romney and Walland Marshes. 16,000 properties are at risk from coastal flooding in the catchment, as are two Ministry of Defence firing ranges, a nuclear power station at Dungeness and large areas of land critical to food production.

The Environment Agency currently maintains the majority of the coastal defences in the catchment, with other small sections being controlled by Shepway District Council to manage coastal erosion, and EDF Energy to protect Dungeness power station. The area is protected by a variety of types of coastal defence, including concrete seawalls, rock armour, shingle beaches and sand dunes.

Due to the flat nature of the Romney Marsh area a continuous line of coastal defences is required between Cliff End and Folkestone to provide protection against flood water outflanking any adjacent sea defence in the area. The Folkestone to Cliff End Strategy identified the required work to improve the coastal defences in this area for a 100 year period. Several projects from this strategy have already been completed, such as the new tidal embankments and walls on the western bank of the tidal River Rother, or the new seawall at Dymchurch.

Five defences remain to be completed; Broomhill Sands (construction of which commenced in summer 2014), and Hythe Ranges, Lydd Ranges, Romney Sands and Rother Tidal Walls East all of which are currently having business cases developed and due to complete construction by 2022 on the current indicative funding plan.

There are several rivers within the catchment that drain out to the sea through culverts and outfalls passing beneath the coastal defences, these are maintained and improved as required to prevent ingress of tidal water into the ditch systems,

Some built up parts of the Rother are susceptible to flooding caused by poor surface water drainage. This may be caused by a high water table. High tides and high river levels can influence the height of the water tables. Known areas that suffer from poor surface water drainage include: Winchelsea Beach (Donald Way, Victoria Way area), Camber, Normans Bay, Rye, parts of the Pett Levels, and Robertsbridge.

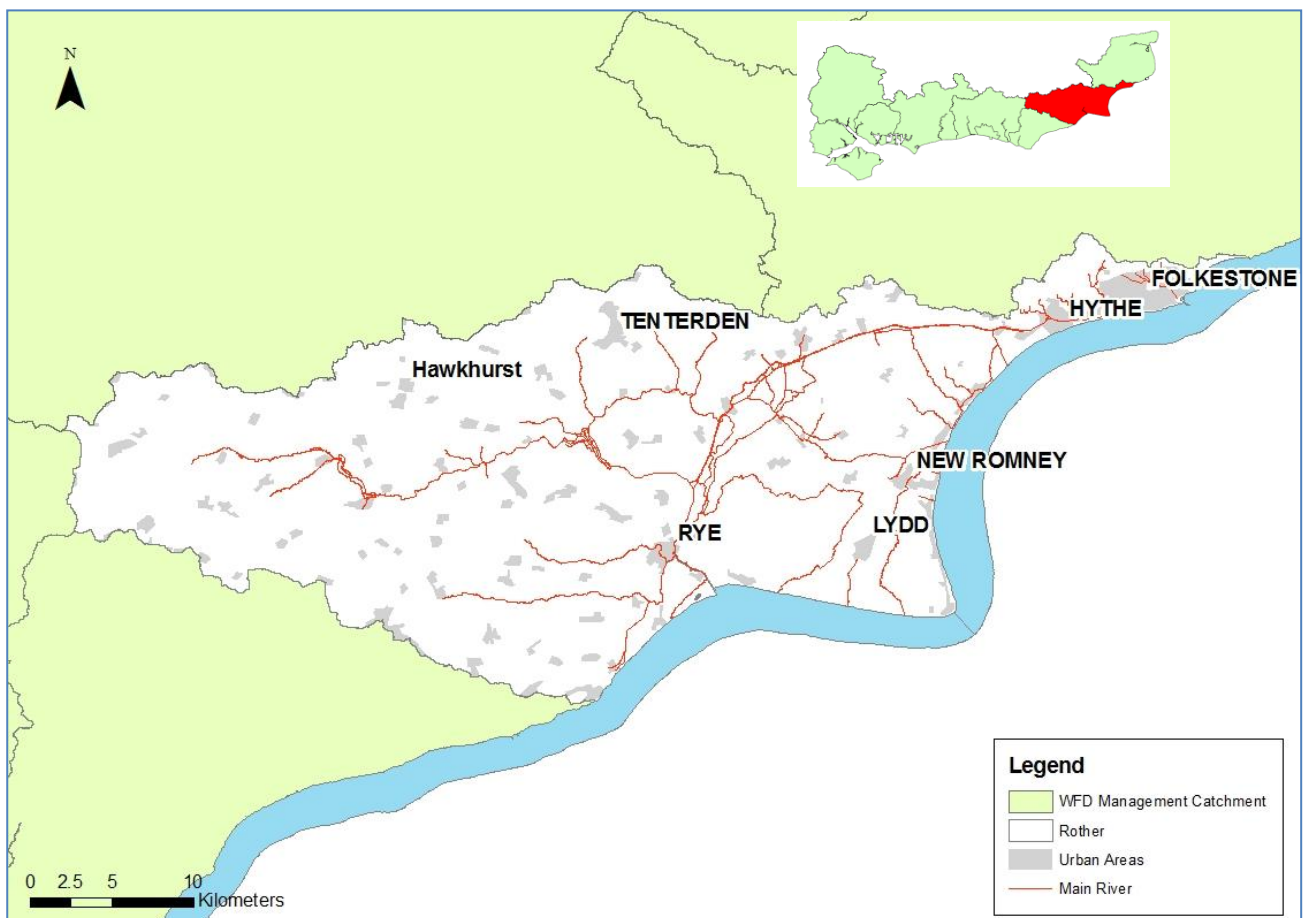


Figure 25: Overview of the Rother and Romney catchment

Land Use and Management

Overall 90% of the Rother catchment is rural and agricultural in nature, with 22% classified as excellent or very good. The upper Rother is mostly rural with mixed agricultural practices. The Marshes are areas of very flat high quality agricultural land. The major towns within the catchment are Folkestone, Hythe, Tenterden, Rye, Dymchurch, Lydd and New Romney. There are also numerous small villages scattered across the catchment flood management plan area. These small rural towns have a significant impact on local flood risk, but less significant at the catchment scale. Light industry is found mainly alongside the Rother Estuary within the port of Rye, but there are some major employers in the marsh areas in the form of the Ministry of Defence bases at Lydd and Hythe, and Dungeness A (in the process of being decommissioned) and B (currently operated by EDF Energy) nuclear power stations.

Geology

Due to its geology, the Rother catchment is an area of sharp contrast. The north and west of the catchment are part of the High Weald, while the south and east are characterised by a wide expanse of reclaimed coastal marshland. The High Weald is comprised of sands, silt and clay ridges dissected by incised river valleys. The layering of the upper catchments results in 'sand' containing impermeable clay and silt layers and following a rainfall event can result in fast run-off and a rapid onset of flooding.

The coastal marshland is bounded by the sea to the south and east and includes the shingle headland of Dungeness extending into the English Channel. The Marshes also consist of alluvium or marine silts and sands and have a shallow water table that can rise above ground level in wet winter conditions. The eastern extremity of Romney Marsh, beyond Hythe consists of Gault clay and Chalk. During rainfall events the combination of the flat landscape and geology means that standing water can quickly form a feature of the marsh lands.

National and International Designations

The Rother and Romney catchments contain a number of environmentally designated sites and historical monuments which both present opportunities and constraints to flood risk management.

There are three Special Area of Conservation (SACs) within the catchment, two of which - Hastings Cliffs and Dungeness - lie within Flood Zone 3. Dungeness to Pett Level is the only Special Protection Area (SPA) in the catchment and Natural England are currently progressing an expansion of this through Government, along with creation of the Dungeness, Romney Marsh and Rye Bay RAMSAR. There are 22 Sites of Special Scientific Interest (SSSIs) within the catchment area, designated as such due to their ecological or geological importance, as well as to protect the unique coastal processes that occur around Dungeness peninsular.

Partnership Working

Within the Romney and Rother catchment the Environment Agency have developed a good working relationship with their main partners; Kent County Council and East Sussex County Council, who are the lead local flood authorities for Kent and East Sussex respectively. In the area there are also two district councils, Rother District Council, and Shepway District Council, as well as Ashford Borough Council which covers a small portion of the boundary of the lower Rother Valley and Romney Marsh. There are numerous town and parish councils in the Rother and Romney catchments which have an active interest in flood risk and have good links with the Environment Agency.

There a number of other organisations who work closely with risk management authorities in the area including; The Ministry of Defence, the operators of the nuclear site at Dungeness, Romney Marshes Area Internal Drainage Board, Southern Water Services, Affinity Water and Natural England.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Rother and Romney catchment are described in the table and figures below.

Flood risk from Rivers and the Sea

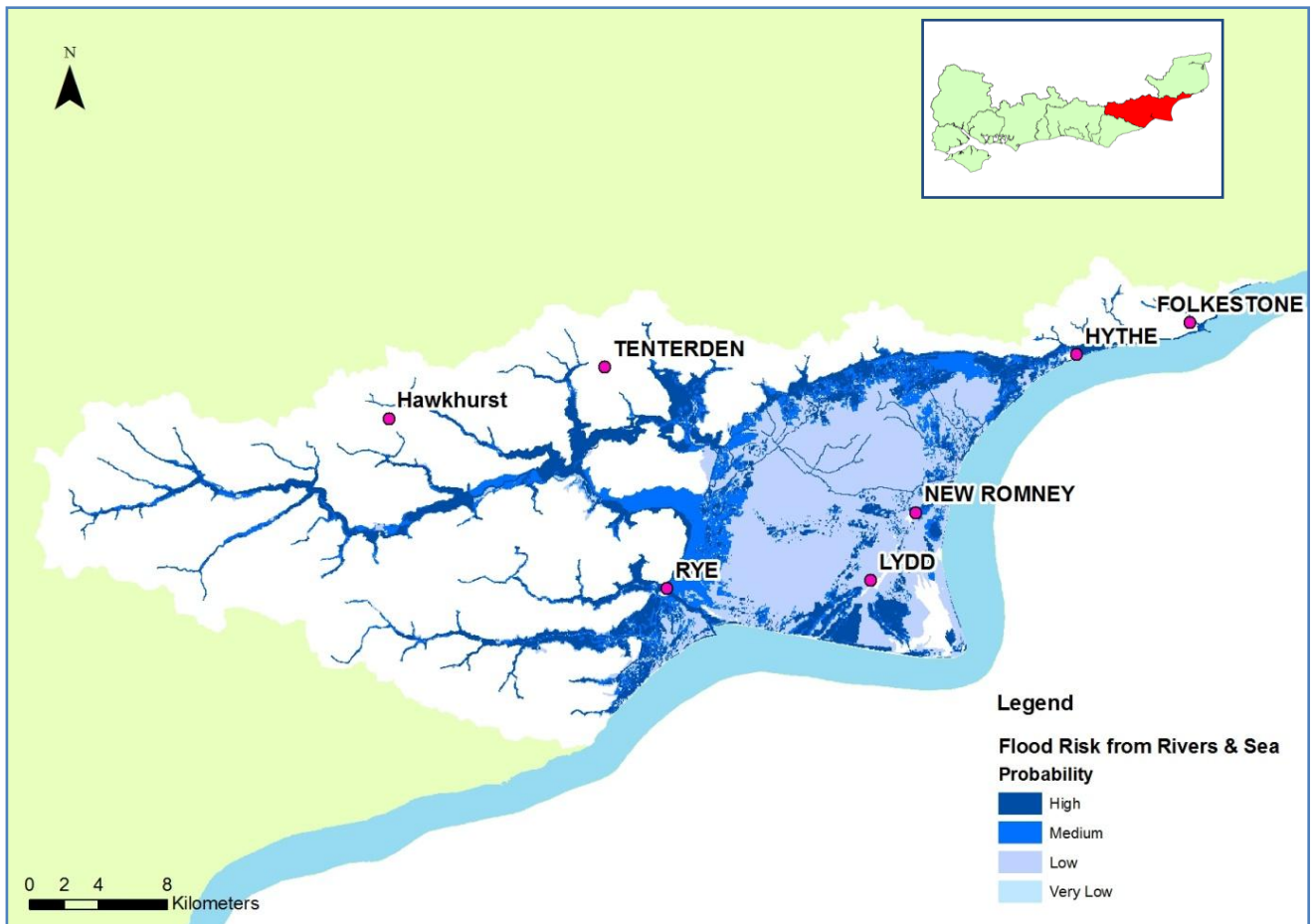


Figure 26: National Flood Risk Assessment (NaFRA) in the Rother and Romney catchment

Table 17: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Rother and Romney catchment.

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	178,600	10,850	7,950	19,000	0
Number of services:	570	70	40	110	0
Risk to economic activity:					
Number of non-residential properties:	32,350	1,200	1,150	4,050	0
Number of airports:	1	0	0	1	0
Length of trunk roads (km):	120	10	10	30	0
Length of railway (km):	100	10	10	20	0
Agricultural land (ha):	71,550	6,300	5,550	13,250	0
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	4	3	0	1	0
Number of EPR installations within 50m:	7	0	0	2	0
Area of SAC within area (ha):	2,700	650	200	900	0
Area of SPA within area (ha):	1,300	400	250	600	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):	9,100	1,850	1,400	3,900	0
Area of Parks and Gardens within area (ha):	650	0	<50	0	0
Area of Scheduled Ancient Monument within area (ha):	300	150	50	50	0
Number of Listed Buildings within area:	3,800	100	50	160	0
Number of Licensed water abstractions within the area:	310	160	20	60	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Flood risk from Reservoirs

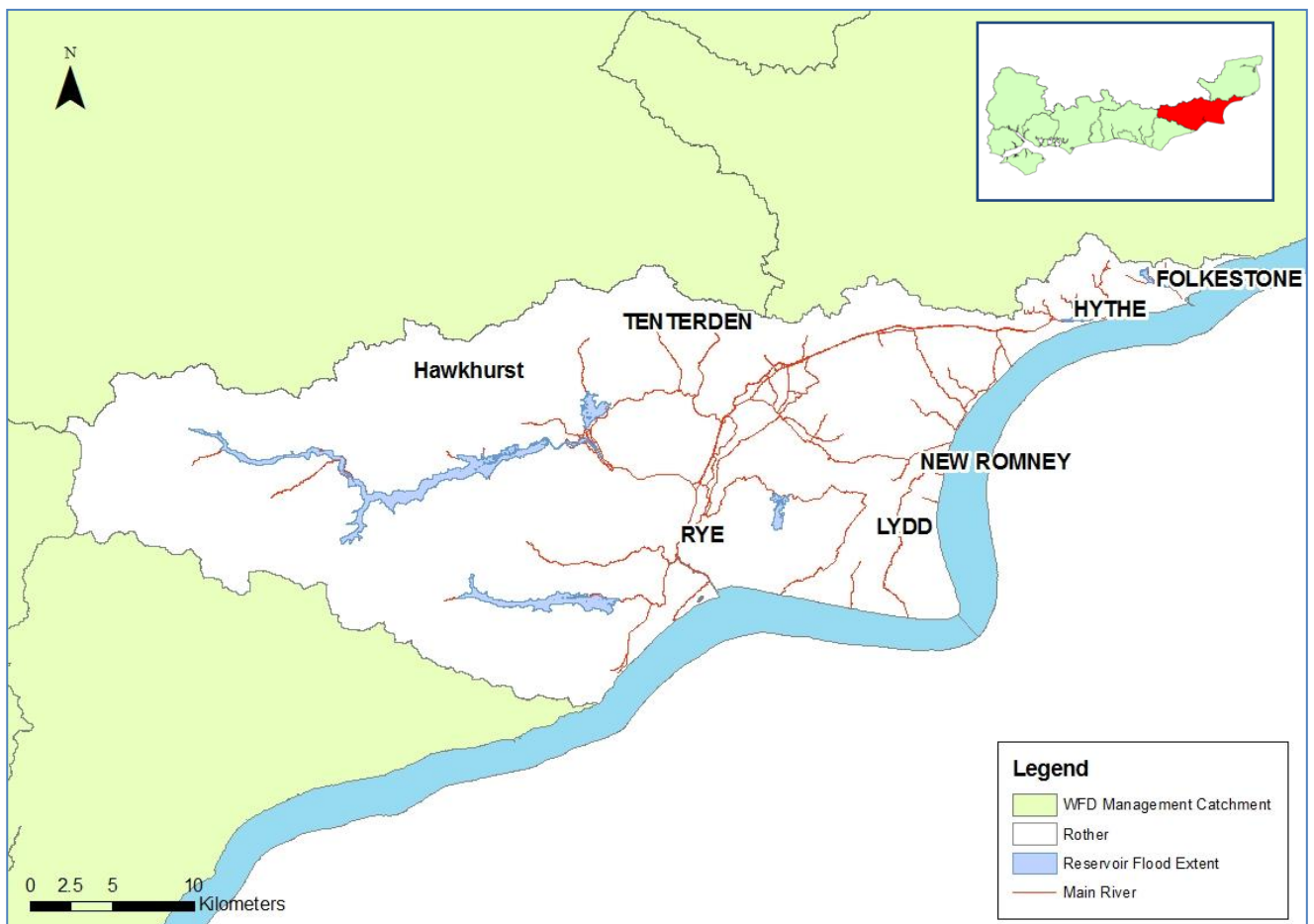


Figure 27: Reservoir flood risk extents in the Rother and Romney catchment

Table 18 : Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Rother and Romney Catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	178,600	2,600
Number of services:	570	20
Risk to economic activity:		
Number of non-residential properties:	32,350	450
Number of airports:	1	0
Length of trunk roads (km):	120	<10
Length of railway (km):	100	10
Agricultural land (ha):	71,550	1,400
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	4	0
Number of EPR installations within 50m:	7	0
Area of SAC within area (ha):	2,700	0
Area of SPA within area (ha):	1,300	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):	9,100	100
Area of Parks and Gardens within area (ha):	650	0
Area of Scheduled Ancient Monument within area (ha):	300	<50
Number of Listed Buildings within area:	3,800	60
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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Conclusions and objectives for the Rother and Romney catchment

The main sources of flood risk in the Rother catchment are river and sea. Flood risk investment is focused on the coastal defences to afford protection to houses near the shoreline.

The Folkestone to Cliff End Strategy sets out the Environment Agency's plan for managing coastal flood risk for the Rother and Romney catchments for a hundred year period. To date approximately £100million has been invested in improvements to the coastal defences in the Rother and Romney catchments; these include shingle recharge at Pett, creation of a new flood embankment along

Nook Drain, construction of new tidal defences in Rye, and constructing two new sections of seawall at Dymchurch. To fully realise the benefit of these projects further defences are required to create a continuous line of coastal defences from Folkestone to Cliff End, thus removing the risk of any improved defence being outflanked by flood water. The Environment Agency will continue to work on implementing the remaining defences around the coastline of Romney Marsh to create the continuous defence line, and are working with the local communities and partners to complete their construction by 2022.

Further actions in the flood risk management plan for the catchment include ongoing maintenance of the existing sea defences through shingle recycling, improvements to tidal basins, pumping stations and sluice structure to prevent tidal water impacting the river networks, investigating options to reduce flood risk on the flashy watercourses around Hythe and, improvements to maximise the sustainability of flood risk management assets in the Rother Valley by making pumping stations and associated embankments more effective and efficient. These schemes all aim to reduce flood risk to properties in the area and, where feasible, enhance the environment.

Objectives

Social

1. Reduce the risk of flooding to people.
2. Reduce the cost of flooding to a sustainable level.

Economic

3. Reduce the risk of flooding to key infrastructure.
4. Planned defences will work with privately constructed defences at Dungeness. Power Station to ensure appropriate protection is provided to a critical site for power supply within the UK.
5. Increasing job security by protecting business against flooding.
6. Reduce risk of flooding to critical areas of farmland for food supply.

Environmental

7. Conserve and enhance internationally and nationally designated nature conservation sites, and promote opportunities to create habitat when managing flood risk.
8. Provide compensatory habitat and/or mitigation where necessary to offset the potential damage construction of new defences may cause to the environmental features of the area. This currently includes plans to create a 19 hectare area of saltmarsh habitat in the Rother Estuary to offset the impacts of rising sea levels and the ongoing management of compensatory habitat area at Rye Harbour Farm.
9. Protect the character of the landscape and designated heritage features within it.

Measures to manage risk across the Rother and Romney catchment

In the Rother and Romney catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work, in the Rother and Romney catchment there are 32 measures to manage risk. Examples of these measures are included here and the full list can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 – 2021.

Preventing risk: there are no measures from the risk management authorities contributing to this FRMP over and above existing flood risk work.

Preparing for risk:

- Ongoing improvements to the Flood Warnings Direct service as new defences are completed, or updated modelling and flood risk data becomes available
- Ongoing improvements to operational response and incident management during flood events
- Manage reservoirs where EA are statutory undertakers
- Maintain Multi Agency Flood Plans for local councils (Shepway District Council and Rother District Council)
- Surveys to identify potential maintenance works for: the clay embankment at Rye Harbour Nature Reserve, which acts as a secondary defence ; and Rother Tidal Walls West flood defences

Protecting from risk:

- Ongoing maintenance of Main River watercourses such as weed cutting, desilting and pioneering of trees and maintenance of flood risk management assets (e.g. sluices, embankments, reservoirs, pumping stations, flood gates, sea defences).
- Shingle Recycling/recharge: Denge Beach Management - shingle recycling at Dungeness Power Station and between Jury's Gap and Dungeness (EA and EDF Energy). Shingle recycling from Nook Point to Cliff End. Shingle recharge at Littlestone beach. Shingle recycling from Folkestone to Hythe (Shepway District Council)
- Appraisal phase for Rother Tidal Walls East defences, Hythe Ranges Sea Defences (EA and MoD), Lydd Ranges Sea Defences (EA and partners) and Romney Sands Sea Defences (4 measures)
- Construction of Broomhill Sands Sea Defences (taking place between Summer 2014 and late 2015)
- Construction of new tidal basin at Jury's Gap

Recovery and review of risk:

- Modelling of flood risk from the Brockhill, Saltwood, Mill Leese and Seabrook Streams, and identification of further improvements to reduce risk in the future (KCC and EA)
- Ongoing review and update of Flood Warning Areas
- Ongoing review and updates of National Flood Risk Assessment maps
- Ongoing review and updates of Flood Map for planning purposes
- Feasibility study to understand the maintenance required at Camber Sands

Other:

- Assess the strategic requirement for habitat creation as a result of implementing the short, medium and long-term policies of the South Foreland to Beachy Head shoreline management plan on European sites (EA working with NE and other relevant local authorities)

The measures above represent the catchment specific flood risk management measures. Please refer to Part A; Background and River Basin District wide Information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

3.9 The Stour catchment

Introduction to the catchment

The Stour catchment is situated in East Kent, in the south east of England. It covers an area of 1,200km² with a population of approximately 500,000 people and 83% of the catchment area is agricultural land. The principle urban centres in the catchment are Ashford, Canterbury, Dover, Deal, Ramsgate and Margate, with just under half the population living in other towns, villages and rural areas. Beyond these urban centres, agriculture forms the main land use with the highest quality agricultural lying to the north of the catchment. Major transport links cross through the Stour catchment including the M20 motorway and the Channel Tunnel Rail Link.

The River Stour has five main tributaries draining the clay headwaters which meet in the large urban area of Ashford. It then flows unimpeded through rural chalk downlands into Canterbury where the river is modified with defences and structures controlling the flow. It then enters the tidally influenced Lower Stour area before flowing out into the sea at Pegwell Bay.

In addition to the River Stour and its tributaries, the Stour catchment includes the River Dour in Dover and the streams that make up the Oyster Coast Brooks. The small streams around Whitstable and Herne Bay that make up the Oyster Coast Brooks drain a clay area, giving them flashy characteristics during heavy rainfall events. In contrast, the Dour in Dover drains a chalk catchment that responds slowly to rainfall, and has a baseflow dominated by groundwater. However, flooding can occur on the Dour during high intensity storm events when run-off causes flooding from both the river and surface water. Surface water flooding occurs elsewhere in the Stour catchment, including Deal and Whitstable. Kent County Council's surface water management plans (SWMPs) aim to identify options to reduce local flooding.

The area has a diverse coastline ranging from sheltered harbours such as Whitstable and Ramsgate to north easterly facing beaches which can bear the brunt of an East coast surge. The majority of the open coast consists of managed shingle beaches, although there are sand beaches such as that of Minnis Bay. Managed shingle beaches are an effective form of flood defence given their ability to dissipate wave energy and are encouraged to grow through the installation of groynes. These beaches are often managed in conjunction with other structures such as sea walls or rock armour. The major coastal towns at risk of tidal flooding include Sandwich, Deal, Dover, Margate, Herne Bay and Whitstable.

To summarise the following streams and rivers drain the Stour catchment:

- ▶ Great Stour and its tributaries the Nailbourne / Little Stour and Petham Bourne.
- ▶ River Dour in Dover
- ▶ Oyster Coast Brooks

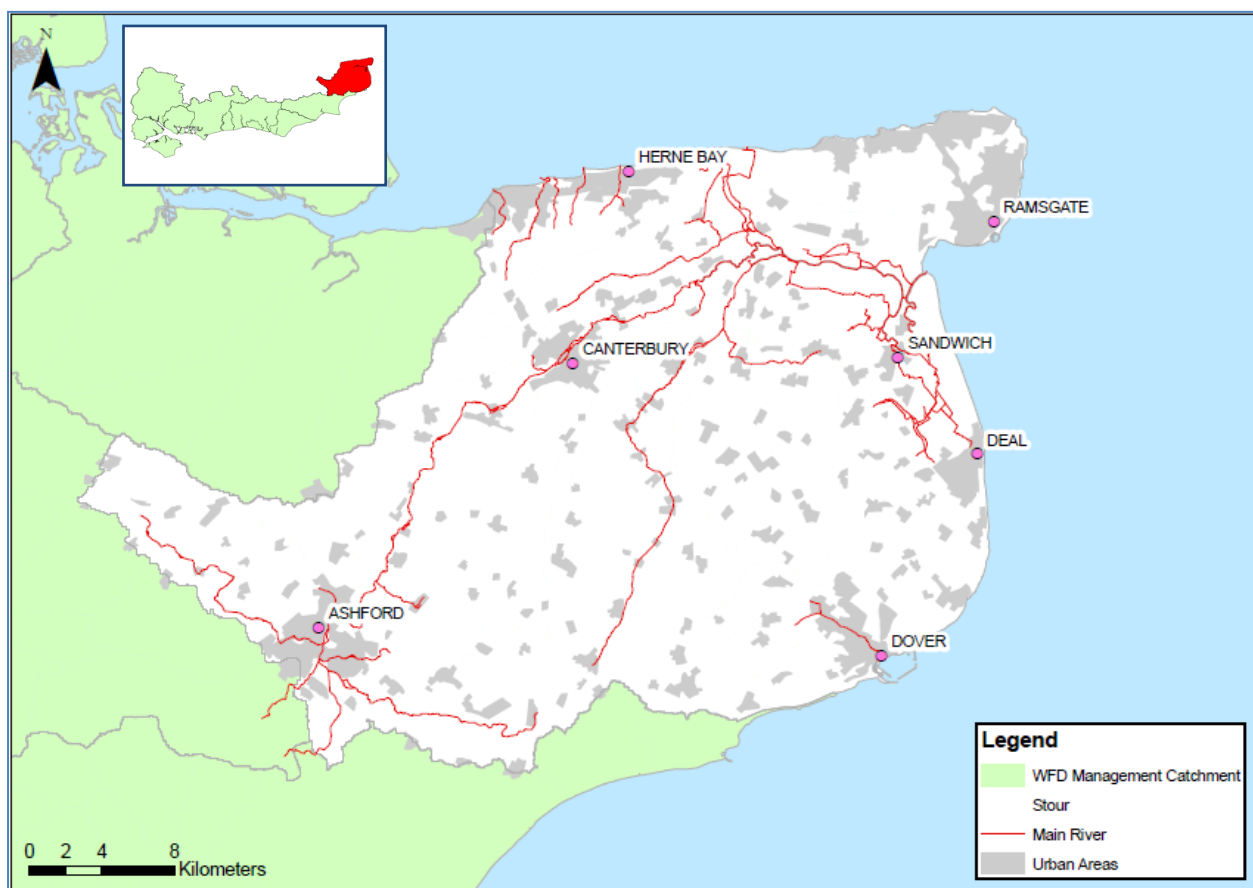


Figure 28 Overview map of the Stour catchment

Land Use and Management

The catchment area is largely rural, characterised by working farmland and dispersed small villages with some of the most productive agricultural land in Kent. About 1,000km² (about 83%) of the Stour catchment flood management plan area is agricultural land.

There is a long section of coast where the majority of urban development has taken place, although there are the main urban centres of Ashford and Canterbury which are vulnerable to fluvial flooding from the River Stour. Coastal towns of note include Whitstable, Herne Bay, Margate, Broadstairs, Ramsgate, Deal, and Dover that are at risk. The key infrastructure at risk from flooding includes parts of the A28 between Ashford and Canterbury, the A299 from Whitstable to Herne Bay and the Ashford to Canterbury railway.

In recent years there has been increased development across the catchment, specifically around Ashford following its designation as a national area of growth. Increased development has of course presented challenges to planning authorities and developers to ensure there is no increased risk of flooding to new or existing communities. Each local planning authority has a strategic flood risk assessment setting out how best to consider flood risk in conjunction with spatial planning.

Geology

The geology of the catchment is predominantly chalk, with outcrops of Gault clay, Lower Greensand and Weald clay along the south west margins of the study area. The chalk is covered by tertiary and recent deposits to the north. The geology of the catchment has a large impact on the landscape, land use, groundwater levels and hydrology of the area, as

well as an impact on the potential and function of infiltration Sustainable Drainage Systems (SuDS).

National and International Designations

The Stour catchment contains a number of environmentally designated sites and historical monuments which present both opportunities and constraints to flood risk management on a catchment scale. When assessing any potential impacts of individual flood management strategies and schemes smaller sites of local importance are taken into account.

There are a number of designated sites of international, national, regional and local nature conservation importance. The three sites of Thanet Coast, Sandwich Bay and Stodmarsh are all designated Ramsar sites, Special Protection Areas (SPA) and Special Areas of Conservation (SAC). There are six other internationally SAC's in addition to those mentioned, these are:

- ▶ Wye Downs SAC
- ▶ Crundale Downs SAC
- ▶ Lydden Valley SAC
- ▶ Etchinghill Escarpment SAC
- ▶ Blean Woods SAC
- ▶ Dover Cliffs SAC

There are 32 SSSI (Sites of Special Scientific Interest) located with the Stour catchment that have been designated for a variety of habitats. The catchment also contains 6 National Nature Reserves (NNR).

Partnership Working

Within the Stour catchment, risk management authorities are working closely alongside a number of partners. Kent County Council is the lead local flood authority for this catchment. There are also the local authorities of Ashford Borough Council, Canterbury City Council, Dover District Council and Thanet District Council with whom the Environment Agency maintain active partnerships. Other partners with include Natural England, River Stour Internal Drainage Board and the National Farmers Union.

Flood risk maps and statistics

The main sources of flood risk to people, property, infrastructure and the land in the Stour catchment are described in the tables and figures below.

Flood risk from Rivers and the Sea

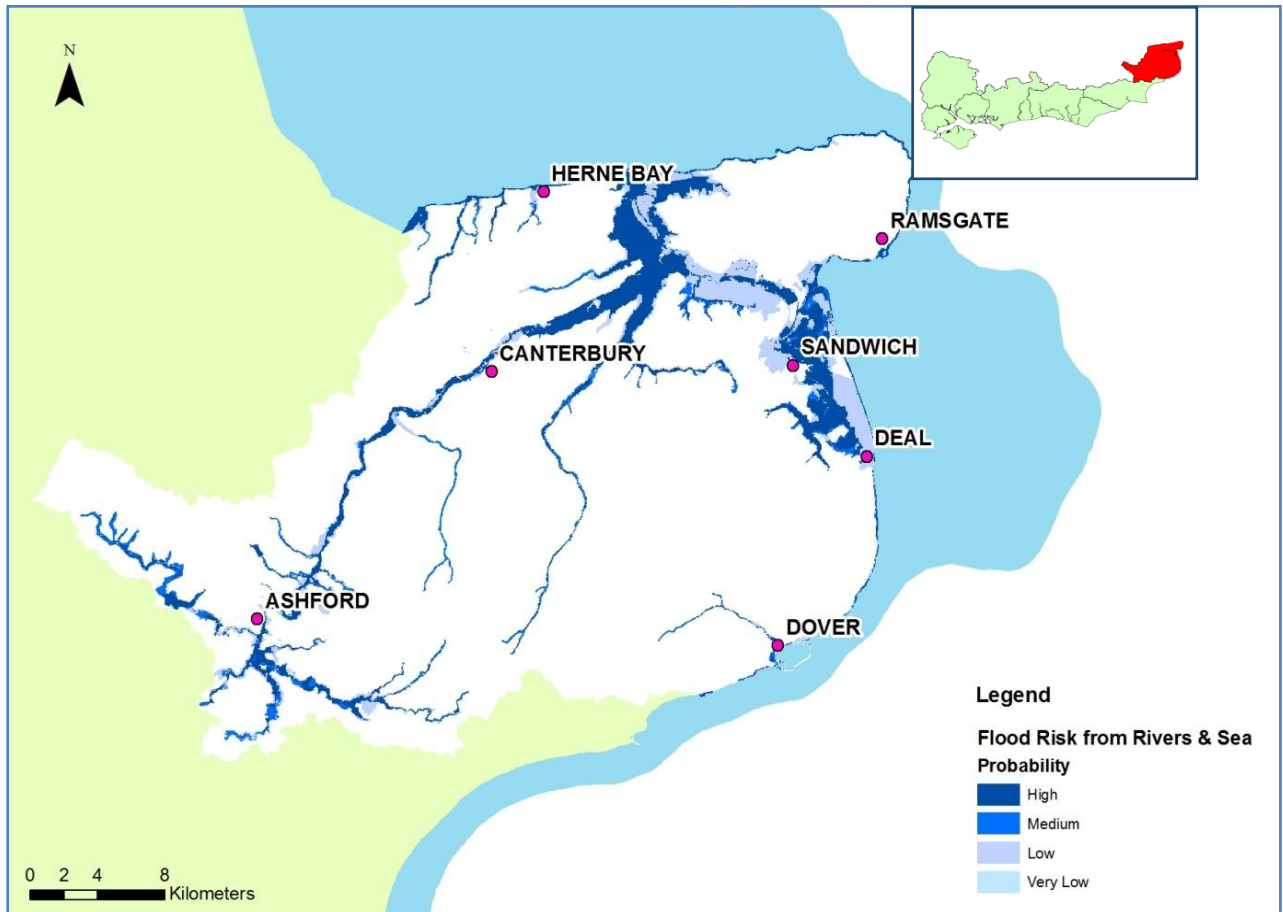


Figure 29: National Flood Risk Assessment (NaFRA) in the Stour Catchment

Table 19: Summary flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Stour Catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	527,750	11,500	3,200	24,300	<50
Number of services:	1,130	50	10	70	0
Risk to economic activity:					
Number of non-residential properties:	54,300	2,150	600	2,850	<50
Number of airports:	1	0	0	0	0
Length of trunk roads (km):	360	10	10	20	0
Length of railway (km):	230	10	<10	20	0
Agricultural land (ha):	88,100	4,700	1,150	2,900	<10
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m::	1	1	0	0	0
Area of SAC within area (ha):	2,050	800	50	300	0
Area of SPA within area (ha):	1,100	800	50	200	0
Area of RAMSAR site within area (ha):	1,400	1,050	50	250	0
Area of World Heritage Site within area (ha):	50	0	0	0	0
Area of SSSI within area (ha):	5,250	1,250	100	500	0
Area of Parks and Gardens within area (ha):	1,500	<50	<50	0	0
Number of EPR installations within 50m:	15	6	1	0	0
Area of Scheduled Ancient Monument within area (ha):	400	<50	<50	<50	0
Number of Listed Buildings within area:	6,310	260	100	710	0
Number of Licensed water abstractions within the area:	590	260	30	80	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 definitions of risk categories please refer to Part A: Background and River Basin District wide information

Tidal Flooding

The other significant source of flooding in the catchment is from the sea, which can affect the coastal towns of Sandwich, Deal, Dover, Margate, Herne Bay and Whitstable. The future planning for tidal flood risk management for this area is predominantly covered by the Isle of Grain to South Foreland shoreline management plan (SMP). The SMP policy for the Stour coastline is 'hold the line' where all urban areas meet the coastline (Whitstable, Margate, Ramsgate, Sandwich and Deal), and 'no active intervention' in some areas (Reculver country park).

With the climate changing, sea levels rising and increased frequency and intensity of storms, existing coastal defences are under increasing threat from the elements. Around the Stour catchment coastline the frontage is characterised by maintained shingle beaches and concrete sea walls. New sea defence schemes have recently been completed at Herne Bay, Deal, Pegwell Bay and Margate, and an even larger scheme is currently under construction at Sandwich. The defences improve protection to thousands of properties around the coastline.

Coastal Erosion

The catchment is dominated by Chalk cliffs along the eastern coast and around the Thanet Peninsula, with softer clay cliffs along parts of the western and central parts of the North Kent coastline. The Chalk cliffs of Thanet are largely protected at the base while those along the southeast coast are largely unprotected and have in the past failed spectacularly, thus maintaining their characteristic white appearance.

Fluvial Flooding

The main source of fluvial flooding within the Stour catchment comes from the River Stour itself. This is most likely to occur during prolonged rainfall which places the urban centres of Ashford and Canterbury most at risk. In the upper end of the catchment, two flood storage reservoirs (Aldington and Hothfield) protect parts of Ashford. Flash flooding is another source of fluvial flooding in the catchment and is most likely to happen on the short rivers in the coastal towns such as Herne Bay, Whitstable and Dover.

The Environment Agency currently maintain flood defences on main rivers, including keeping flood walls, flood gates and embankments maintained, and undertaking channel maintenance such as clearing culverts, and weed clearance.

High tides can worsen the impact of inland flooding as the fluvial flood waters are unable to drain to the sea as effectively. At the lower end of the River Stour is the Stonar Cut, which was constructed in 1776 under an Act of Parliament in order to alleviate potential flooding to farmland in the area upstream of Sandwich. With the climate changing, sea levels rising the operation of this asset is becoming more frequent, which was particularly the case during the winter of 2013 to 2014.

Groundwater Flooding

Groundwater flooding is both complex but common in the areas underlain by chalk across the Stour catchment. This is particularly apparent in the Nailbourne and Petham Bourne, when the porous rock becomes saturated following prolonged rainfall; causing the water to rise to the surface and flow above ground causing a risk to properties and infrastructure to local villages.

This occurs throughout the length of these valleys, within and outside the river channels. Both catchments are rural, flowing through small villages with listed structures and properties. Flooding can cause road closures, cutting off communities for lengthy periods, until groundwater levels recede. High groundwater also causes major problem for Southern Water Services who operate the foul water systems in the area.

Flood risk from Reservoirs

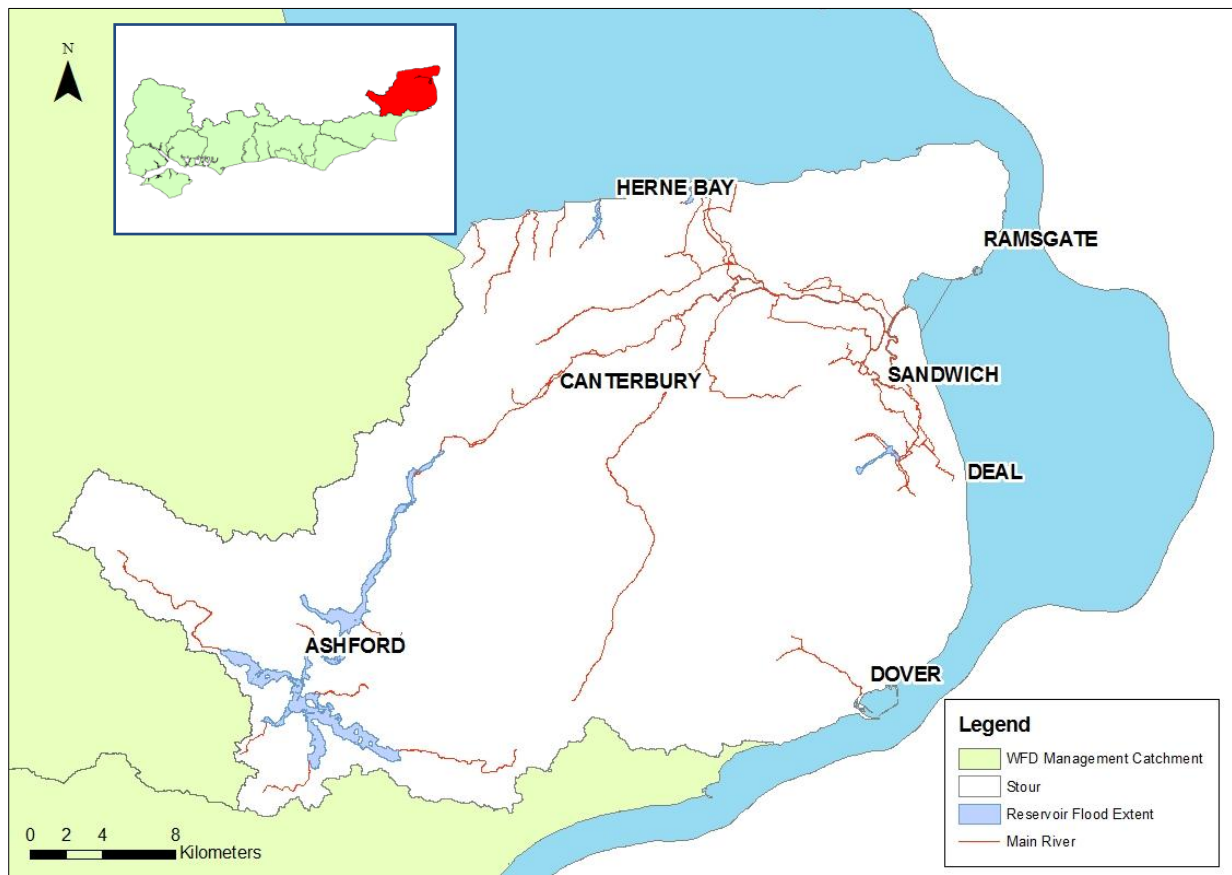


Figure 30: Reservoir flood risk extents in the Stour Catchment

Reservoir Flooding

There are very few reservoirs in this catchment owing to the majority of drinking water coming from the chalk aquifers.

There are flood storage areas that are classified as large raised reservoirs in the Reservoirs Act such as the reservoirs that provide protection to Ashford - Aldington and Hothfield. The majority of properties at risk from reservoir flooding are apportioned to these reservoirs on the River Stour. Flooding would only occur if these reservoirs failed when storing large quantities of water during major floods. Due to the intensive supervision and maintenance of these reservoirs failure is extremely unlikely. There are a number of private reservoirs such as Northwood Lagoon on the Plenty Brook that the Environment Agency are not the undertakers for, but provide benefits to flood risk.

Table 20: Summary flood risk from reservoirs to people, economic activity and the natural and historic environment across the Stour Catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	527,750	7,250
Number of services:	1,130	20
Risk to economic activity:		
Number of non-residential properties:	54,300	850
Number of airports:	1	0
Length of trunk roads (km):	360	<10
Length of railway (km):	230	10
Agricultural land (ha):	88,100	1,450
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	1	0
Number of EPR installations within 50m:	15	3
Area of SAC within area (ha):	2,050	0
Area of SPA within area (ha):	1,100	0
Area of RAMSAR site within area (ha):	1,400	50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	5,250	50
Area of Parks and Gardens within area (ha):	1,500	50
Area of Scheduled Ancient Monument within area (ha):	400	0
Number of Listed Buildings within area:	6,310	50
Number of Licensed water abstractions within the area:	590	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

For definitions of risk categories please refer to Part A: Background and River Basin District wide information

Conclusions and objectives for the Stour catchment

Flood risk within the catchment is from a variety of sources; rivers, the sea, surface water, ordinary watercourses, groundwater, sewers and reservoirs. The main source of risk in the Stour catchment is from rivers and the sea.

Work is being carried out with communities to increase people's awareness of the risk of flooding and the associated actions that they should take. The Environment Agency needs to continue to contribute to this by working with other partners. The importance of the need to

improve and maintain the defences is demonstrated by the reduction in likelihood of these communities flooding. Improved mapping and modelling is one of the most effective ways of communicating and illustrating flood risk. Across the catchment there is an ongoing programme of modelling to ensure that risk from a variety of sources is better understood.

Historically, most flood risk investment has focused on coastal defences to afford protection to houses near to the shoreline in areas along the north Kent coast and more recently in Sandwich Bay and Deal. Actions in the flood risk management plan to address tidal risk for the catchment include beach management plans, tidal walls and wetland creation. There has been flood risk investment in upstream areas, where solutions to fluvial risk are more easily determined. Other actions in the FRMP will address fluvial risk and include increasing defence heights, conveyance through structures and further upstream storage. These schemes all aim to reduce flood risk to properties in the area and where feasible, enhance the environment.

Other sources of flooding from reservoirs, surface water, ordinary watercourses and sewers continue to be a source of risk in this catchment. During the winter of 2014 flooding from these sources were known to impact householders and businesses throughout the catchment. Groundwater is major concern on the Nailbourne and Little Stour as well as the Alkham Valley and other parts underlain by chalk aquifers.

Surface water flooding can occur across the catchment. Kent County Council as the lead local flood authority has produced surface water management plans (SWMPs) for areas that have been identified at high risk of surface water flooding. Surface Water Management Plans are now available for Ashford, Canterbury, Dover and Thanet. Catchment flood management plans published in 2008 considered possible increases in flood levels, extent and risk if climate change were to increase flood flows by 20%. Climate projections since then suggest flood flows could increase by more than that but acknowledge significant uncertainty. No additional analysis is proposed at this stage; instead the preferred approach is to emphasise the uncertainty in climate change impacts. Planners, Emergency Planners, Asset Managers and others should ask questions such as: “have we considered what might happen if flood risk is worse than previously considered?” and “what can we do to mitigate the increased flood risk?”

Objectives

Social

1. Provide sustainable flood risk management options to manage the risk of fluvial flooding to the built environment, taking account of future climate, sea level and land-use changes.
2. Ensure there is no overall negative impact of new developments on catchment flood risk.
3. Reduce the cost of flooding to a sustainable level.
4. Reduce the risk of flooding to people.

Economic

5. Reduce the risk of flooding to key infrastructure.
6. Avoid increasing the current fluvial flood risk to all transport links and reduce flood risk to key road and rail routes.
7. Increasing job security by protecting business against flooding.
8. Minimise flood risk to high grade agricultural land both on the Lower Stour and in other parts of the Stour catchment.

Environmental

9. Conserve and enhance internationally and nationally designated nature conservation sites, and promote opportunities to create freshwater habitat when managing flood risk.
10. Provide compensatory habitat and/or mitigation where necessary to offset the potential damage construction our new defences may cause to the environmental features of the area.
11. Protect the character of the landscape and designated heritage features within it.
12. Protect and enhance the landscape character recognising its value for agriculture, whilst contributing to sustainable flood risk management.

Measures to manage risk across the Stour catchment

In the Stour catchment the Environment Agency undertakes maintenance of fluvial and coastal assets. In addition to the maintenance work across the Stour catchment there are 64 measures to manage flood risk. Examples of the measures are included here and the full list of the measures can be found in Part C: Appendices. The Environment Agency measures in this catchment are all statutory measures; the lead local flood authority measures are all non-statutory. The only measures included in this plan are those that are ongoing or are proposed to begin during the period of 2015 to 2021.

Preventing risk: there are no ongoing measures from the risk management authorities contributing to this FRMP over and above existing flood risk work.

Preparing for risk:

- Ongoing improvements to the Flood Warnings Direct service as new defences are completed, or updated modelling and flood risk data becomes available. Ongoing review and update of Flood Warning Areas
- Ongoing improvements to operational response and incident management during flood events.
- Maintain Multi Agency Flood Plans for Local Authorities (Ashford Borough Council, Canterbury City Council, Dover District Council, Thanet District Council)
- Manage reservoirs where the EA are statutory undertakers
- Ongoing review and updates of National Flood Risk Assessment maps and Flood Map for planning purposes
- Multiagency operational response manual for the Nailbourne and Little Stour (working with Canterbury City Council, Shepway District Council, Kent County Council and Southern Water Services)

Protecting from risk:

- Ashford conveyance improvements study
- Shingle recycling to maintain the existing defences between: Reculver and Minnis Bay; Sandwich Bay Estate and Sandown Castle
- Ongoing maintenance of Main River watercourses such as weed cutting, desilting and pioneering of trees and maintenance of flood risk management assets (e.g. sluices, embankments, reservoirs, pumping stations, flood gates, sea defences).

- Deal beach management (Dover District council)
- Flood Alleviation Schemes: Great and Little Stour and Littlebourne and Wickhambreaux
- Local Authority coast protection schemes including works at Whitstable Harbour (Canterbury City Council) and Walmer to Kingsdown timber groyne replacement (Dover District Council)
- South Ashford Flood Alleviation Scheme

Recovery and review of risk:

- Modelling of fluvial flood risk from the River Dour, and identification of further improvements to reduce risk in the future
- Modelling of coastal flood risk along the East Kent coast from Ramsgate to Hythe, and identification of further improvements to reduce risk in the future
- Modelling of fluvial flood risk from the Oyster Coast Brooks, and identification of further improvements to reduce risk in the future
- Nailbourne options investigation – detailed flood risk modelling
- Review of the South Foreland to Beachy Head shoreline management plan

Other:

- Review of Sandwich to Hacklinge Marshes Water Level Management Plan
- Lampen Stream modelling to look at options to achieve Water Framework Directive objectives
- Assess the strategic requirement for habitat creation as a result of implementing the short, medium and long term policies of the South foreland to Beachy Head shoreline management plan on European sites. Key partner is Natural England.

The measures above represent the catchment specific flood risk management measures. Please refer to Part A; Background and River Basin District wide information, section 8 to see the measures that apply to the entire or large parts of the river basin district.

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