



Thames River Basin District
Flood Risk Management Plan
2015- 2021

PART B – sub areas in the Thames
river basin district

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Glossary and abbreviations

AAP	Area Action Plan
AONB	Area of Outstanding Natural Beauty
BAP	Biodiversity Action Plan
Catchment	The watershed of a surface water river system
Catchment based approach (CaBA)	An approach to environmental planning that focuses on local engagement and partnerships
CFMP	Catchment Flood Management Plan
CDA	Critical Drainage Area
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
EPR	Environmental Protection Regulations
EU	European Union
FCERM	Flood and coastal erosion risk management
FDGiA	Flood Defence Grant in Aid
Floods Directive	The European Floods Directive (2007/60/EC) on the assessment and management of flood risks.
Flood risk area (FRA)	Areas where the risk of flooding from local flood risks is significant as designated under the Flood Risk Regulations.
FRM	Flood Risk Management
FRMP	Flood Risk Management Plan – plan produced to deliver the requirements of the Regulations.
GIS	Geographical Information Systems – a type of software used for mapping
Government	The term government is used within this report to refer to Defra (the Department for Environment, Food and Rural Affairs) and Welsh Government.
GLA	Greater London Authority
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
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
MAFP	Multi-agency Flood Plan
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
Ordinary watercourses (OW)	All watercourses that are not designated Main River, and which are the responsibility of Local Authorities or, where they exist, Internal Drainage Boards.
Preliminary Flood Risk Assessment (PFRA)	Preliminary Flood Risk Assessments 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
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
TFL	Transport for London
UFMfSW	Update Flood Map for Surface Water

The format of the flood risk management plan

Flood risk management plans (FRMPs) have been divided into 4 sections to help readers identify and access information relevant to them. This is Part A. The plan is divided into 4 parts:

Name	Audience
Summary Document	For those who want a high level overview of the plan
Part A: Background and river basin district (RBD) wide information	For those who need some legislative background and RBD 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 preliminary flood risk assessments) and other strategic areas across the RBD
Part C: Appendices	For those who would like to see the detailed programme of work for individual communities

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

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

Introduction

There are a number of sub-areas within the Thames river basin district (RBD), as shown in **Figure 1** and outlined below. These sub-areas and issues in them are described in catchment summaries in Part B of the FRMP. These are:

- flood risk areas (identified in the preliminary flood risk assessments). These are areas which require flood risk management plans for local sources of flooding.
- catchments (which are set out according to Water Framework Directive (WFD) management catchments)
- other strategic areas

Flood risk areas

These are areas identified through the preliminary flood risk assessments as areas of potentially significant local flood risk (for instance surface run-off, groundwater and ordinary watercourses), for which FRMPs need to be prepared. Within the Thames RBD, there are two primary flood risk areas, and one which is only partly within the Thames RBD (see **Figure 1**).

- The London flood risk area falls completely within the Thames RBD. It encompasses Greater London as well as small part of Surrey and falls across several catchments.
- The Medway flood risk area falls completely within the Thames RBD, and within the Medway catchment.
- The South Essex flood risk area is partly within the Thames RBD, but falls mostly within the Anglian RBD, so is included within the separate consultation document for the Anglian Flood Risk Management Plan.

Management catchments

These are areas where we focus engagement to enable a catchment based approach to water management. There are 17 catchments in the Thames RBD, as listed below:

- Cherwell and Ray
- Colne
- Cotswolds
- Darent and Cray
- Gloucestershire and the Vale
- Kennet and tributaries
- Loddon and tributaries
- London
- Maidenhead to Sunbury
- Medway
- Mole
- North Kent
- Roding, Beam and Ingrebourne

- [South Essex](#)
- [Thame and South Chilterns](#)
- [Upper Lee](#)
- [Wey and tributaries](#)

Strategic areas

These are areas where it is important to consider flood risk management across more than one sub-area, so that interested parties can work in a co-ordinated way to set out conclusions, objectives and measures to manage risk. Within the Thames RBD, there is one strategic area:

- [The tidal Thames strategic area](#) covers the tidal Thames and its floodplain from Teddington in the west to Sheerness and Shoeburyness in the east. This has been considered a strategic area, as through our Thames Estuary 2100 plan (TE2100), we are planning for the future. We have made recommendations on what actions are needed to adapt across the estuary, which is changing as a result of climate change and other pressures. You can read more about how we are doing this in Section 12 of this document - conclusions, objectives and measures in the tidal Thames strategic area.

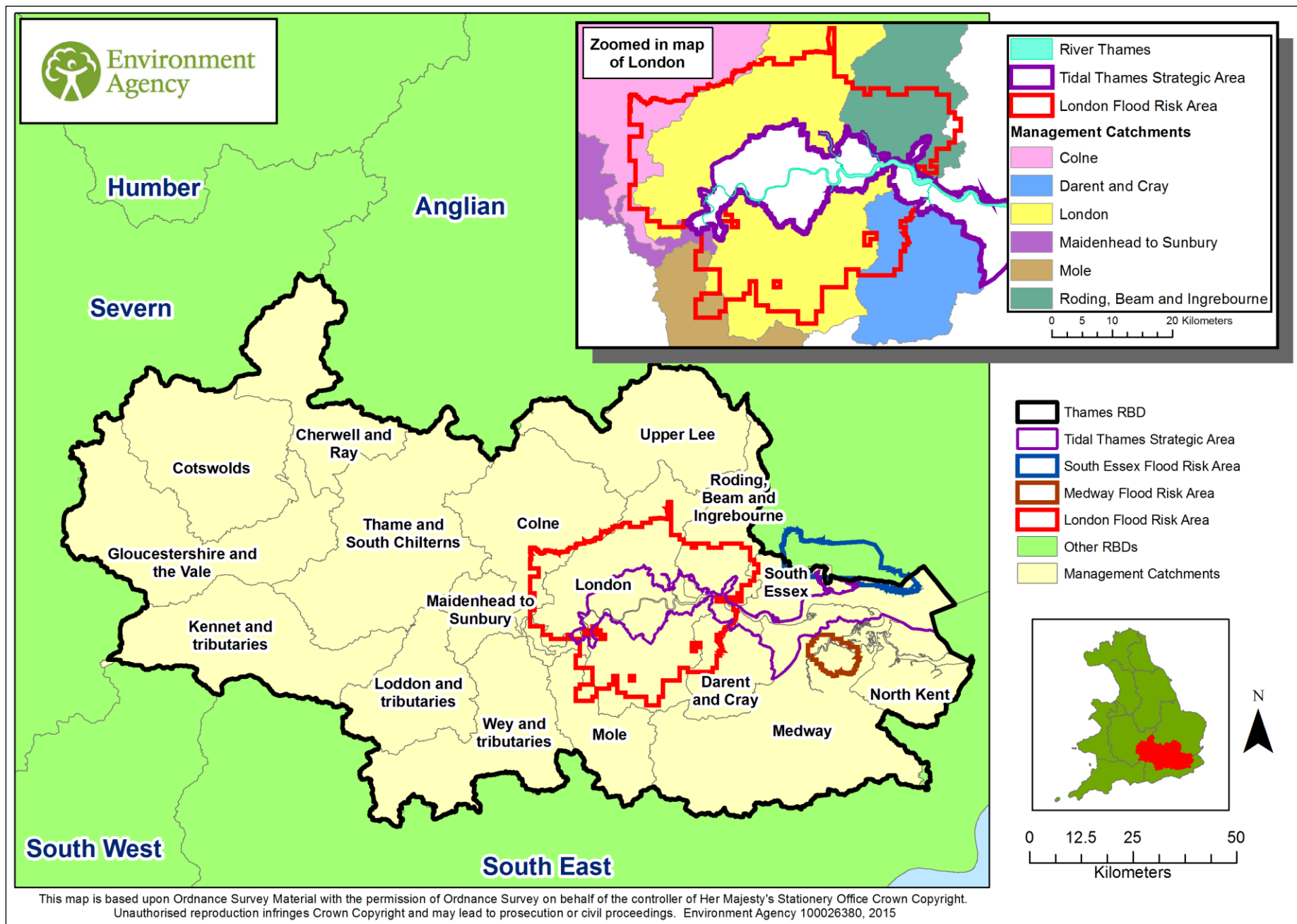


Figure 1: Thames RBD showing catchments, flood risk areas and other strategic areas

Working with lead local flood authorities

Table 1 lists the lead local flood authorities (LLFAs) in the Thames RBD and which of the sub-areas listed above they cover. Where they have included their information in this plan it is indicated in the “link to further information” column. If they have a published local flood risk management strategy then there is a link to it, otherwise there is a link to their web pages where you can go to find out more about how they are managing flooding locally.

Table 1: LLFAs across the Thames RBD, which management catchment, flood risk area and strategic area they fall within (where relevant) and where to go for more information about how they are managing flood risk in their area

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
County Councils				
Buckinghamshire County Council	<ul style="list-style-type: none"> Cherwell and Ray Colne Maidenhead to Sunbury Thame and South Chilterns 	N/A	N/A	Buckinghamshire local flood risk management strategy
East Sussex County Council	<ul style="list-style-type: none"> Medway 	N/A	N/A	East Sussex local flood risk management strategy
Essex County Council	<ul style="list-style-type: none"> London Roding, Beam and Ingrebourne South Essex Upper Lee 	N/A	Tidal Thames	Essex local flood risk management strategy Measures included in the relevant catchment sections in this plan
Gloucestershire County Council	<ul style="list-style-type: none"> Gloucestershire and the Vale Cotswolds 	N/A	N/A	Gloucestershire local flood risk management strategy
Hampshire County Council	<ul style="list-style-type: none"> Kennet and tributaries Loddon and tributaries Wey and tributaries 	N/A	N/A	Hampshire local flood risk management strategy

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
Hertfordshire County Council	<ul style="list-style-type: none"> Colne London Thame and South Chilterns Upper Lee 	N/A	N/A	Hertfordshire local flood risk management strategy
Kent County Council	<ul style="list-style-type: none"> Darent and Cray Medway North Kent 	N/A	Tidal Thames	Kent local flood risk management strategy Measures included in the relevant catchment sections in this plan
Northamptonshire County Council	<ul style="list-style-type: none"> Cherwell and Ray 	N/A	N/A	Northamptonshire flood risk management strategy Measures included in the relevant catchment sections in this plan
Oxfordshire County Council	<ul style="list-style-type: none"> Cherwell and Ray Cotswolds Thame and South Chilterns Gloucestershire and the Vale 	N/A	N/A	Oxfordshire flood risk management strategy
Surrey County Council	<ul style="list-style-type: none"> Colne Loddon and tributaries London Maidenhead to Sunbury Medway Mole Wey and tributaries 	London	N/A	Surrey local flood risk management strategy Measures included in the London flood risk area chapter of this plan

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
West Sussex County Council	<ul style="list-style-type: none"> Mole 	N/A	N/A	West Sussex flood risk management strategy Measures included in the relevant catchment sections in this plan
Unitary Authorities				
Bracknell Forest	<ul style="list-style-type: none"> Loddon and tributaries Maidenhead to Sunbury 	N/A	N/A	Bracknell Forest flood risk management strategy
Central Bedfordshire	<ul style="list-style-type: none"> Upper Lee 	N/A	N/A	Central Bedfordshire flood risk management strategy
Luton	<ul style="list-style-type: none"> Upper Lee 	N/A	N/A	Luton draft local flood risk management strategy
Medway	<ul style="list-style-type: none"> Medway 	Medway	Tidal Thames	Medway flood risk management strategy Measures included in the Medway flood risk area chapter of this plan
Reading	<ul style="list-style-type: none"> Kennet and tributaries Thame and South Chilterns 	N/A	N/A	Reading flood risk management strategy
Slough	<ul style="list-style-type: none"> Colne Maidenhead to Sunbury 	N/A	N/A	Slough flood risk management strategy
Swindon	<ul style="list-style-type: none"> Gloucestershire and the Vale 	N/A	N/A	Swindon flood risk management strategy
Thurrock	<ul style="list-style-type: none"> South Essex Roding, Beam and Ingrebourne 	N/A	Tidal Thames	Thurrock flood risk management strategy

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
West Berkshire	<ul style="list-style-type: none"> • Kennet and tributaries • Thame and South Chiltern 	N/A	N/A	West Berkshire flood risk management strategy
Wiltshire	<ul style="list-style-type: none"> • Kennet and tributaries • Gloucestershire and the Vale 	N/A	N/A	Wiltshire flood risk management strategy
Windsor and Maidenhead	<ul style="list-style-type: none"> • Colne • Loddon and tributaries • Maidenhead to Sunbury • Thame and South Chilterns 	N/A	N/A	Windsor and Maidenhead flood risk management strategy
Wokingham	<ul style="list-style-type: none"> • Kennet and tributaries • Loddon and tributaries • Thame and South Chilterns 	N/A	N/A	Wokingham flood risk management strategy
London LLFAs				
London Borough of Barking and Dagenham	<ul style="list-style-type: none"> • Roding, Beam and Ingrebourne 	London	Tidal Thames	London Borough of Barking and Dagenham flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Barnet	<ul style="list-style-type: none"> • London • Colne 	London	N/A	Barnet website flood pages Measures included in the London flood risk area chapter of this plan

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
London Borough of Bexley	<ul style="list-style-type: none"> London Darent and Cray 	London	Tidal Thames	London Borough of Bexley flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Brent	<ul style="list-style-type: none"> London 	London	N/A	Brent website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Bromley	<ul style="list-style-type: none"> London Darent and Cray 	London	N/A	London Borough of Bromley flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Camden	N/A	London	N/A	Camden local flood risk management strategy Measures included in the London flood risk area chapter of this plan
City of London Corporation	N/A	London	Tidal Thames	City of London local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Croydon	<ul style="list-style-type: none"> London 	London	N/A	Croydon website for flood risk Measures included in the London flood risk area chapter of this plan
London Borough of Ealing	<ul style="list-style-type: none"> London 	London	N/A	Ealing local flood risk management strategy Measures included in the London flood risk area chapter of this plan

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
London Borough of Enfield	<ul style="list-style-type: none"> London 	London	N/A	London Borough of Enfield flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Greenwich	<ul style="list-style-type: none"> London Darent and Cray 	London	Tidal Thames	London Borough of Greenwich draft flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Hackney	<ul style="list-style-type: none"> London 	London	N/A	London Borough of Hackney website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Hammersmith and Fulham	N/A	London	Tidal Thames	London Borough of Hammersmith and Fulham surface water management plan Measures included in the London flood risk area chapter of this plan
London Borough of Haringey	<ul style="list-style-type: none"> London 	London	N/A	London Borough of Haringey website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Harrow	<ul style="list-style-type: none"> London Colne 	London	N/A	Harrow website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Havering	<ul style="list-style-type: none"> Roding, Beam and Ingrebourne South Essex 	London	Tidal Thames	London Borough of Havering flood risk management strategy Measures included in the London flood risk area chapter of this plan

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
London Borough of Hillingdon	<ul style="list-style-type: none"> London Colne 	London	N/A	Hillingdon website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Hounslow	<ul style="list-style-type: none"> London Colne 	London	Tidal Thames	Hounslow draft local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Islington	N/A	London	N/A	London Borough of Islington strategic flood risk assessment Measures included in the London flood risk area chapter of this plan
London Borough of Kensington and Chelsea	N/A	London	Tidal Thames	Kensington and Chelsea local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Kingston upon Thames	<ul style="list-style-type: none"> London Maidenhead to Sunbury 	London	N/A	Kingston flood risk management website Measures included in the London flood risk area chapter of this plan
London Borough of Lambeth	<ul style="list-style-type: none"> London 	London	Tidal Thames	Lambeth local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Lewisham	<ul style="list-style-type: none"> London 	London	Tidal Thames	London Borough of Lewisham flood risk assessment Measures included in the London flood risk area chapter of this plan
London Borough of Merton	<ul style="list-style-type: none"> London 	London	N/A	Merton local flood risk management strategy Measures included in the London flood risk area chapter of this plan

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
London Borough of Newham	<ul style="list-style-type: none"> Roding, Beam and Ingrebourne London 	London	Tidal Thames	London Borough of Newham website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Redbridge	<ul style="list-style-type: none"> Roding, Beam and Ingrebourne London 	London	Tidal Thames	London Borough of Redbridge website flood pages Measures included in the London flood risk area chapter of this plan
London Borough of Richmond upon Thames	<ul style="list-style-type: none"> London Maidenhead to Sunbury 	London	Tidal Thames	London Borough of Richmond flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Southwark	<ul style="list-style-type: none"> London 	London	Tidal Thames	Southwark local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Sutton	<ul style="list-style-type: none"> London 	London	N/A	Sutton flood risk management flooding web pages Measures included in the London flood risk area chapter of this plan
London Borough of Tower Hamlets	<ul style="list-style-type: none"> London 	London	Tidal Thames	Tower Hamlets local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Waltham Forest	<ul style="list-style-type: none"> London 	London	Tidal Thames	Waltham Forest local flood risk management strategy Measures included in the London flood risk area chapter of this plan
London Borough of Wandsworth	<ul style="list-style-type: none"> London 	London	Tidal Thames	Wandsworth local flood risk management strategy Measures included in the London flood risk area chapter of this plan

LLFA	Relevant management catchments	Relevant flood risk area(s)	Relevant strategic area	Link to further information
Westminster City Council	N/A	London	Tidal Thames	Westminster City Council draft local flood risk management strategy Measures included in the London flood risk area chapter of this plan

2. Conclusions, objectives and measures to manage risk for the flood risk areas in Thames river basin district

The following section considers the measures for each of the following flood risk areas in the Thames river basin district (RBD):

- London flood risk area
- Medway flood risk area

2.1 The London flood risk area

Introduction to the London flood risk area

As shown in **Figure 2**, the London flood risk area covers the Greater London administrative area as well as a small part of Surrey County Council.

This flood risk areas was produced (along with others across England and Wales) based on a method identified in Defra and Welsh Government's guidance. As a starting point for lead local flood authorities (LLFAs), the Environment Agency used its national surface water mapping products to define indicative flood risk areas. By law LLFAs must now produce flood risk management plans (FRMPs) for all flood risk areas covering flooding from local sources (surface water, ordinary watercourses and groundwater).

This chapter of the Thames FRMP focuses on the measures which LLFAs in the London flood risk area have put forward to better understand and manage their local flood risk. It should be read in conjunction with the other sections of this plan for information on how risk from other sources will be managed. **Figure 3** shows how the flood risk area overlaps with the management catchments and the tidal Thames strategic area. These sections need to be viewed together to give a full picture of flood risk across London.

All of the LLFAs in the London flood risk area (the 33 London LLFAs plus Surrey County Council) have included their information in this FRMP. The source of this information is shown in **Table 1**.

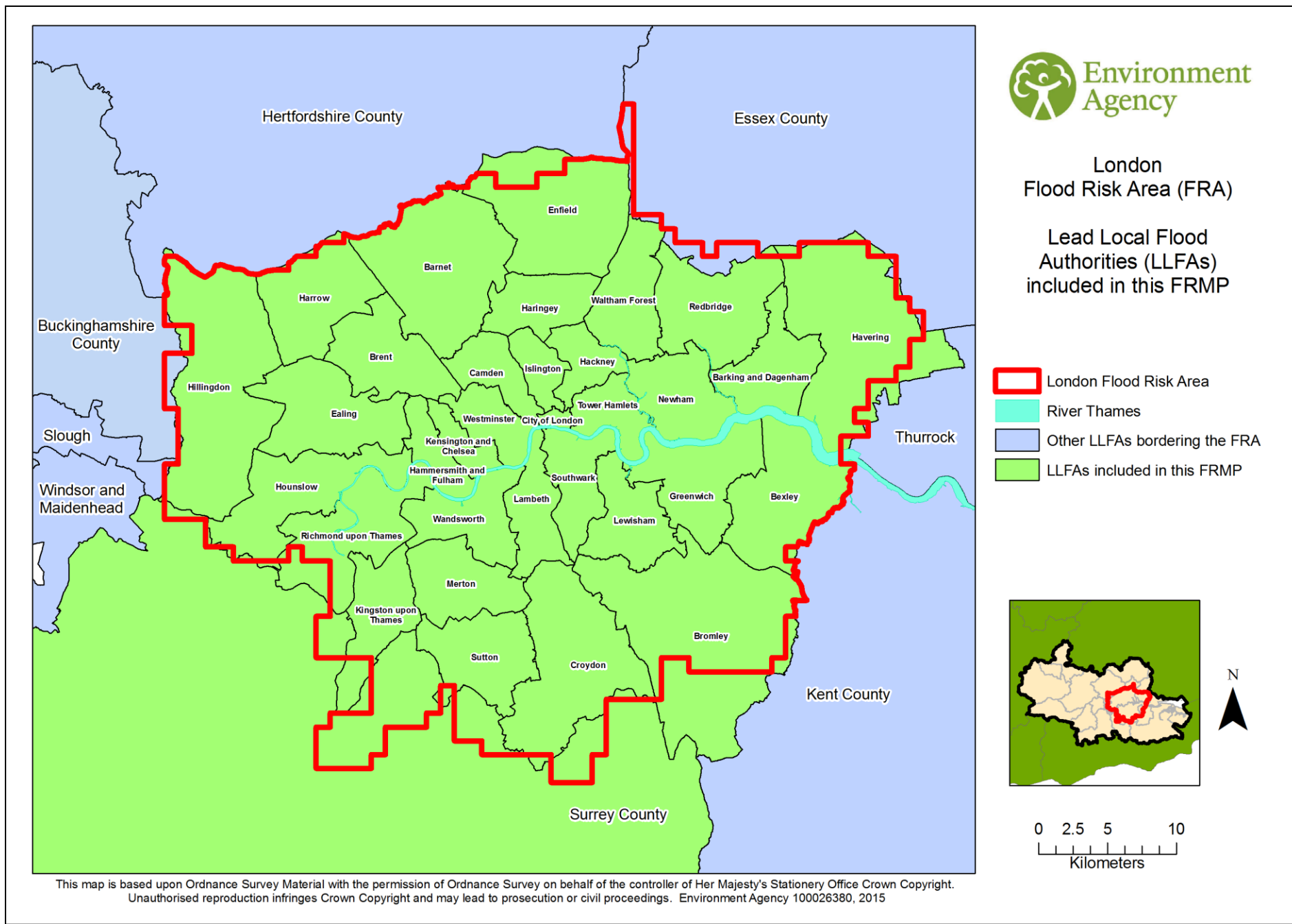


Figure 2: London flood risk area overview map

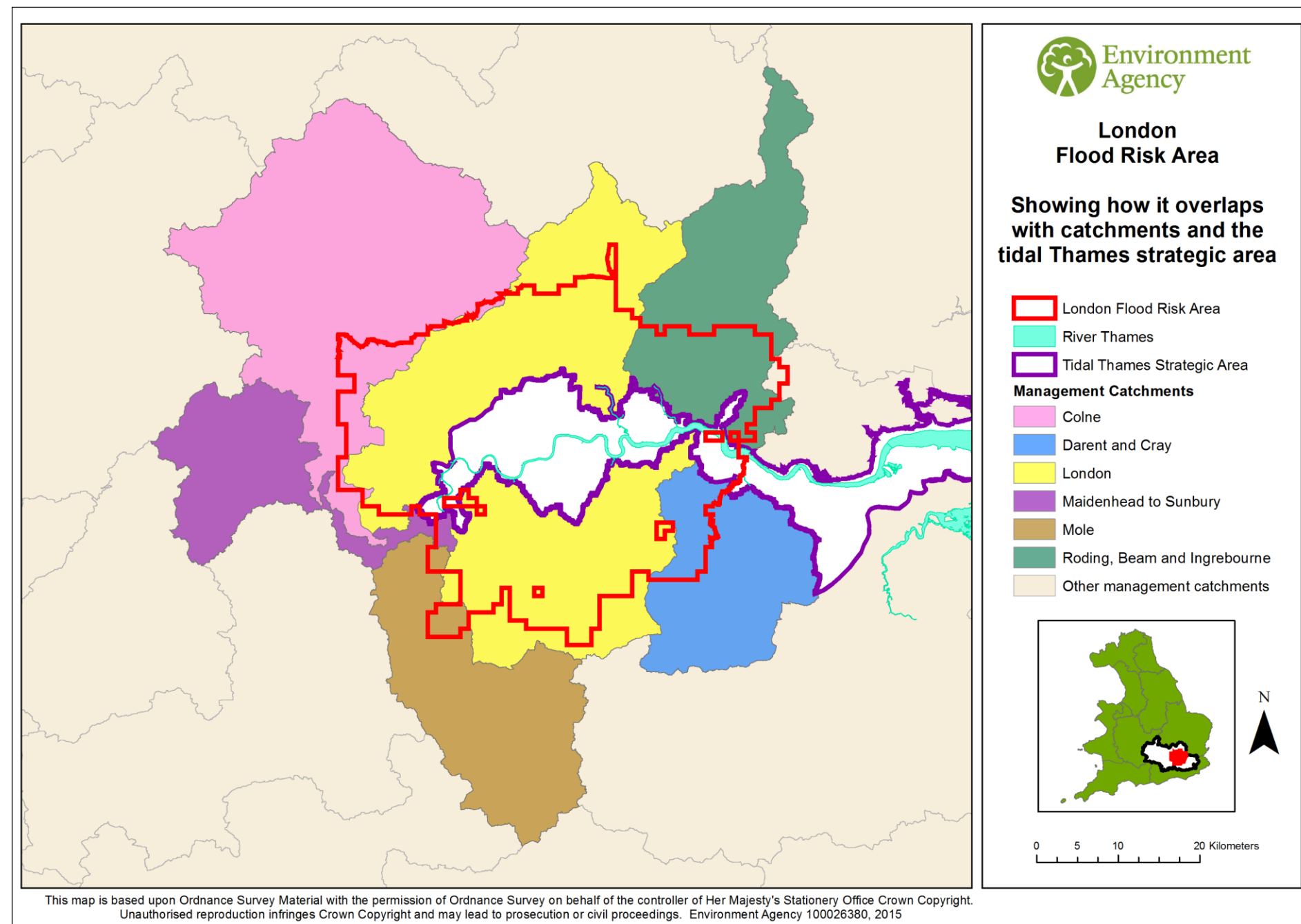


Figure 3: London flood risk area - showing how it overlaps with catchments and the tidal Thames strategic area

Flood risk statistics

The information contained in these tables has been calculated using the [surface water flood map](#) which have been developed and published by the Environment Agency.

Table 2: Summary of flood risk from surface water to people, economic activity and the natural and historic environment across the whole of the London flood risk area

Surface Water	Total in flood risk area	High risk	Medium risk	Low risk
Risk to people:				
Number of people in area:	8,225,950	140,850	229,550	1,062,000
Number of services:	6,700	100	200	960
Risk to economic activity:				
Number of non-residential properties:	394,300	7,400	13,250	55,000
Number of airports:	3	0	0	1
Length of main roads (km):	1,030	80	100	250
Length of railway (km):	830	80	70	150
Agricultural land (ha):	17,100	400	350	1,350
Risk to the natural and historic environment:				
Number of EU designated bathing waters within 50m:	1	1	0	0
Number of EPR installations within 50m:	84	40	24	14
Area of SAC within area (ha):	1,300	50	50	100
Area of SPA within area (ha):	300	0	<50	50
Area of RAMSAR site within area (ha):	300	0	<50	50
Area of World Heritage Site within area (ha):	800	<50	<50	<50
Area of SSSI within area (ha):	3,750	100	100	350
Area of Parks and Gardens within area (ha):	5,200	100	150	400
Area of Scheduled Monument within area (ha):	300	<50	<50	<50
Number of Listed Buildings within area:	19,180	530	570	1,420
Number of Licensed water abstractions within the area:	650	40	0	90

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Flood risk in London

Flood risk management authorities have acknowledged for some time that flood risk is a major issue for London, and that the probability of flooding is increasing with climate change. As London's population continues to grow, the potential consequences of flooding also increase.

London is at risk from a combination of flooding from the tidal River Thames, fluvial watercourses (main rivers and ordinary watercourses), surface water, groundwater, sewers and reservoirs.

As set out above, this chapter focuses on the management of local sources of flood risk (surface water, groundwater and ordinary watercourses) and needs to be read in conjunction with other information in this plan. Flooding from different sources across London interact to exacerbate the risk, so all need to be considered when deciding how best to manage the risk.

Each risk, with where to go for more information is set out briefly below:

Tidal flood risk

The River Thames and the lower reaches of some of the rivers flowing into it are affected by the tide. The River Thames has a very large tidal range, in excess of 7 metres on spring tides. The tide's influence reaches to Teddington Lock on the Thames and up several of the tributaries.

Without the current river walls many areas of London along the Thames and along the tidal stretches of the tributaries would be inundated twice a day through the normal tidal cycle. River walls have been steadily built up to give increasing levels of flood protection and to enable urban development.

For more information about risk of flooding from the tidal Thames and how it is being managed see the section later on in this document on the tidal Thames strategic area which sets out how the Thames Estuary (TE2100) plan is being implemented.

Fluvial flood risk

London has several other river catchments leading to the River Thames. The Thames itself is a fluvial river upstream of Teddington Lock. As with any river system there is a possibility that any of these rivers could flood. This is likely to come from either intense rainfall within the catchment or from a blockage or restriction to flow within the river channel.

For more information about risk of flooding from the fluvial rivers in London and how it is being managed see;

- The Colne catchment
- The Darent catchment
- The Maidenhead to Sunbury catchment
- The Mole catchment
- The Roding, Beam and Ingrebourne catchment

Surface water flood risk

This type of flooding occurs when rainfall overwhelms the drainage system or is of such intensity that it flows over land. This can happen in localised areas as a result of particularly intense storms. As such it is very hard to predict.

Lower lying areas of all London boroughs are at risk from surface water flooding. Given the complexity of the land form, topography and the drainage network it is impossible to predict precisely where the risks will lie. Details such as the height of kerbs or level and construction of boundary walls can determine which way surface water will flow.

The mapping of surface water risks has improved significantly in recent years, culminating in the [surface water flood map](#) which has been developed and published by the Environment Agency.

Several of the London LLFAs are also in the process of undertaking modelling to refine their understanding of surface water risks. See the tables in Part C to see which LLFAs have set out a measure to refine their risks from surface water.

Sewer flood risk

Flooding from sewers can occur when the network becomes blocked or overloaded. This often affects basement flats or premises in low lying areas. Sewer flooding is clearly particularly unpleasant and distressing as its contents are highly contaminated.

In most of central and inner London the surface water and sewerage networks are combined in “Combined Sewers”. During periods of heavy rain the combined sewage and rainwater is diverted to the River Thames via combined sewer overflows to prevent significant flooding of homes, businesses, streets and gardens. In parts of London where these combined sewers are still present, there are historical flooding issues, particularly due to the foul sewerage system backing up as a consequence of being overloaded with surface water. This piped or culverted surface water drainage system is unable to handle the volumes of water and thus under pressure forces surface water into the foul sewerage system through informal cross-connections. This has led to several flooding incidents in parts of London over the last 30 years.

Groundwater flood risk

Groundwater flows out of the ground at the point where the water table meets the surface. Heavy rainfall can infiltrate the ground causing saturation; surplus water will then flow out to rivers or onto land potentially causing flooding. Groundwater responds slowly to rainfall, so when groundwater flooding occurs it can persist for some time. Within London there have only been a few recorded groundwater flooding events, but some South London boroughs were affected by groundwater flooding in February 2014.

Reservoir flood risk

The chances of a reservoir failing and causing flooding are very low; however, in the unlikely event that a reservoir dam failed, a large volume of water would escape at once and flooding could happen with little or no warning. This means they are an important consideration when managing flood risk in London. The extent of flooding from a reservoir can be up to 50 miles from its source. This is because the local geography, such as valleys, can channel flood water long distances.

The [reservoir flood maps](#) published on the Environment Agency website show the largest areas that might flood if a reservoir were to fail.

Working in partnership

In 2007 the Drain London project was established, led by the Greater London Authority. This was formed following analysis in the Regional Flood Risk Appraisal and the severe flooding experienced elsewhere in the UK that year. Climate change, significant population growth and increasing urbanisation have been recognised as challenges that will add

pressure to already stressed drainage systems. The Drain London project has established a forum which brings together all the major organisations with a responsibility for managing surface water in the capital. It has worked with London's 33 LLFAs to help them to meet their responsibilities under the Flood and Water Management Act (2010) and Flood Risk Regulations (2009). As part of Drain London, Preliminary Flood Risk Assessments, Surface Water Management Plans and mapping has been produced for all 33 LLFAs. Drain London has also secured funding, enabling several studies and schemes to be undertaken to better understand local flood risk and protect communities and infrastructure from flooding.

All of the LLFAs in London work in partnership with each other to effectively understand and manage their flood risks. London has seven partnership groups who meet regularly to share best practice and ensure that cross-boundary flooding issues are considered. Each of these partnership groups are represented by a single member on the Thames Regional Flood and Coastal Committee (RFCC). As set out in Part A, the RFCCs play an important role in local funding and approving programmes of work that protect communities from flooding. The RFCC supports the Environment Agency and lead local flood authorities in working with these communities and other partners to identify and bring in funding. The Environment Agency annually submits the six year investment programme to the RFCC, which contains the funding bids for the Environment Agency and LLFAs for the next 6 years.

Conclusions and objectives for the London flood risk area

We have set out the following for the London flood risk area:

Conclusions:

As described above, flooding from different sources is considered to pose a serious threat to London – either individually, or in combination. This chapter of the FRMP focuses on the risks from local sources of flooding, but they cannot be considered in isolation. A full understanding of the risks from different sources is necessary to be able to effectively manage those risks.

For the detail on numbers at risk from the tidal Thames, fluvial watercourses and reservoirs please see the other sections of this document. **Table 2** below sets out the numbers at risk from surface water across the London FRA. This shows that over a million people and over a thousand important services could be affected by surface water flooding. This has the potential to cause severe disruption to residents, businesses and vital infrastructure across the capital.

Objectives:

These objectives are specific to this flood risk area and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the number of properties affected by flooding from surface water through techniques to manage and reduce the speed of run-off in London.
- Reduce disruption caused by flooding to transport networks and critical infrastructure.

- Ensure, where possible, that flooding to communities across London does not increase as a result of climate change.

Economic

- Reduce the number of businesses and critical infrastructure affected by flooding from surface water through techniques to manage and reduce the speed of run-off in London.
- Reduce the impacts and associated costs of flood damages and ensure flood damages do not increase in the future (for example due to climate change).

Environmental

- Conserve, restore and enhance environmental sites and promote opportunities for biodiversity and habitat creation.

Measures across the London flood risk area

Across the London flood risk area, the LLFAs have set out 739 individual measures to manage local flood risk. The source of this information and full details of the measures for each LLFA are set out in Part C. They are summarised below:

Preventing risk

There are 285 measures set out to prevent risk. These include;

- undertaking modelling to better understand the risk from surface water flooding
- influencing development proposals using policies to achieve run-off reduction and increase the use of sustainable drainage systems
- working with other risk management authorities in partnership to manage flood risk
- recording and managing flood risk assets
- updating strategic level and local plans with the most up-to-date information to effectively assess local flood risk

Preparing for risk

There are 268 measures to prepare for risk. These primarily relate to;

- emergency planning and ensuring the lead local flood authorities are prepared to manage flood risk
- assessing where critical infrastructure is at risk
- updating multi-agency flood plans using up-to-date risk information
- working with internal and external partners to prepare for flooding
- developing databases to effectively record flood events
- improving the information available on flooding on council websites
- engaging with local communities to ensure they are prepared for flooding

- undertaking local assessment using up-to-date information to ensure local flood risk is properly understood

Protecting from risk

There are 89 measures to prevent flood risk. These are mainly concerned with;

- undertaking feasibility work to assess the most appropriate type of scheme within areas identified at risk
- identifying appropriate flood protection schemes within locations identified as critical drainage areas
- installation of sustainable drainage systems to reduce run-off (for example rain gardens or flood storage areas)
- promoting resistance and resilience measures to enable individual properties to protect themselves from flooding
- working in partnership with other organisations to identify flood risk schemes

Recovery and review of risk

There are 38 measures relating to recovery and review of flooding. These are primarily concerned with;

- learning from previous flood events
- setting up systems to effectively record flooding when it is reported
- setting the criteria for and investigating flooding events where necessary

Other

There are 59 measures which have been considered as 'other'. These are measures which don't fit directly into any of the other categories. They include measures to work in partnership with other internal teams and external partners to manage flooding and ensure there is cross-boundary engagement between London boroughs as well as with other organisations.

2.2 The Medway flood risk area

Introduction to the Medway flood risk area

The Medway flood risk area covers a part of the administrative area of Medway Council. Medway Council is a unitary authority covering a total area of 26,876 hectares. Of this, 7,511 hectares is water and 19,365 hectares is land. The flood risk area covers the urban part of the council, encompassing the towns of Rochester, Chatham and Gillingham. An overview of the Medway flood risk area is shown in **Figure 4**.

Information regarding historic and future flood risk has been used to formally identify flood risk areas. To achieve this, flood risk indicators were used to determine the impacts of flooding on human health, economic activity, cultural heritage and the environment. The Preliminary Flood Risk Assessment completed by Medway Council in 2011, concluded that there is potential risk of surface water flooding which has the potential to cause significant harmful consequence.

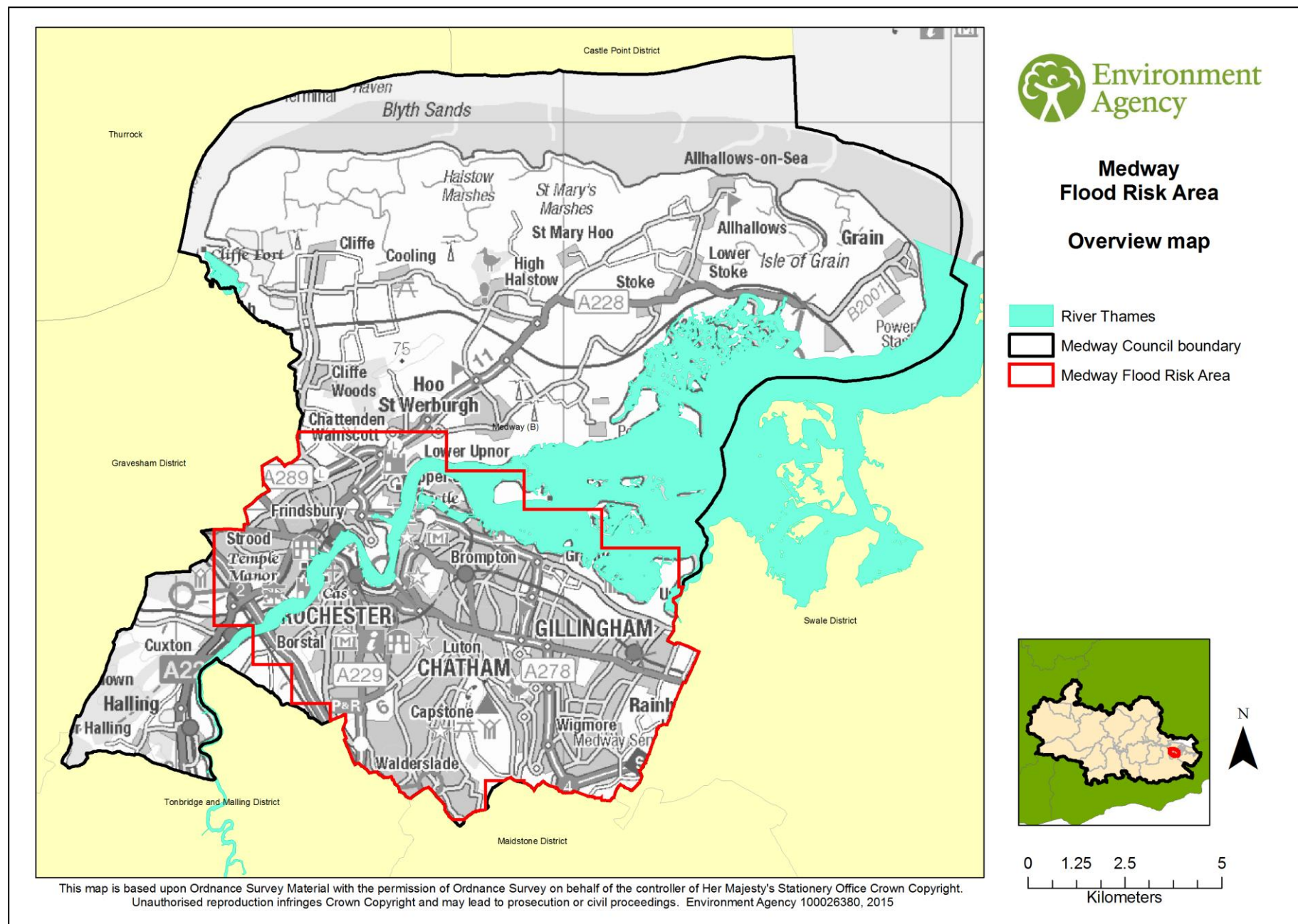


Figure 4: Medway flood risk area overview map

Flood risk statistics

The information contained in these tables has been calculated using the [surface water flood map](#) which have been developed and published by the Environment Agency.

Table 3: Summary of flood risk from surface water to people, economic activity and the natural and historic environment across the Medway flood risk area

Surface Water	Total in flood risk area	High risk	Medium risk	Low risk
Risk to people:				
Number of people in area:	234,250	6,650	7,350	21,750
Number of services:	250	<10	<10	30
Risk to economic activity:				
Number of non-residential properties:	11,300	600	550	1,400
Number of airports:	0	0	0	0
Length of main roads (km):	20	<10	<10	<10
Length of railway (km):	30	<10	<10	<10
Agricultural land (ha):	2,650	50	50	200
Risk to the natural and historic environment:				
Number of EU designated bathing waters within 50m:	0	0	0	0
Number of EPR installations within 50m:	1	0	1	0
Area of SAC within area (ha):	550	0	<50	<50
Area of SPA within area (ha):	550	0	<50	<50
Area of RAMSAR site within area (ha):	0	0	0	0
Area of World Heritage Site within area (ha):	600	<50	<50	<50
Area of SSSI within area (ha):	<50	0	0	0
Area of Parks and Gardens within area (ha):	<50	0	0	0
Area of Scheduled Monument within area (ha):	<50	<50	<50	<50
Number of Listed Buildings within area:	530	<10	10	40
Number of Licensed water abstractions within the area:	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

Conclusions and objectives for the Medway flood risk area

We have set out the following for the Medway flood risk area:

Conclusions:

As shown in **Table 3**, over 35,000 people and over 2000 important services could be affected by surface water flooding. This has the potential to cause severe disruption to residents, businesses and vital infrastructure across the Medway flood risk area. These are concentrated in the urban areas of Rochester, Chatham and Gillingham.

Objectives:

These objectives are specific to this flood risk area and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the number of properties affected by flooding from surface water
- Reduce disruption caused by flooding to transport networks and critical infrastructure.
- Ensure, where possible, that flooding to communities does not increase as a result of climate change.

Economic

- Reduce the number of businesses and critical infrastructure affected by flooding from surface water.
- Reduce the impacts and associated costs of flood damages and ensure flood damages do not increase in the future (for example due to climate change).

Environmental

- Conserve, restore and enhance environmental sites and promote opportunities for biodiversity and habitat creation.

Measures across the Medway flood risk area

Across the Medway flood risk area, there are 11 measures to manage flood risk. The source of this information and full details of the measures are set out in Part C. They are summarised below:

Preventing risk

There are 4 measures to prevent risk. These include measures to monitor flood risk (including climate change impacts) and improve incident recording. There are also measures relating to the review of local policy and ensuring development doesn't have a detrimental impact on flood risk in the area.

Preparing for risk

There are 4 measures to prepare for risk. These relate to working with other stakeholders to develop a collective understanding of local flood risk and sharing information about this risk with other authorities and the public. There is also a focus on increasing public awareness in areas at risk from flooding and developing tools for flood prediction and warning.

Protecting from risk

There are 3 to prevent flood risk. These are mainly concerned with promoting the use of sustainable drainage systems (SuDS) as well as consideration of how infrastructure improvements in the area can contribute towards delivering local flood risk reduction. There is also a measure relating to capital investment and maintenance programmes. This will be achieved using the council's asset register to inform investment decisions.

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3. Conclusions, objectives and measures to manage risk in the Thames river basin district catchments

The following section considers each of the catchments in the Thames river basin district (RBD). These are:

- [Cherwell and Ray](#)
- [Colne](#)
- [Cotswolds](#)
- [Darent and Cray](#)
- [Gloucestershire and the Vale](#)
- [Kennet and tributaries](#)
- [Loddon and tributaries](#)
- [London](#)
- [Maidenhead to Sunbury](#)
- [Medway](#)
- [Mole](#)
- [North Kent](#)
- [Roding, Beam and Ingrebourne](#)
- [South Essex](#)
- [Thame and South Chilterns](#)
- [Upper Lee](#)
- [Wey and tributaries](#)

We have considered each of the catchments in turn. Within each section we have included a summary of the catchment, flood risk statistics, and conclusions and objectives on flood risk. We then summarise the measures to manage this risk (which are listed in full in Part C). Within each catchment section there is also a short description of the river basin management plan (RBMP) priorities so we can determine how to effectively achieve multiple benefits through our work on this flood risk management plan (FRMP).

3.1 The Cherwell and Ray catchment

Introduction to the Cherwell and Ray catchment

The Cherwell and Ray catchment consists of the River Cherwell and its tributaries, of which the River Ray (Oxon) is the largest. From its headwaters near the village of Charwelton in Northamptonshire, the River Cherwell flows southwards, passing through Banbury and Kidlington before flowing into the Thames at New Hinksey in Oxford. The River Ray has its headwaters near Quainton, from which it flows slowly south-west past Bicester to its confluence with the River Cherwell at Islip. Other than these key urban areas, the Cherwell catchment is very rural, with a high proportion of arable land as well as some improved pasture. The underlying geology is clay. An overview of the Cherwell and Ray catchment is shown in **Figure 5**.

For much of its length, the Cherwell runs parallel with the Oxford Canal, crossing it at Nellbridge and sharing the same channel between Enslow and Shipton-on-Cherwell.

The Ray is of particular significance as, despite heavy modifications to its channel, its floodplain includes areas of nationally rare species-rich meadow. This includes several Sites of Special Scientific Interest (SSSIs), including Meadow Farm, a site of historical importance with medieval ridge-and-furrow farming techniques still visible today.

Further downstream, the RSPB manages a large nature reserve at Otmoor, famous for its bird life. Both the Ray and the Cherwell form part of the RSPB's wide-reaching "Futurescapes" project for the Upper Thames River Valleys, highlighting once again the national importance of this area.

Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Cherwell and Ray catchment include action to gain Water Framework Directive improvement through proposed development and taking the catchment approach to enhance and expand the floodplain.

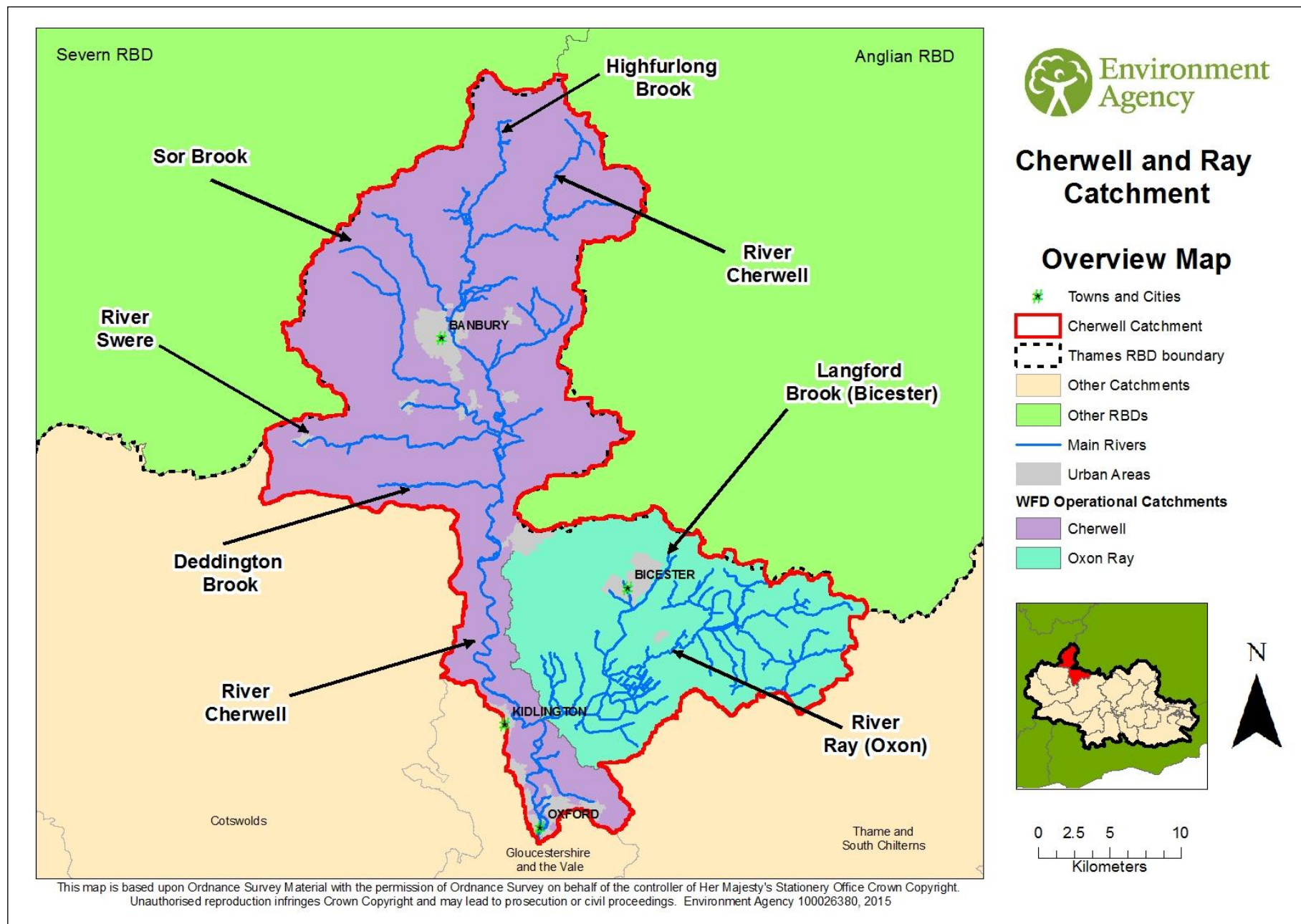


Figure 5 – The Cherwell and Ray catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

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

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	185,950	550	750	3,450	0
Number of services:	630	20	10	20	0
Risk to economic activity:					
Number of non-residential properties:	30,400	350	350	800	0
Number of airports:	0	0	0	0	0
Length of main roads (km):	190	<10	<10	<10	<10
Length of railway (km):	90	<10	<10	<10	<10
Agricultural land (ha):	63,000	1,200	700	550	<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:	15	3	2	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):	950	200	<50	<50	0
Area of Parks and Gardens within area (ha):	2,000	50	<50	<50	<50
Area of Scheduled Monument within area (ha):	300	<50	<50	<50	<50
Number of Listed Buildings within area:	4,190	60	40	90	0
Number of Licensed water abstractions within the area:	80	20	<10	0	0

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Table 5: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Cherwell and Ray catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	185,950	1,200
Number of services:	630	10
Risk to economic activity:		
Number of non-residential properties:	30,400	450
Number of airports:	0	0
Length of roads (km):	190	<10
Length of railway (km):	90	<10
Agricultural land (ha):	63,000	450
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	15	2
Area of SAC within area (ha):	0	0
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	950	<50
Area of Parks and Gardens within area (ha):	2,000	100
Area of Scheduled Monument within area (ha):	300	<50
Number of Listed Buildings within area:	4,190	30
Number of Licensed water abstractions within the area:	80	<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

Conclusions and objectives for the Cherwell and Ray catchment

We have set out the following for the Cherwell and Ray catchment:

Conclusions:

The primary flood risk in the Cherwell and Ray catchment is from rivers, however some areas are at risk from other sources, including surface water. The majority of land within the catchment is rural, but there are a few significant urban centres including Banbury and Bicester. There are currently flood defences in Banbury which reduce flood risk to the town. The National Farming Union (NFU) is looking into the future protection rural floodplain with a pilot project on the Ray River catchment. For more information please see:

<http://www.nfuonline.com/about-us/our-offices/south-east/berks-bucks-and-oxon/upper-thames-flood-project/>

The Environment Agency is proposing to develop detailed modelling at locations around the catchment to improve our understanding the risk of flooding in other areas.

In key areas, we will aim to help communities to prepare for flooding through raising awareness of flooding, increasing resilience and by encouraging appropriate redevelopment. We will aim to safeguard natural floodplains to reduce the consequence of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the impact of flooding through community awareness and flood response

Economic

- To reduce the risk of flooding where possible through the delivery of the 6 year programme
- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces the risk wherever possible

Environmental

- To have a better understanding of the flood risk from rivers in certain areas in the Cherwell and Ray catchment
- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive

Measures across the Cherwell and Ray catchment

Across the Cherwell and Ray catchment there are 40 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk:

There are 13 measures to prevent risk. These include Northamptonshire County Council in their role as lead local flood authority (LLFA). They are aiming to:

- Increase knowledge of groundwater flooding
- Develop mapping tools
- Inform development plan policy
- Promote Sustainable Urban Drainage Systems
- Encourage riparian activities

The Environment Agency is working to reduce flood risk by working with the planning authorities to steer development to areas with the least risk of flooding. There are measures to continue the effective maintenance of rivers through the regime of inspections and

clearance set out in the system asset management plan. There are 2 measures to investigate flood attenuation measures and 3 measures for flood modelling at Islip, Blackthorn and Bloxham.

Preparing for risk

There are 10 preparing measures which include working with local resilience forums to improve multi-agency response to flooding, encouraging communities to produce flood plans and reviewing flood warning and alert areas across the Cherwell and Ray catchment. Northamptonshire LLFA will train staff and develop a community resilience project and to help communities prepare for risk. This includes the Northamptonshire LLFA Flood Awareness Campaigns, and exploring flood warnings linked to CCTV.

Protecting from risk

There are 12 measures for protecting flood risk including maintaining existing defences in the catchment and using the catchment approach to enhance and expand the floodplain. Northamptonshire LLFA will:

- promote Water Framework Directive (WFD) improvements and environmental actions on ordinary watercourses
- complete a district-wide surface water management plan in Northamptonshire
- construct the flood alleviation scheme at Kings Sutton Wales Street
- investigate flood risk improvement works in Woodford Halse and High St Charwelton
- assess the impact of floods on heritage sites in Northamptonshire

Recovery and review of risk

There are 2 measures relating to preparedness which includes delivering the recovery programme after the winter floods in 2014 and investigating flood incidents which have occurred.

Other:

In total there are 3 other measures within the Cherwell and Ray catchment which relate to Northamptonshire County Council promoting partnership working and securing funding.

3.2 The Colne catchment

Introduction to the Colne catchment

The Colne catchment contains a unique collection of watercourses, ranging from internationally rare chalk streams in the north, to canals, rivers and lakes, which have been heavily influenced by gravel extraction and urban development, to the south.

The northern part of the catchment predominantly lies within the Chilterns Area of Outstanding Natural Beauty, recognised as a landscape of national importance. Chalk streams are an intrinsic part of the landscape, and have a centuries-old connection to the people and communities living in, working in, and visiting the area.

Further south, the catchment extends via a significant green corridor including the Colne Valley Park, through which the rivers connect to the urban populations of northwest London. The park extends over 40 square miles and hosts a mosaic of farmland, woodland and water with 200 miles of rivers, canals and lakes. The area surrounding the park is a living, working environment, providing employment and homes for many people.

The upper reaches of the Colne catchment are mainly rural with a few significant urban areas, including Watford, Rickmansworth, Radlett, London Colney and Potters Bar. The lower reaches of the Colne flow through the more urban and densely populated areas of North West London. An overview of the catchment is shown in **Figure 6**.

As well as the River Colne itself this management catchment includes:

- the River Ash in Staines which connects the lower reaches of the River Colne with the River Thames in Shepperton
- the Chalk tributaries in the West of the Ver, Gade, Bulbourne, Chess and Misbourne which emerge from the areas surrounding the Chilterns Hills
- the River Pinn which flows through the urban areas of Harrow and Hillingdon before joining the River Colne in Yiewsley

Linking with the River Basin Management Plan

We are working collaboratively through the Colne Catchment Action Network (catchment partnership) to understand the catchment and to develop plans to improve the health of the local water environment. Better understanding of the catchment and the ideas and commitment of our partners means that we can be confident that together we can resolve the issues we have identified. The priorities in the Colne catchment include action to reduce pollution from a variety of sources including waste water and transport infrastructure, and the removal or adaption of structures such as weirs and concrete channels and other changes to rivers.

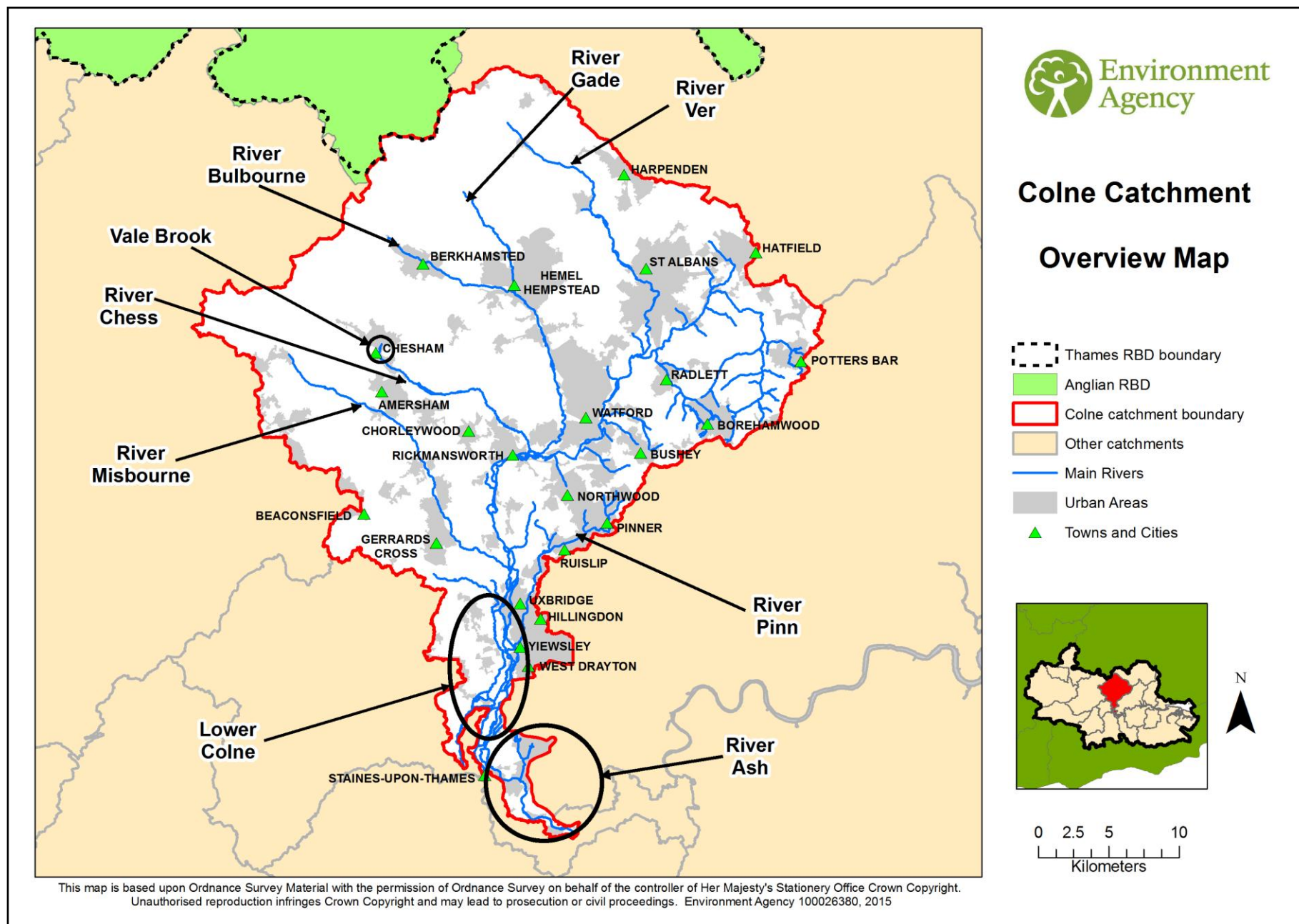


Figure 6: The Colne catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

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

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	900,600	4,500	9,650	33,600	4,050
Number of services:	1,330	10	20	50	<10
Risk to economic activity:					
Number of non-residential properties:	73,400	750	1,250	3,350	650
Number of airports:	0	0	0	0	0
Length of main roads (km):	500	<10	<10	20	<10
Length of railway (km):	140	<10	<10	<10	<10
Agricultural land (ha):	71,250	1,200	550	800	200
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	3	0	3	0
Area of SAC within area (ha):	650	0	0	0	0
Area of SPA within area (ha):	450	50	<10	0	0
Area of RAMSAR site within area (ha):	450	50	<10	<10	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	2,450	250	50	100	<50
Area of Parks and Gardens within area (ha):	3,350	50	<50	<50	<50
Area of Scheduled Monument within area (ha):	400	<50	<50	<50	<50
Number of Listed Buildings within area:	4,300	70	100	200	30
Number of Licensed water abstractions within the area:	320	60	20	30	<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

Table 7: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Colne catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	900,600	71,300
Number of services:	1,330	110
Risk to economic activity:		
Number of non-residential properties:	73,400	5,950
Number of airports:	0	0
Length of main roads (km):	500	50
Length of railway (km):	140	10
Agricultural land (ha):	71,250	2,400
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	17	6
Area of SAC within area (ha):	650	0
Area of SPA within area (ha):	450	100
Area of RAMSAR site within area (ha):	450	100
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	2,450	300
Area of Parks and Gardens within area (ha):	3,350	100
Area of Scheduled Monument within area (ha):	400	<50
Number of Listed Buildings within area:	4,300	410
Number of Licensed water abstractions within the area:	320	70

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the Colne catchment

We have set out the following for the Colne catchment:

Conclusions:

In the Colne catchment there is a risk of flooding from rivers, surface water and ground water. The primary source of risk varies across the catchment:

- In the upper reaches of the catchment there are a number of communities at risk from flooding from rivers. Within the urban areas there is also a risk from surface water flooding.
- In the lower reaches and along the eastern tributary of the River Pinn the risk is from a combination of river flooding and surface water flooding. This is due to the urban nature of the area and the underlying clay geology. The River Pinn is a very fast-responding river, and therefore we need to manage risk differently to the more rural upper reaches.

- The western tributaries of the Colne are in mostly rural settings, and are fed primarily from groundwater. The rivers are therefore slower to respond, but are more likely to suffer prolonged flooding. There are some small communities along the tributaries of the Misbourne, Chess, Gade and Ver which are at risk from groundwater flooding.
- The River Ash is an independent catchment, but influenced by the water levels on the Colne. River flooding is the primary risk in this area, with surface water flooding also a potential risk due to the urban nature of the watercourse.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible.
- Raise community awareness and understanding of all sources of flooding.
- Enhance recreation and general amenity across the catchment.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Promote the use of sustainable drainage systems in development to help reduce pressure on existing drainage networks.

Environmental

- Restore naturally functioning river systems where possible and aim to achieve Water Framework Directive (WFD) objectives through flood risk management.
- Protect and enhance biodiversity through flood risk management schemes, contributing to local targets for priority habitat creation and to the aims of Biodiversity Opportunity Areas.
- Promote sustainable land use management to land owners across the catchment to achieve reductions in flood risk.

Measures across the Colne catchment

Across the Colne catchment there are 46 measures to manage risk. These measures are listed in full in Part C and include:

Preventing risk

There are 29 measures falling into this category. These measures relate to;

- preventing risk through influencing the planning process to ensure development and redevelopment in areas at risk is appropriate
- modelling to better understand the current level of risk

- continuing to manage flood defence assets to ensure existing flood alleviation schemes continue to operate effectively
- promoting property level resilience measures where they are appropriate
- assessing constrictions within the channel to better understand the flood risk from these

Preparing for risk

There are 5 measures across the Colne catchment relating to preparing for flood risk. These measures include;

- maintaining and improving our existing flood warning service
- raising awareness of flooding in communities across the catchment

Protecting from risk

There are currently 12 measures across the Colne catchment to protect from flood risk. These are in areas where we are either undertaking work to manage flood risk now or have identified the potential for flood alleviation schemes in the future. The majority of these schemes are in the early stages of development, and we started work on these projects from 2015 onwards. More detail on these can be found in Part C.

These projects include;

- the refurbishment of a culvert on the Vale Brook to reduce the flood risk
- ongoing development of a wider scheme to reduce flood risk in the River Chess and Vale Brook areas
- improvement works in Watford which will involve a combined fluvial and surface water study to find a way of jointly alleviating surface water and fluvial flooding in Watford
- implementing a new scheme to reduce the risk of flooding from the River Ash and Staines Reservoir aqueduct, considering flooding from all watercourses including Colne Brook, County Ditch, Thames, Staines Reservoir aqueduct and River Ash
- developing a flood alleviation scheme to reduce the risk of flooding from the River Pinn, Cannon Brook and Mad Bess Brook
- reviewing options to address flood risk in Longford and Colnbrook and Poyle (both in the Lower Colne as shown on **Figure 6**)
- investigating the potential for a flood alleviation project for the River Misbourne
- reviewing the potential for localised flood alleviation in the London Colney and Rickmansworth areas

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.3 The Cotswolds catchment

Introduction to the Cotswolds catchment

The Cotswolds catchment lies to the west of Oxford and is situated in the Northwest of the Thames River Basin. The catchment contains the Evenlode and Windrush operational catchments. Part of the catchment lies within the Cotswolds Area of Outstanding Natural Beauty. The River Evenlode and Windrush flow in a south-easterly direction through the counties of Gloucestershire and Oxfordshire, to the River Thames. The Upper River Thames flows in an easterly direction from Leach to Newbridge. A catchment overview is provided in **Figure 7**. The majority of the upper Evenlode is on clay, with tributaries rising from limestone on the valley sides. The middle to lower reaches of the Evenlode flow over limestone, and receive a basal groundwater flow. It has several tributaries, the largest being the groundwater fed River Glyme which enters the River Evenlode in its lower reaches at Bladon. The Windrush is a limestone stream and contains predominantly wild brown trout and grayling populations.

It is predominantly a rural catchment with land use dominated by agriculture, particularly arable farming. Several large parkland estates are situated in the Cotswolds catchment, the largest of which is the World Heritage Site of Blenheim Palace and its 'Capability' Brown landscaped parks and lakes on the River Glyme.

The main urban areas are Stow-on-the-Wold, Witney, Burford and Charlbury, with numerous villages located in the river corridors.










The Cotswolds catchment is a predominantly clay river, has a relatively low gradient and exhibits a flashy flow regime. Consequently, for much of its length the river channels have been extensively modified by historical dredging and straightening for land drainage purposes.

Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Cotswolds catchment include action to gain water framework directive improvement through proposed development and taking the catchment approach to enhance and expand the floodplain.

Cotswolds Catchment

Overview Map

-  Towns and Cities
-  Cotswolds Catchment
-  Thames RBD boundary
-  Other RDBs
-  Other
-  Main Rivers
-  Urban Areas
- WFD Operational Catchments**
 -  Evenlode
 -  Windrush



0 2 4 8
Kilometers



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Figure 7: The Cotswolds catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 8: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Cotswolds catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	139,000	1100	1200	4050	<50
Number of services:	540	20	20	30	0
Risk to economic activity:					
Number of non-residential properties:	30,550	500	500	1050	<50
Number of airports:	0	0	0	0	0
Length of main roads (km):	130	0	0	<10	0
Length of railway (km):	40	<10	<10	<10	0
Agricultural land (ha):	100,450	3,300	1,950	1550	<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:	9	1	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):	950	50	0	<50	0
Area of SSSI within area (ha):	1,450	150	<50	<50	0
Area of Parks and Gardens within area (ha):	3,850	100	50	<50	0
Area of Scheduled Monument within area (ha):	900	<50	<50	<50	0
Number of Listed Buildings within area:	4,990	130	90	230	0
Number of Licensed water abstractions within the area:	250	60	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

Table 9: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Cotswolds catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	139,000	750
Number of services:	540	<10
Risk to economic activity:		
Number of non-residential properties:	30,550	300
Number of airports:	0	0
Length of roads (km):	130	0
Length of railway (km):	40	<10
Agricultural land (ha):	100,450	1100
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	9	0
Area of SAC within area (ha):	0	0
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	950	<50
Area of SSSI within area (ha):	1,450	<50
Area of Parks and Gardens within area (ha):	3,850	50
Area of Scheduled Monument within area (ha):	900	<50
Number of Listed Buildings within area:	4,990	40
Number of Licensed water abstractions within the area:	250	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

Conclusions and objectives for the Cotswolds catchment

We have set out the following for the Cotswolds catchment:

Conclusions:

In the Cotswolds catchment the primary flood risk is from rivers, however surface water flooding is also a risk in some areas. The majority of land within the catchment is rural; however, there are a number of towns including Witney, Burford, Bourton-on-the-Water and Woodstock.

It will not be possible to reduce the probability of flooding everywhere but we are proposing measures in various areas to protect their communities from the risk of flooding. In key areas, the Environment Agency will support the communities in preparing for flooding through raising awareness, increasing resilience and encouraging appropriate redevelopment. We will aim to safeguard natural floodplains to reduce the consequences of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the impact of flooding through community awareness and flood response.

Economic

- Reduce flood risk through effective maintenance.
- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces the risk wherever possible.

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Cotswolds catchment

Across the Cotswolds catchment there are 10 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are currently 4 measures to continue working with the planning authorities at both the strategic and planning application stage to steer development to areas with the least risk of flooding. Where possible we will also seek to re-establish and enhance natural river corridors through development in line with the Water Framework Directive. There are measures to continue the effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan. There is 1 measure to develop location-specific modelling in Bampton.

Preparing for risk

There are 3 preparing measures. These are:

- Working with local resilience forum partners to improve the multi-agency response to flooding
- Encouraging communities to produce flood plans
- Reviewing flood warning and flood alert areas across the catchment

Protecting from risk

There are currently 2 measures to protect from risk. These are to continue maintaining existing flood defences and rivers in urban locations, as well as continuing to take the catchment based approach to enhance and expand the floodplain and restore urban watercourses to minimise the impact of flooding where possible.

Recovery and review of risk

There is currently 1 measure to deliver the recovery programme following the winter floods in 2014.

3.4 The Darent and Cray catchment

Introduction to the Darent and Cray catchment

The Darent and Cray catchment encompasses the tidal Thames estuary and the Rivers Darent, Cray and Shuttle. These are shown in **Figure 8**.

The upper reach of the Darent is mainly rural with a number of villages at risk of flooding predominantly from the River Darent and highways flooding from the A25. Communities at risk include Westerham, Brasted and Sundridge. The lower reaches of the Darent flow through Dartford where it becomes a more urban watercourse as a result.

The risk of flooding across the catchment varies greatly and comes from a number of sources including surface and ground water. The tidal area is protected from flooding from the tidal River Thames through a system of defences.

The River Cray and its tributary the Shuttle are steep, relatively urbanised, rivers that respond quickly to rainfall. The River Shuttle has been categorised as a high risk rapid response catchment. Rapid response catchments are a selection of rivers and streams that we expect to react rapidly to extreme rainfall, resulting in extreme flash flooding. Extreme flash flooding is where a river or stream reacts very rapidly to rainfall, and generates dangerous flood depths and high velocities of water that pose an extreme threat to life. Although the Shuttle has a narrow floodplain, much of this is developed including the residential areas of Black Fen, Sidcup and Bexley. The Cray, which rises in Bromley, flows through the more industrialised areas of Foots Cray where it then opens up into water meadows and eventually flows through the built up area of Crayford Town Centre. Here, industrial estates lie in the bottom of the valley making them most at risk from flooding.

The Borough of Bexley regularly experiences flooding caused by overwhelming of surface water drainage networks and flooding from the River Cray and Shuttle. The most significant river flooding event was in 1977 which caused extensive flooding to Crayford.

Occurrences of flooding along the whole catchment include 1897, 1953, 1958, 1968, 1977, 1979, 2005 and 2014.

The Darent can be divided into three sub-catchments:

- Upper Darent, flowing from its source on the Kent Surrey border in an easterly direction to Sevenoaks;
- Mid Darent, flowing north to south from Sevenoaks to South Darenth;
- Lower Darent, which is the urban area through Dartford and includes the tidal creek down to the confluence with the Thames estuary. Dartford is protected from tidal flooding by the Dartford Creek Barrier as well as a series of flood embankments and walls along Dartford Marshes and through the Town Centre.

The source of the River Darent is located at the western edge of Westerham, where it is fed by spring flow from the Lower Greensand and surface run-off. It flows in an easterly direction as far as Sevenoaks, from where the channel turns north and continues to flow in a northerly direction until the confluence with the tidal Thames at Dartford Creek. There are relatively few tributaries, but the most notable are the Watercress Stream and the Honeypot Stream, both of which join the Darent south of Otford. North of Otford, the river is dominated by groundwater from the chalk. It is this groundwater influence which has led to the Darent being designated as a low-flow river, following prolonged periods of low rainfall such as those which occurred in 1991 and 2006.

The catchment has a rich historical and landscape heritage, including roman villas, medieval castles and mills. Parts of the river have been modified, particularly by construction of mills and their associated structures and leats. Some mills have been converted for residential use but the

adjoining structures remain and while still maintaining a function for regulating flows and levels, others now appear to be redundant.

Linking with the River Basin Management Plan

We are working collaboratively with other members of the Darent Catchment Improvement Group and the Cray Catchment Improvement Group to develop plans to improve the ecology of the rivers in the Darent catchment. We are working to better understand human impacts on the water environment and with partners to resolve the issues we have identified. The priority in the Darent catchment is to make modified rivers more natural, in particular to improve fish passage in the Darent, and in the Cray to reduce urban diffuse pollution. Wherever possible through delivery of this FRMP we will seek improvements to the water environment through our work to manage flood risk.

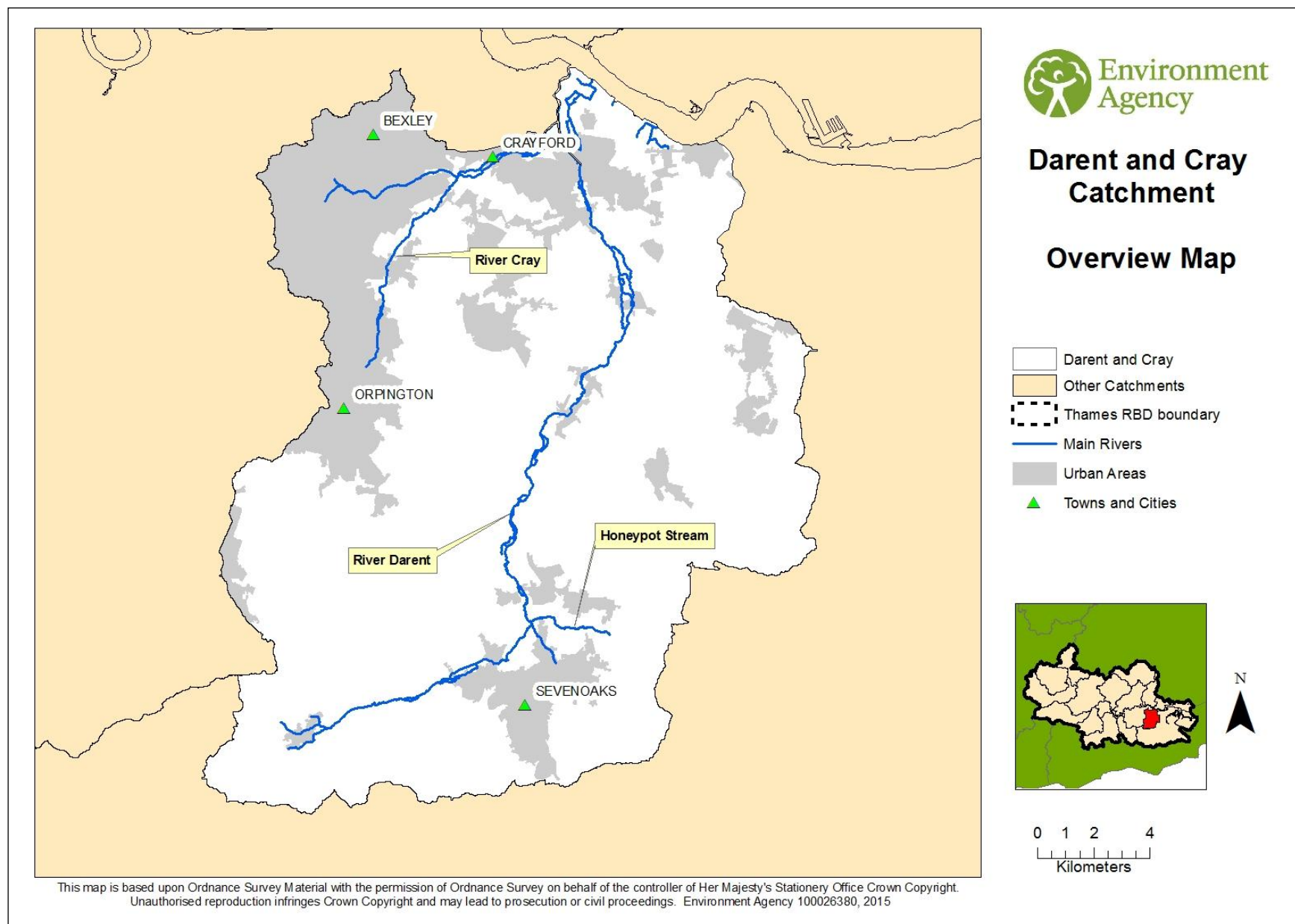


Figure 8: The Darent and Cray catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 10: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Darent and Cray catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	403,000	350	4,100	7,200	50
Number of services:	490	<10	10	30	0
Risk to economic activity:					
Number of non-residential properties:	31,400	100	1,050	1,750	<50
Number of airports:	1	0	0	0	0
Length of main roads (km):	220	<10	<10	<10	<10
Length of railway (km):	80	<10	<10	<10	<10
Agricultural land (ha):	24,600	150	250	350	<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:	10	1	0	4	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):	1,350	50	<50	<50	0
Area of Parks and Gardens within area (ha):	1,500	<50	<50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	<50	<50	<50	<50	<50
Number of Listed Buildings within area:	1,460	20	50	70	<10
Number of Licensed water abstractions within the area:	110	10	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

Table 11: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Darent and Cray catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	403,000	2,500
Number of services:	490	<10
Risk to economic activity:		
Number of non-residential properties:	31,400	500
Number of airports:	1	0
Length of main roads (km):	220	<10
Length of railway (km):	80	<10
Agricultural land (ha):	24,600	200
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	10	0
Area of SAC within area (ha):	0	0
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	1,350	0
Area of Parks and Gardens within area (ha):	1,500	50
Area of Scheduled Ancient Monument within area (ha):	50	0
Number of Listed Buildings within area:	1,460	<10
Number of Licensed water abstractions within the area:	110	<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

Conclusions and objectives for the Darent and Cray catchment

We have set out the following for the Darent and Cray catchment:

Conclusions

The sources of flood risk in the Darent and Cray catchment include river, surface water, ground water and in the lower reaches at Dartford, tidal flooding.

The primary source of risk varies across the catchment:

- In the upper reaches there are communities at risk from flooding from the river itself, from small local watercourses, and from surface run-off, predominantly from public highways.
- In the middle reaches of the River Darent, groundwater flooding may also occur in addition to the sources described for the Upper Darent.
- Through Dartford, the flood risk is from rivers and surface run-off. The Dartford Barrier and associated defences provide protection against tidal flooding.

- A significant risk along the Cray and Shuttle is from intense rainfall leading to a fast rise of water levels in the Shuttle and its tributary, the Wyncham Stream. This has led to the river being designated a rapid response catchment (as explained above) for incident management purposes.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible.
- Encourage the take-up of flood resilience measures by people living within the floodplain.
- Investigate improvements to flood modelling and warning along the Shuttle and Cray.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Review privately owned/maintained structures.
- Investigate how the Chipstead Valley lake operates
- Remodel Darent Valley with improved hydrological information and considering recent style rainfall events.
- Investigate surface water flooding risk.

Environmental

- Seek opportunities to work with landowners to create wetlands habitat.
- Protect and enhance biodiversity through flood risk management schemes.
- Restore naturally functioning river systems where possible.
- Investigate soil erosion and land management to provide recommendations for catchment wide measures to improve land management.

Measures across the Darent and Cray catchment

Across the Darent and Cray catchment there are 30 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 11 prevention measures on the Cray and Darent. On the Cray we are managing risk through sustainable drainage with new development and working closely with local councils on their surface water plans. In the Ebbsfleet area we are assessing groundwater pumping

requirements. We are also working with Kent County Council to improve highways drainage and reduce surface water flooding.

Preparing for risk

We are improving preparedness in the catchment through 5 measures including working with communities to improve flood resilience and improving flood warning systems and procedures.

Protecting from risk

The 14 measures to protect the catchment from flood risk include improving modelling of the rivers and the operation of structures to control levels along the catchment. We will investigate numerous flood risk issues with potential solutions including the Dartford Town Centre Flood Alleviation Scheme; optimising flood attenuation and flood flow conveyance of river channels; maintaining existing defences. We are also working closely with local councils to develop schemes to reduce risk from surface water flooding. We will continue to review and improve maintenance of the channel as funding allows. On the Darent, measures include investigating ways to increase flood storage in the rural floodplain and improve conveyance through the villages.

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.5 The Gloucestershire and the Vale catchment

Introduction to the Gloucestershire and the Vale catchment

The Gloucestershire and the Vale catchment contains the Upper Thames and Ock operational catchments. The catchment is predominantly rural. The major urban areas are Cirencester, Oxford, and Swindon. These are illustrated in **Figure 9**. The Upper Thames catchment includes stretches of the River Thames extending from its source south west of Cirencester at Kemble to Lechlade in the Cotswolds. The largest tributaries are the Coln, the Ray (Wilts), the Churn and the Cole. The Vale part of the catchment is dominated by the river Ock.

The north west part of the catchment falls within the Cotswolds Area of Outstanding Natural Beauty and the southern catchments fall partly within the North Wessex Downs Area of Outstanding Natural Beauty.










The area contains a wide variety of habitats and landscapes. The limestone streams to the north of the area, including the Rivers Coln, Churn, Ampney Brook, and the River Leach, contain predominantly wild brown trout and grayling populations. The Ock drains a predominantly shallow rural clay catchment, and is bordered to the north by a small limestone and sandstone escarpment and to the south by the chalk 'Ridgeway'. It is a relatively slow-flowing river with only occasional in-channel runs and riffles, as many of the watercourse have been extensively modified by land drainage and impoundments.

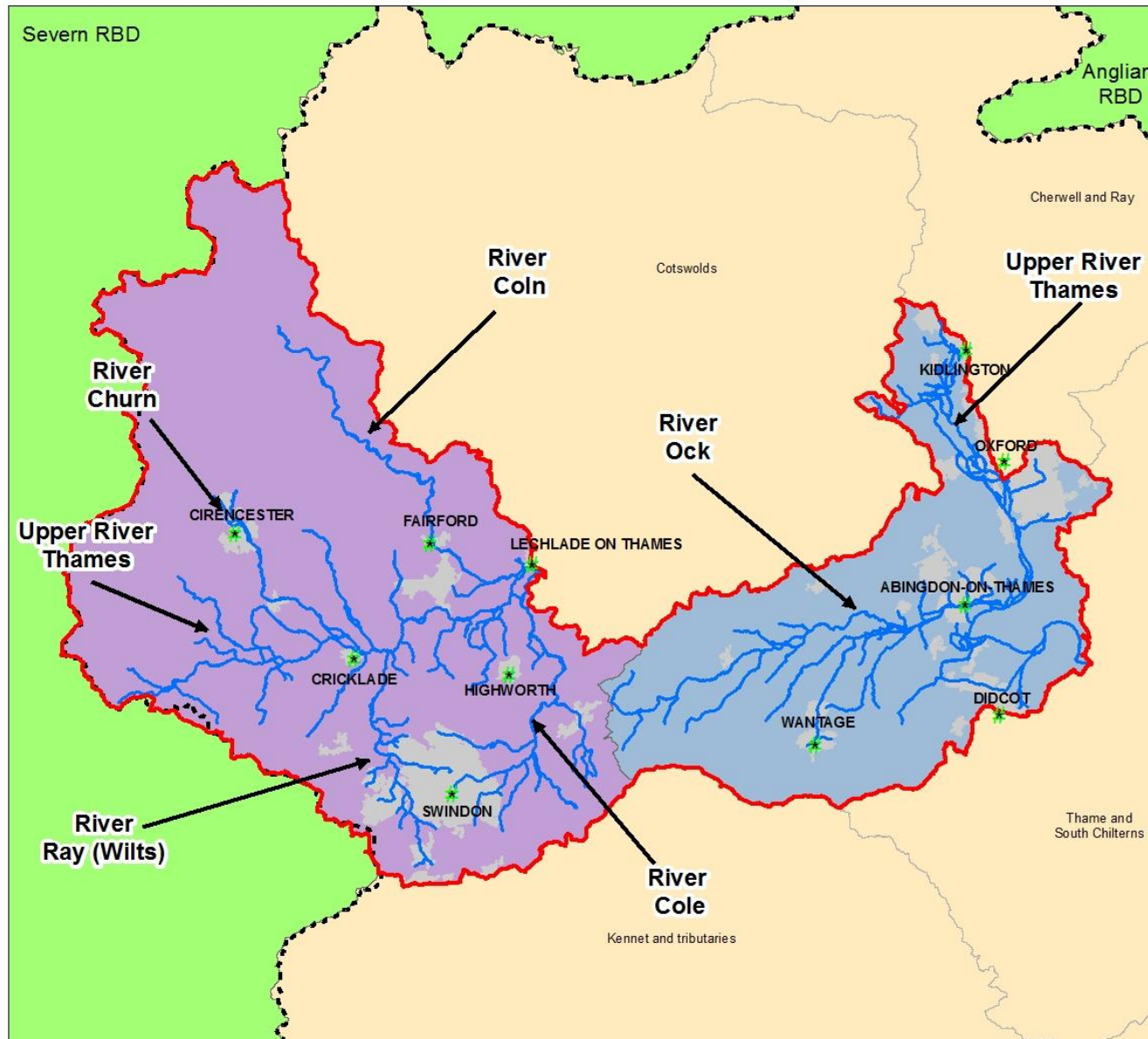
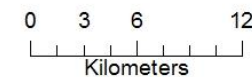
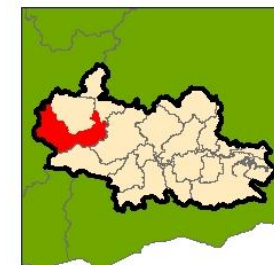
Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Cotswolds and Vale catchment include action to gain Water Framework Directive improvement through proposed development and taking the catchment approach to enhance and expand the floodplain.

Gloucestershire and the Vale Catchment

Overview Map

-  Towns and Cities
-  Gloucestershire & the Vale Catchment
-  Thames RBD boundary
-  Other RBDs
-  Other catchments
-  Main Rivers
-  Urban Areas
- WFD Operational Catchments**
 -  Ock
 -  Upper Thames



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Figure 9: The Gloucestershire and the Vale catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 12: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Gloucestershire and the Vale catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	515,350	7,150	11,350	17,950	100
Number of services:	1,060	40	30	50	<10
Risk to economic activity:					
Number of non-residential properties:	58,150	1,250	1,250	1,950	50
Number of airports:	1	0	0	0	0
Length of main roads (km):	350	<10	<10	20	<10
Length of railway (km):	110	<10	<10	<10	<10
Agricultural land (ha):	106,000	7,200	2,100	2,850	<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:	29	3	1	1	0
Area of SAC within area (ha):	500	350	50	50	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):	1,850	550	50	100	<50
Area of Parks and Gardens within area (ha):	2,150	50	<50	<50	<50
Area of Scheduled Monument within area (ha):	1,150	250	50	50	<50
Number of Listed Buildings within area:	5,590	150	150	240	<10
Number of Licensed water abstractions within the area:	230	40	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

Table 13: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Gloucestershire and the Vale catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	515,350	14,400
Number of services:	1,060	20
Risk to economic activity:		
Number of non-residential properties:	58,150	850
Number of airports:	1	0
Length of main roads (km):	350	<10
Length of railway (km):	110	<10
Agricultural land (ha):	106,000	700
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	29	1
Area of SAC within area (ha):	500	200
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	1,850	250
Area of Parks and Gardens within area (ha):	2,150	50
Area of Scheduled Monument within area (ha):	1,150	150
Number of Listed Buildings within area:	5,590	70
Number of Licensed water abstractions within the area:	230	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

Conclusions and objectives for the Gloucestershire and the Vale catchment

We have set out the following for the Gloucestershire and the Vale catchment:

Conclusions:

Rivers are the primary source of flood risk in the catchment. However there is some risk of flooding from other sources including surface water and groundwater. The majority of land within the catchment is rural, however, there are also significant urban centres including Oxford, Abingdon, Swindon and Cirencester.

It may not be possible to reduce the probability of flooding everywhere however we are proposing a number of measures in different areas to protect and prepare communities for flooding. There are projects to investigate what could be done to reduce flooding in Abingdon and Oxford. The Environment Agency is proposing to undertake detailed modelling at locations around the catchment to better understand the risk of flooding in certain areas.

In key areas, we are helping communities to prepare for flooding through raising awareness, increasing resilience and encouraging appropriate redevelopment. We want to safeguard natural floodplains to reduce the consequences of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- To reduce the risk of flooding where possible through the delivery of the 6 year programme
- Reduce the impact of flooding through community awareness and flood response.
- To have a better understanding of flood risk from rivers in certain areas of the catchment.

Economic

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

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Gloucestershire and the Vale catchment

Across the Gloucestershire and the Vale catchment there are 33 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are currently 22 prevention measures including reducing flood risk through redevelopment. The Environment Agency will work with the planning authorities at both the strategic and planning application stages to steer development to areas with the least risk of flooding. Through these measures we will also seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive. Specifically within Oxford, we will continue to progress options from the strategy to reduce the long term flood risk. All possible options will be reviewed of the River Churn Flood Risk Management Strategy. There are measures to continue the effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan. There are measures to develop location-specific modelling in East Hagbourne, Bibury, Witchebstow (Swindon Development Area), and Steventon and Sutton Courteney. This is in addition to catchment modelling along the Upper Cole in Swindon. This is to understand the flood risk in more detail.

Preparing for risk

There are 4 preparing measures which are outlined below:

- working with local resilience forum partners to improve the multi-agency response to flooding
- encouraging communities to produce flood plans
- reviewing flood warning and flood alert areas across the catchment
- look into the re-mapping the flood warning areas in Oxford

Protecting from risk

There are 6 measures including maintaining existing defences in the catchment to ensure the standard of protection is maintained. The Environment Agency area also continuing to take the catchment based approach to enhance and expand the floodplain and restore urban watercourses to minimise the impact of flooding where possible.

Recovery and review of risk

There is 1 measure to deliver the recovery programme following the winter floods in 2014.

3.6 The Kennet and tributaries catchment

Introduction to the Kennet and tributaries catchment

The Kennet and tributaries catchment extends from Marlborough in the west, through Hungerford, Newbury and Thatcham, to Reading in the east (shown in **Figure 10**). It includes the rivers and tributaries of the Kennet, Dun, Lambourn, Enborne and Foudry Brook. Land use in the catchment is predominantly agricultural, with arable dominating pasture. However, there are also some significant urban centres in the catchment, with the M4 motorway driving urban development and a recent significant increase in population.

The Kennet is one of England's premier chalk streams. Much of its length is a Site of Special Scientific Interest (SSSI) on account of its chalk stream habitats and associated wildlife. One of its main tributaries, the Lambourn, is also a SSSI and has been designated a Special Area of Conservation (SAC). The Kennet and Avon canal runs parallel with the River Dun from its source, then with the River Kennet downstream of Hungerford, at times sharing the same channel.

Watercourses in this catchment are used for a variety of activities, including recreation, public water supply, fisheries and conservation. The area is rich in landscape and wildlife heritage, including the North Wessex Downs Area of Outstanding Natural Beauty and parts of the Berkshire and Marlborough Downs.

Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Kennet and tributaries catchment include action to gain Water Framework Directive improvement through proposed development and taking the catchment approach to enhance and expand the floodplain.

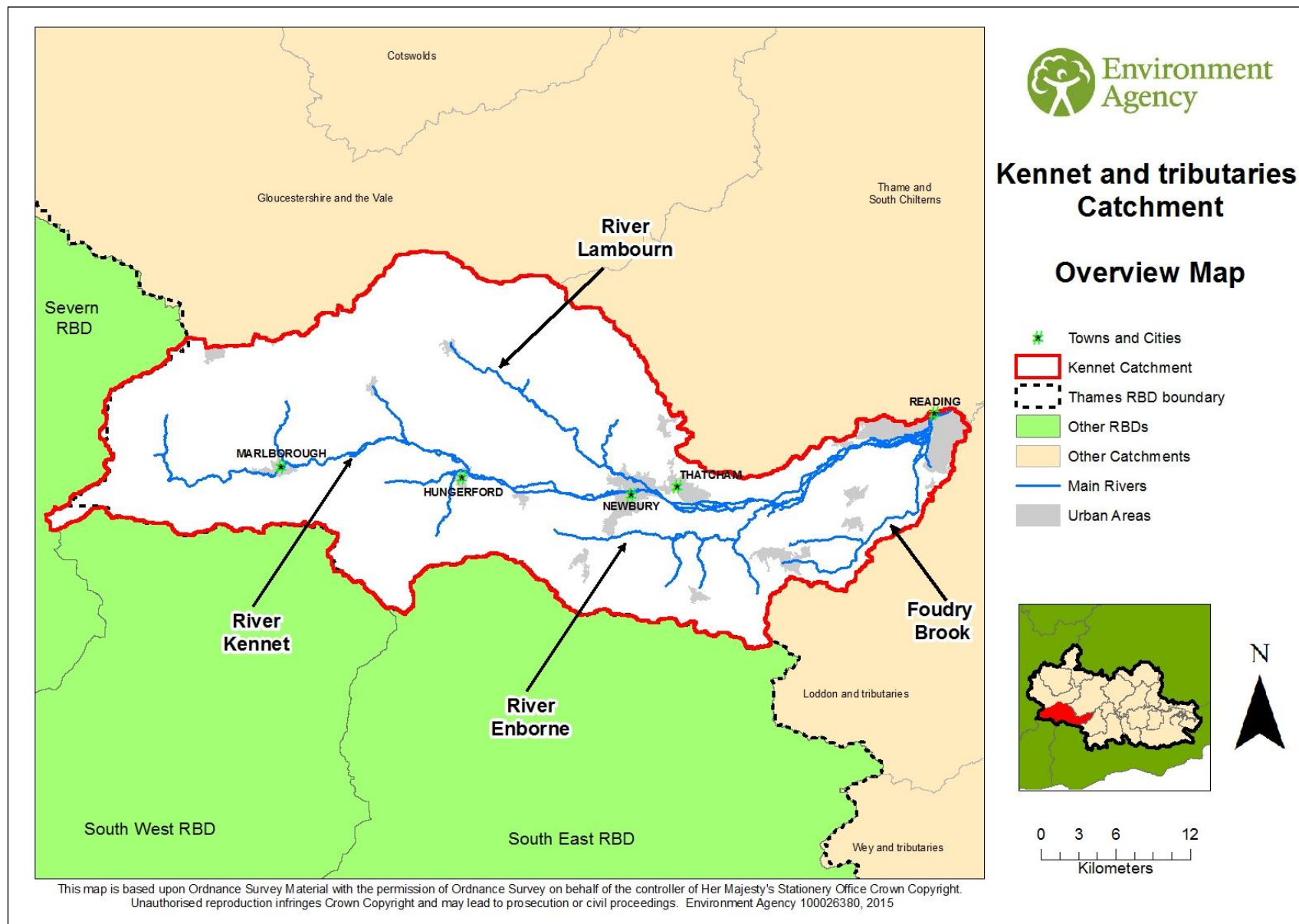


Figure 10: The Kennet and tributaries catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 14: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Kennet and tributaries catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	247,950	2,050	1,400	8,800	0
Number of services:	550	10	<10	20	0
Risk to economic activity:					
Number of non-residential properties:	34,250	450	450	1,650	<50
Number of airports:	0	0	0	0	0
Length of main roads (km):	210	<10	<10	10	0
Length of railway (km):	70	<10	<10	<10	<10
Agricultural land (ha):	97,500	1,050	750	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:	15	3	0	3	0
Area of SAC within area (ha):	200	100	<50	<50	<50
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0	0
Area of World Heritage Site within area (ha):	2,550	<50	<50	<50	<50
Area of SSSI within area (ha):	3,000	250	50	100	<50
Area of Parks and Gardens within area (ha):	3,550	100	<50	<50	<50
Area of Scheduled Monument within area (ha):	1,100	<50	<50	<50	0
Number of Listed Buildings within area:	3,200	60	70	100	<10
Number of Licensed water abstractions within the area:	280	50	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

Table 15: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Kennet and tributaries catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	247,950	4,500
Number of services:	550	10
Risk to economic activity:		
Number of non-residential properties:	34,250	300
Number of airports:	0	0
Length of main roads (km):	210	0
Length of railway (km):	70	<10
Agricultural land (ha):	97,500	200
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	15	0
Area of SAC within area (ha):	200	<50
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	2,550	0
Area of SSSI within area (ha):	3,000	<50
Area of Parks and Gardens within area (ha):	3,550	<50
Area of Scheduled Monument within area (ha):	1,100	<50
Number of Listed Buildings within area:	3,200	60
Number of Licensed water abstractions within the area:	280	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

Conclusions and objectives for the Kennet and tributaries catchment

We have set out the following for the Kennet and tributaries catchment:

Conclusions:

The primary flood risk in the Kennet and tributaries catchment is from rivers however other sources include surface water and groundwater. The majority of land within the catchment is rural, however, there are also significant urban centres including Marlborough, Newbury, Theale and Reading.

The Environment Agency is currently constructing a flood storage area in Eastbury and we are working on a number of measures in other areas to protect the communities from the risk of flooding. We are proposing to undertake detailed modelling at locations around the catchment to better understand the risk of flooding in certain areas.

In key areas, the Environment Agency will support communities to prepare for flooding through raising flood awareness, improving resilience and encouraging appropriate redevelopment. We will aim to safeguard natural floodplains to reduce the consequences of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- To reduce the risk of flooding where possible through the delivery of the 6 year programme
- Reduce the impact of flooding through community awareness and flood response.
- Improve the flood warning system through improved river gauging.

Economic

- To have a better understanding of the fluvial flood risk in certain areas in the Kennet and tributaries catchment.
- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces the risk wherever possible.

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Kennet and tributaries catchment

Across the Kennet and tributaries catchment there are 17 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk:

There are currently 8 preventing measures including reducing flood risk through redevelopment and working with the planning authorities to steer development to areas with the least risk of flooding. There are measures to continue the effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan. New flood modelling is planned at Tadley, along the River Kennet from Tyle Mill to the Thames confluence, and along the Foudry Brook, to understand the risk of flood in more detail.

Preparing for risk

There are 5 preparation measures including working with local resilience forums to improve multi-agency response to flooding, encourage communities to produce flood plans and review flood warning and alert areas across the Kennet and tributaries catchment. The Environment Agency plan to relocate a river level gauge to improve accuracy of our flood warning service at Eastbury and there is a measure to investigate the benefits of an additional river level gauge at Burghfield and Stanford Dingley.

Protecting from risk

There are 3 measures relating to protecting including constructing a flood storage area on the River Lambourn and continuing to use the catchment approach to enhance and expand the floodplain.

Recovery and review of risk

There is currently 1 measure to deliver the recovery programme following the winter floods in 2014.

3.7 The Loddon and tributaries catchment

Introduction to the Loddon and tributaries catchment

The Loddon and tributaries catchment covers an area of 680 square kilometres and crosses the counties of Hampshire, Surrey and Berkshire. In the upper reaches of the catchment, the rivers are wide and shallow, typical of chalk fed streams. However, broad, low-land river valleys, through which the rivers Loddon, Whitewater, Hart, Blackwater and Bow Brook meander, dominate much of the catchment. This is illustrated in **Figure 11**.

The River Loddon rises from chalk-fed springs at West Ham Farm, Basingstoke, and flows north easterly over chalk and clay passing through several sites of special scientific interest (SSSIs), joining the River Thames just west of Wargrave. The Blackwater rises to the south of Aldershot and flows over sands and gravels, again passing through several SSSIs before joining the Loddon near Swallowfield. The Cove Brook flows in the River Blackwater at Farnborough and has a flood storage area to protect the area. The Basingstoke canal runs through the catchment and crosses the top of the Cove Brook. During severe weather the Basingstoke canal can overtop into the Cove Brook.

Land use in the Loddon and tributaries catchment is a combination of suburban areas, agricultural land and semi-natural grasslands. Urban and suburban development accounts for 39% of the land area; the main urban centres are Basingstoke, the east of Reading, Bracknell, Wokingham and the Camberley- Farnborough-Aldershot conurbation.

Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Loddon and tributaries catchment include action to gain Water Framework Directive improvement through proposed development and taking the catchment approach to enhance and expand the floodplain.

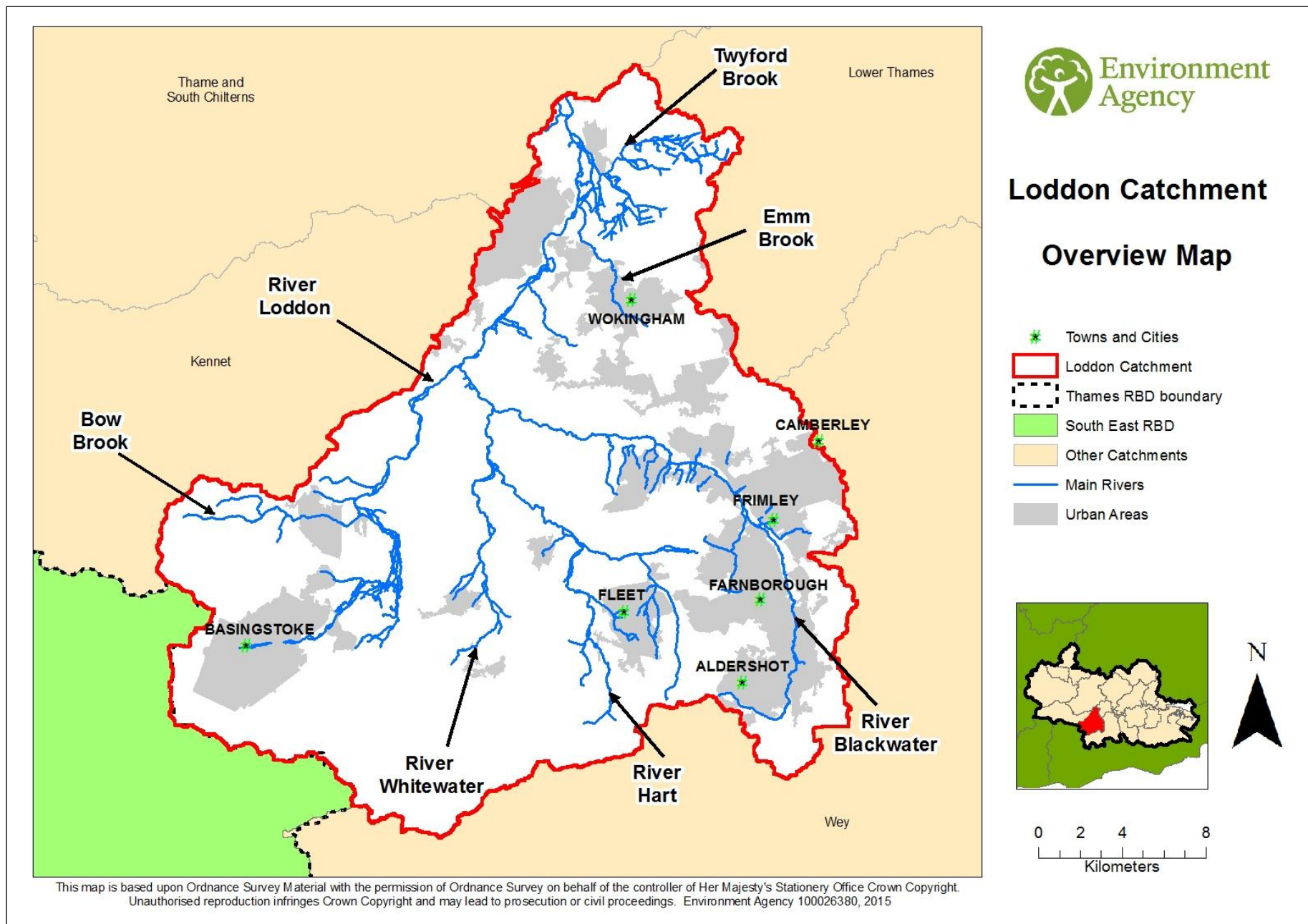


Figure 11: The Loddon and tributaries catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 16: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Loddon and tributaries catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	537,900	1,250	10,150	14,650	200
Number of services:	760	10	30	30	0
Risk to economic activity:					
Number of non-residential properties:	45,150	250	1,050	1,400	<50
Number of airports:	1	0	0	0	0
Length of main roads (km):	200	<10	<10	20	<10
Length of railway (km):	110	<10	<10	<10	<10
Agricultural land (ha):	34,500	550	650	800	<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:	10	0	1	2	0
Area of SAC within area (ha):	550	0	0	0	0
Area of SPA within area (ha):	4,250	<50	<50	<50	<50
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):	5,000	50	100	<50	<50
Area of Parks and Gardens within area (ha):	3,500	50	100	<50	<50
Area of Scheduled Monument within area (ha):	150	<50	<50	<50	<50
Number of Listed Buildings within area:	2,330	20	80	50	0
Number of Licensed water abstractions within the area:	130	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

Table 17: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Loddon and tributaries catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	537,900	14,650
Number of services:	760	20
Risk to economic activity:		
Number of non-residential properties:	45,150	900
Number of airports:	1	0
Length of main roads (km):	200	<10
Length of railway (km):	110	<10
Agricultural land (ha):	34,500	650
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	10	2
Area of SAC within area (ha):	550	0
Area of SPA within area (ha):	4,250	50
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):	5,000	200
Area of Parks and Gardens within area (ha):	3,500	100
Area of Scheduled Monument within area (ha):	150	0
Number of Listed Buildings within area:	2,330	40
Number of Licensed water abstractions within the area:	130	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

Conclusions and objectives for the Loddon and tributaries catchment

We have set out the following for the Loddon and tributaries catchment:

Conclusions:

The primary flood risk in the Loddon and tributaries catchment is from rivers, however the upstream end of the catchment is also at risk from surface water and groundwater flooding.

There is a flood storage area on the Cove Brook in Farnborough which reduces the risk of flooding to the town. The Environment Agency is proposing to carry out detailed modelling at locations around the Loddon and tributaries catchment to develop a better understanding of the risk of flooding.

In key areas, the Environment Agency will support communities to prepare for flooding through raising awareness, increasing resilience and appropriate redevelopment. We will aim to safeguard natural floodplains to reduce the consequences of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- To have a better understanding of the fluvial flood risk in certain areas in the Loddon and tributaries catchment.
- Reduce the impact of flooding through community awareness and flood response.

Economic

- To reduce the risk of flooding where possible through the delivery of the 6 year programme
- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces the risk wherever possible.

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Loddon and tributaries catchment

Across the Loddon and tributaries catchment there are 24 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 17 measures relating to preventing risk. These measures involve helping reduce flood risk through redevelopment by working with the planning authorities at both the strategic and planning application stage to steer development to areas with the least risk of flooding. Where possible we will also seek to re-establish and enhance natural river corridors through development in line with the Water Framework Directive. Specifically, on the Emm Brook and River Loddon we are working with Wokingham Borough Council on their Strategic Development Locations to encourage flood risk reductions where possible. There are measures to continue the effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan. There are measures to develop flood modelling at Fleet, Waltham St Lawrence, Hurst (Wokingham), and along the Arborfield Drain and Coachmans Grove Ditch to improve our understanding of flood risk.

Preparing for risk

There are 3 measures. These are:

- Working with local resilience forum partners to improve the multi-agency response to flooding
- Encouraging communities to produce flood plans
- Reviewing flood warning and flood alert areas across the catchment

Protecting from risk

There are 3 measures relating to continued maintenance of an existing flood storage area on the Cove Brook and taking a catchment approach to enhance and expand the floodplain.

Recovery and review of risk

There is 1 measure to deliver the recovery programme following the winter floods in 2014

3.8 The London catchment

Introduction to the London catchment

At 1487 km², the London management catchment is relatively small, but has by far the largest population of any management catchment, with complex, intertwined and conflicting socio-economic pressures. It covers roughly 70% of the Greater London area, extending into Hertfordshire and Essex in the north, and Surrey in the south.

While many consider the tidal Thames to be London's iconic river, only non-tidal tributaries belong to the London management catchment, which covers 8 separate river systems 3 (Brent, Crane, and Lower Lee) lie north of the Thames, with another 5 south of the River: the Hogsmill, Beverley Brook, Wandle, Ravensbourne and Marsh Dykes. There are also numerous 'lost rivers' in central London that run underground in culverts, having been incorporated into the Victorian sewer network.

Typically, the rivers rise in the rolling hills and relatively open spaces of rural or suburban areas around the outskirts of London. As they flow towards the Thames, they pass through increasingly built-up areas, with dense housing development and industrial estates often built right to the river's edge. The catchment area is intersected by roads and railways. This dense urban development has resulted in major modifications to most rivers, and serious pollution problems. Nevertheless, in many places the rivers serve as valuable green corridors leading into the heart of the capital and connecting city-dwellers with nature. An overview of the catchment is provided in **Figure 12**.

Groundwater is mainly contained in chalk aquifers beneath a layer of clay, but in the south the rivers have their sources in the groundwater springing from a chalk ridge.

Linking with the River Basin Management Plan

We are working collaboratively with 8 local catchment partnerships to develop plans to improve the ecology of the rivers in the London catchment. Over recent years our investigation programme has helped us to better understand human impacts on the water environment and helped us to work with partners to resolve the issues we have identified. The priorities in the London catchment are; to reduce pollution, make modified rivers more natural and tackle invasive non-native species,

Links to other sections of this document

This chapter focuses on risk of flooding from rivers and how it is being managed across the London management catchment. It covers the eight river systems as listed below. To get a full picture of risk and how it is being managed, this needs to be read in conjunction with the following;

- Later in this document, the section on the tidal Thames strategic area sets out how risk is being managed, now and in the future throughout the Thames estuary - this borders the river systems of the Lower Lee, Brent, Crane, Beverley Brook, Wandle, Ravensbourne and Marsh Dykes as set out in this section
- Later in this document, the section on the London flood risk area section sets out how lead local flood authorities (LLFAs) in London plan to manage flood risk from other sources.

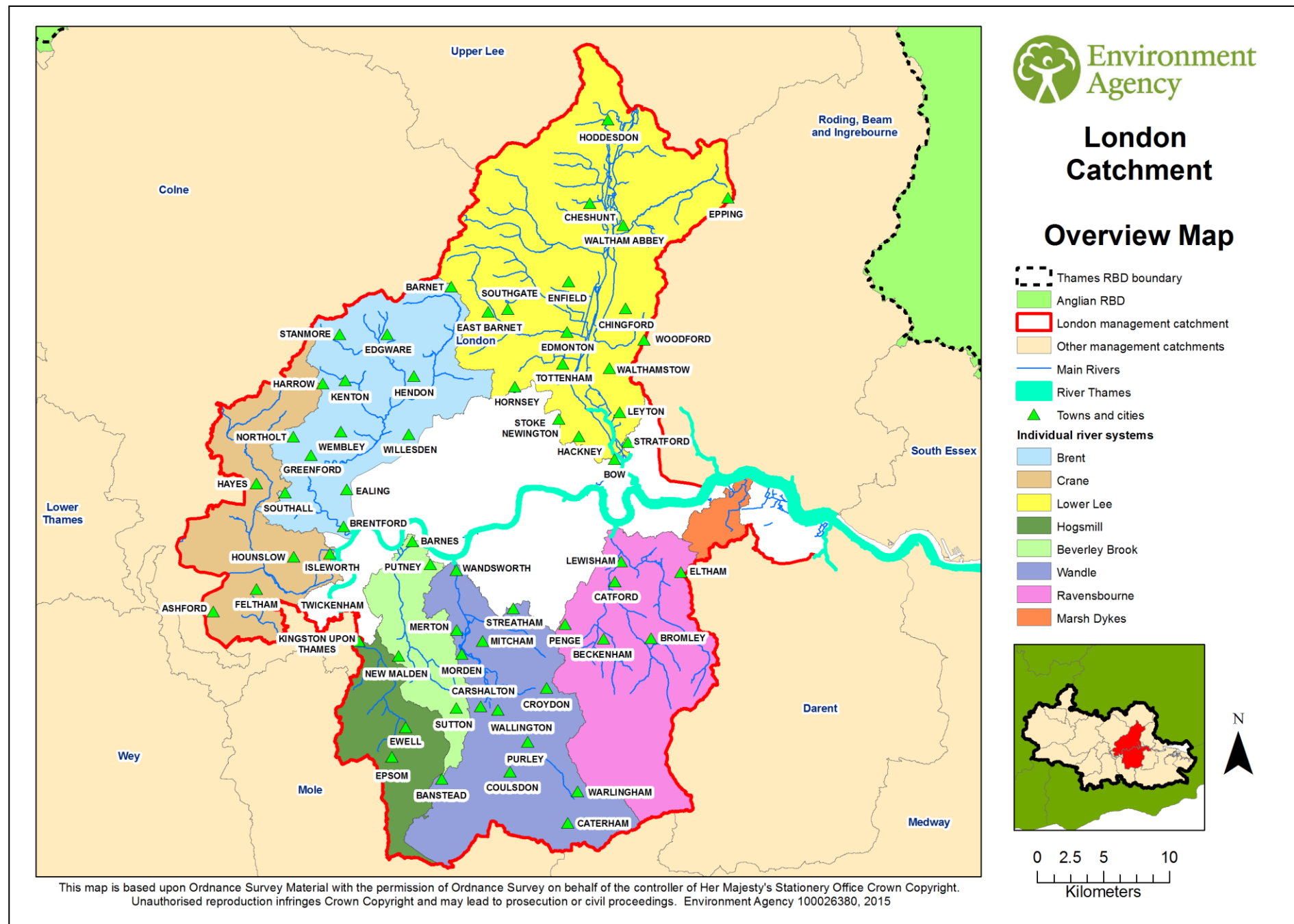


Figure 12 – The London catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 18: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the London catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	7,252,650	20,550	58,250	944,050	2,950
Number of services:	6,160	50	60	830	<10
Risk to economic activity:					
Number of non-residential properties:	356,850	2,300	4,150	52,100	500
Number of airports:	3	1	0	1	0
Length of main roads (km):	910	<10	20	100	<10
Length of railway (km):	750	<10	<10	70	<10
Agricultural land (ha):	28,250	400	250	750	<50
Risk to the natural and historic environment:					
Number of EU designated bathing waters within 50m:	1	0	0	0	0
Number of EPR installations within 50m:	66	6	3	28	1
Area of SAC within area (ha):	2,350	<50	<50	<50	<50
Area of SPA within area (ha):	400	150	<50	<50	0
Area of RAMSAR site within area (ha):	400	150	<50	<50	0
Area of World Heritage Site within area (ha):	750	150	<50	150	<50
Area of SSSI within area (ha):	4,600	450	<50	150	<50
Area of Parks and Gardens within area (ha):	4,900	200	<50	350	<50
Area of Scheduled Monument within area (ha):	300	<50	<50	<50	<50
Number of Listed Buildings within area:	18,750	130	60	2,670	10
Number of Licensed water abstractions within the area:	590	40	30	130	<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

Table 19: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the London catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	7,252,650	613,400
Number of services:	6,160	520
Risk to economic activity:		
Number of non-residential properties:	356,850	32,200
Number of airports:	3	1
Length of main roads (km):	910	90
Length of railway (km):	750	70
Agricultural land (ha):	28,250	500
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	1	0
Number of EPR installations within 50m:	66	23
Area of SAC within area (ha):	2,350	100
Area of SPA within area (ha):	400	100
Area of RAMSAR site within area (ha):	400	100
Area of World Heritage Site within area (ha):	750	250
Area of SSSI within area (ha):	4,600	400
Area of Parks and Gardens within area (ha):	4,900	500
Area of Scheduled Monument within area (ha):	300	50
Number of Listed Buildings within area:	18,750	1,060
Number of Licensed water abstractions within the area:	590	120

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the London catchment

We have set out the following for the London catchment:

Conclusions:

North of the River Thames, there are 3 separate river systems. These are the Crane, Brent and Lower Lee.

South of the River Thames, there are 5 separate river systems. These are the Hogsmill, Beverley Brook, Wandle, Ravensbourne and Marsh Dykes.

Each of these systems is considered in turn:

- **Crane:** In the upper parts of the Crane system there is a high risk of combined fluvial and surface water flooding, due to the steep, urbanised upper tributaries with heavily modified channels. In the middle reaches, the river is still in a semi-natural state. Here, the river flows through an undeveloped corridor, where out-of-bank flow does

not cause major problems, and the risk has already been reduced through the provision of flood storage and bypass channels. Where the Crane joins the River Thames at Isleworth, upstream of the Thames Barrier, the risk of flooding from the river is compounded by tidal flood risk. The Thames Barrier currently provides a certain level of protection to the Crane catchment during storm surges, reducing the risk of tidal flooding. However, if high flows on the Crane coincide with high tide, tidal water can flow into the River Crane, further increasing the amount of water in the channel and increasing the potential for flooding from the river.

- **Brent:** In the upper parts of the Brent system, there is a relatively steep gradient and large impermeable areas which result in a rapid response to rainfall. High flows can occur shortly after the onset of a rainfall event. The catchment is particularly susceptible to summer thunderstorms. Surface water flooding can also occur independently of the river system during storm events. The Brent catchment is heavily developed, particularly in the upper and middle reaches. Flooding can therefore result from channel capacity being exceeded, either from large flows or reduced capacity from blockages. Often these types of flooding happen together, which can make it difficult to determine the source.

- **Lower Lee:** The Lower Lee is a complex river system comprising the Lee Flood Relief Channel and the associated sluice gates, radial gates and weirs which control the system. We have reviewed how we manage fluvial flood risk, the flood risk associated with rivers, in the Lower Lee catchment. Our recommendations for management actions now and over future decades are identified in the [Lower Lee Flood Risk Management Strategy](#) that was finalised in 2011.

In addition, due to the urban nature of the Lower Lee river system the overflow of surface drains, the inundation of sewers, and rapid run-off arising from urban expansion, can all result in flooding.

- **Hogsmill:** The upper part of the Hogsmill catchment is steep, and relatively suburban with large areas of open space. The river flows in a deep, fairly wide channel and properties are located away from the banks. The lower reaches of the Hogsmill including Surbiton Stream, a major tributary, are more developed right up to the edge of the river channel which is mostly modified. The Hogsmill joins the Thames upstream of the tidal limit at Teddington and is not tidally influenced. However if high flows on the Hogsmill coincide with high flows on the Thames it can exacerbate flooding, and a number of properties in the catchment are at risk from flooding from both the River Thames and the River Hogsmill. The catchment is susceptible to urban drainage and sewer flooding, particularly after intense rainfall, and often in combination with high river levels.
- **Beverley Brook:** The Beverley Brook catchment is steep and impermeable so it is particularly susceptible to flooding during intense summer thunderstorms. The run-off rates are high and flooding can happen very quickly after a rainfall event, giving very little time to warn people of flooding. Blockages can exacerbate flooding locally from the Beverley Brook and its tributaries. At high tide, there is also a risk that the brook might not be able to drain away which can cause flooding in the area upstream of the confluence with the Thames. Other sources of flooding exist throughout the catchment; the overflow of surface drains; the inundation of sewers, and rapid run-off arising from urban expansion. Often these types of flooding happen together, which can make it difficult to determine the cause.

- **Wandle:** The River Wandle catchment covers large parts of South London and the North Downs. At source, there are two main branches, the Carshalton Branch and Beddington Branch. Here in the chalky upper catchment, the river channel remains natural in most places and there is negligible surface water run-off into the Wandle. The lower catchment has more urban characteristics with underlying clay which mean that run-off rates are high and flooding can happen very quickly after a rainfall event, giving very little time to warn people of flooding. The Graveney catchment, a major tributary, is particularly susceptible to flooding during intense summer thunderstorms. The potential increases in risk will come from urban development, land use change and climate change. Caterham Bourne, an ephemeral watercourse which feeds into the Beddington Branch, flows on average every seven years and poses a risk of groundwater flooding to local area when the groundwater level is high.
- **Ravensbourne:** The Ravensbourne and its tributaries flood when the banks overtop; either because the channel's capacity is exceeded during high flows, or blockages reduce the channel capacity. Other sources of flooding in the catchment are overflowing surface drains; the inundation of sewers, and rapid run-off arising from urban expansion. Often these types of flooding happen together, which can make it difficult to determine the cause. At the bottom of the Ravensbourne catchment at the confluence with the Thames there is also a risk from tidal flooding or a combination of tidal and river flooding.
- **Marsh Dykes:** The Marsh Dykes are located in the London Boroughs of Greenwich and Bexley and consists largely of low lying reclaimed land from the Thames estuary floodplain defended by the Thames tidal flood defences, a series of large embankments along the tidal frontage. The former Greater London Council constructed a system of lakes and canals, together with surface water pumping stations to drain the low lying area of Thamesmead and Belvedere. Some areas are drained to the combined sewers that flow into Crossness Sewerage Treatment works.

The main flood risk to the area is from the tidal Thames, although this is defended to a high standard following construction of the tidal embankments after the flooding of 1953. Flooding to the area from surface water and groundwater is managed through four pumping stations and through gravity sluices discharging the water through the flood defences. These are owned and operated by the Environment Agency.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible.
- Raise community awareness and understanding of all sources of flooding.
- Enhance recreation and general amenity across the catchment.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Promote the use of sustainable drainage systems in development to help reduce pressure on existing drainage networks.

Environmental

- Protect and enhance biodiversity through flood risk management schemes.
- Restore naturally functioning river systems where possible.
- Promote sustainable land use management to land owners across the catchment to achieve reductions in flood risk.

Measures to manage risk across the London catchment

Across the London catchment there are 94 measures to manage risk. These measures are listed in full in Part C and include:

Preventing risk

There are 43 measures across the London catchment to prevent risk. These measures are primarily concerned with;

- preventing risk through influencing the planning process to ensure development and redevelopment in areas at risk is appropriate
- modelling to better understand the risk
- continued short term management of assets to ensure existing flood alleviation schemes continue to operate effectively
- promoting property level resilience measures where they are appropriate
- assessing the structures and constrictions within the channel to better understand these risks

Preparing for risk

There are 12 measures across the London catchment to prepare for flood risk. These measures mostly focus on;

- preparing for flooding through maintaining flood warnings
- improving flood awareness in communities across the catchment
- ensuring communities have taken appropriate precautions to be resilient and prepared during a flood event

Protecting from risk

There are 39 measures across the London catchment to protect from flood risk. Most of these measures are related to;

- longer term asset management and maintenance to ensure that existing schemes continue to operate effectively through renewal or upgrading of these assets
- protecting areas at risk through development of new flood alleviation schemes

These are areas where we have identified the potential for flood alleviation schemes in the future. These schemes are in the early stages of development, and work will be starting in future years on these to achieve flood risk management objectives and contribute towards environmental outcomes. More detail on the specific details of these schemes can be found in Part C.

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.9 The Maidenhead to Sunbury catchment

Introduction to the Maidenhead to Sunbury catchment

The non-tidal Lower River Thames provides benefits to many people and businesses as well as the economy. It provides drinking water for a large population, including much of Greater London, it is managed to protect local people and property from flooding, and is maintained for boating.

Pressure from development is high in this catchment, with many developments creating long stretches of manmade banks. The River Thames is world famous and attracts people from far and wide who enjoy it for walking, fishing, cruising, canoeing, and rowing or to simply sit beside. The Thames Path National Trail runs its entire length and also forms part of a national cycleway. The catchment includes the Lower River Thames and a number of its tributaries, including the Cut, Maidenhead, Boveney and Chalvey Ditches, the Salthill Stream and Datchet Common Brook. Centres of urban development include the towns of Bracknell, Maidenhead, Windsor, Slough, Staines and Kingston. An overview map of the catchment is shown in **Figure 13**.

The area has some landscape and wildlife heritage, including Windsor Forest and Great Park and Burnham Beeches Sites of Special Scientific Interest. Natural habitats such as natural river banks and channels are relatively limited along the River Thames because of development pressures and the way in which the river is managed. Protecting and restoring important habitats improves the amount and diversity of wildlife, improving the water environment to benefit everyone.

Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Maidenhead to Sunbury catchment include action to gain Water Framework Directive improvement through proposed development.

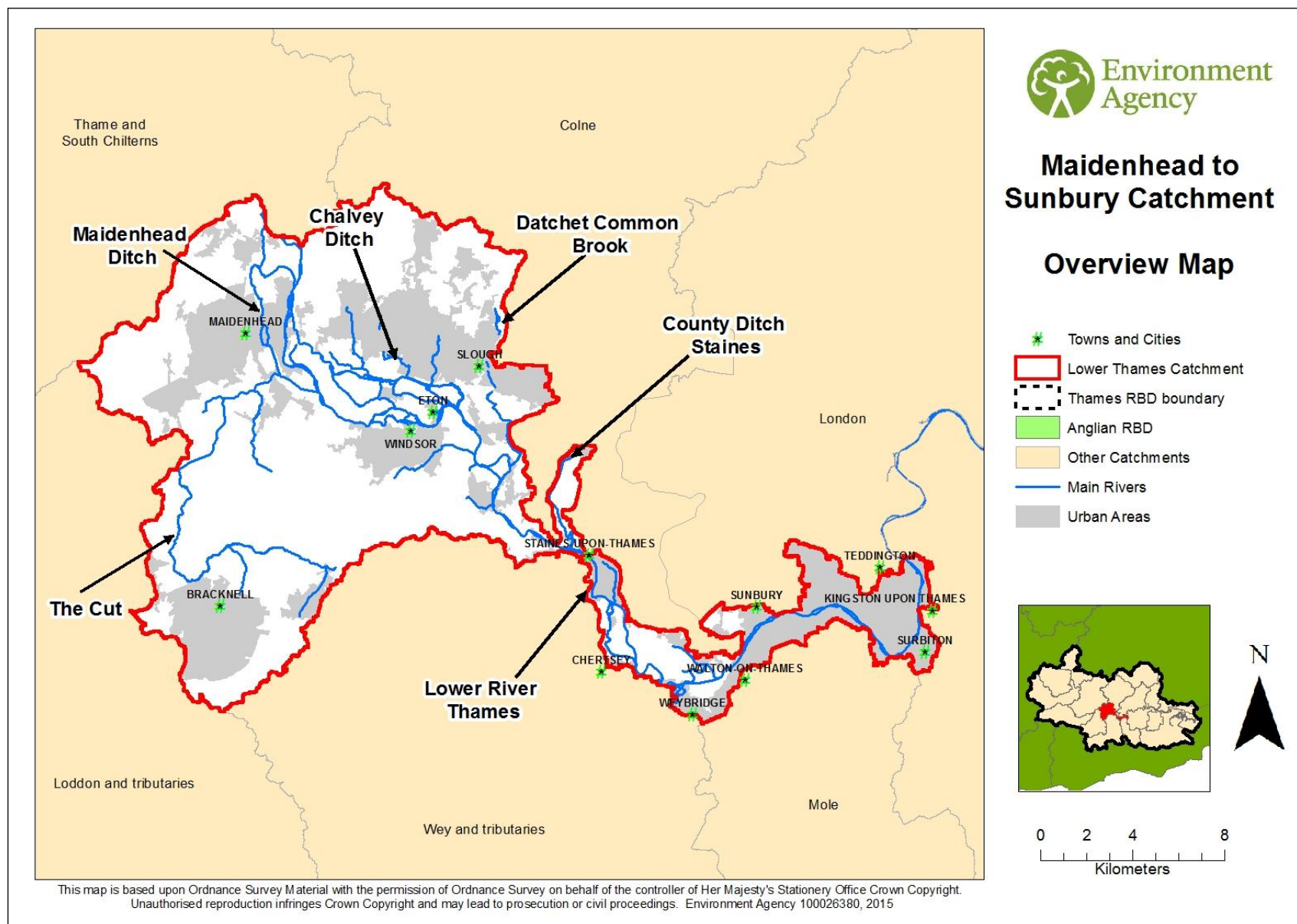


Figure 13: The Maidenhead to Sunbury catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 20: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Maidenhead to Sunbury catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	451,800	29,250	19,200	42,700	250
Number of services:	560	60	20	80	<10
Risk to economic activity:					
Number of non-residential properties:	34,800	3,250	1,400	3,700	200
Number of airports:	0	0	0	0	0
Length of main roads (km):	100	<10	<10	20	0
Length of railway (km):	50	<10	<10	<10	0
Agricultural land (ha):	14,650	1,550	450	850	<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:	10	0	0	0	0
Area of SAC within area (ha):	1,550	<50	<50	<50	0
Area of SPA within area (ha):	600	50	0	<50	<50
Area of RAMSAR site within area (ha):	300	50	0	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	2,450	100	<50	<50	<50
Area of Parks and Gardens within area (ha):	2,850	250	100	150	<50
Area of Scheduled Monument within area (ha):	150	50	<50	<50	0
Number of Listed Buildings within area:	1,760	160	30	270	<10
Number of Licensed water abstractions within the area:	200	60	20	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

Table 21: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Maidenhead to Sunbury catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	451,800	90,550
Number of services:	560	130
Risk to economic activity:		
Number of non-residential properties:	34,800	7,150
Number of airports:	0	0
Length of roads (km):	100	20
Length of railway (km):	50	10
Agricultural land (ha):	14,650	1,300
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	10	0
Area of SAC within area (ha):	1,550	<50
Area of SPA within area (ha):	600	50
Area of RAMSAR site within area (ha):	300	50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	2,450	100
Area of Parks and Gardens within area (ha):	2,850	750
Area of Scheduled Monument within area (ha):	150	100
Number of Listed Buildings within area:	1,760	470
Number of Licensed water abstractions within the area:	200	60

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the Maidenhead to Sunbury catchment

We have set out the following for the Maidenhead to Sunbury catchment:

Conclusions

The primary source of flood risk in the Maidenhead to Sunbury catchment is the rivers. Some areas are also at risk from surface water and groundwater. The majority of land within the catchment is urban, with only a small percentage of agricultural land.

The Maidenhead, Windsor and Eton Flood Alleviation Scheme protect parts of these towns and surrounding areas from flooding. We are currently working on developing flood alleviation schemes including in Slough and for the River Thames Scheme for Datchet to Teddington. The Environment Agency will be working with partners to secure the funding for the project to go ahead. We are also developing flood modelling along the River Thames to better understand the risk of flooding in certain areas.

In key areas, the Environment Agency will support communities to prepare for flooding through raising awareness, resilience and encouraging appropriate redevelopment. We will aim to safeguard natural floodplains to reduce the consequences of flooding.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the impact of flooding on communities through community awareness and flood response.
- Improve the flood warning service through more resilient river gauging
- Ensure partners and emergency responders can manage the consequences of flood risk in the River Thames Scheme area.
- To manage the risk of flooding to people and minimise the adverse impacts of flooding to property and the environment.

Economic

- To reduce the risk of flooding where possible through the delivery of the 6 year programme
- To have a better understanding of the fluvial flood risk in certain areas of the catchment.
- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces the risk wherever possible.

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Maidenhead to Sunbury catchment

Across the Maidenhead to Sunbury catchment there are 16 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 6 prevention measures including reducing flood risk through redevelopment and we will work with the planning authorities to steer development to areas with the least risk of flooding. We are developing detailed hydraulic modelling along the River Thames from Hurley to Teddington and will continue to maintain the Maidenhead, Windsor and Eton Flood Alleviation Scheme (FAS). There are measures to continue the effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan. There is a measure which is for flood modelling to better understand the flood risk in Bray Wick. This will help us to determine options to manage this risk into the future.

Preparing for risk

There are 5 measures relating to preparedness including continuing to work with local resilience forums to improve multi-agency response to flooding. Other measures are to continue to encourage communities to produce flood plans and review flood warning and alert areas across the Maidenhead to Sunbury catchment. The Environment Agency is producing a major flood response protocol within the River Thames Scheme area. There is a measure to improve resilience of key river flow and level gauges on the River Thames.

Protecting from risk

There are 4 measures which include progressing with the River Thames Scheme, which is along the River Thames from Datchet to Teddington. This involves the capacity improvements, new flood channel, and property level protection and securing the funding for the project. The Environment Agency is also reviewing the operation procedure of the Maidenhead Windsor and Eton FAS.

Recovery and review of risk

There is 1 measure to deliver the recovery programme following the winter floods in 2014.

3.10 The Medway catchment

Introduction to the Medway catchment

The Medway catchment is situated in the South East of England and covers approximately 1388km². **Figure 14** provides an overview of the catchment. It contains the heavily managed River Medway and its four main tributaries the Eden, Bourne, Teise and Beult.

The River Medway rises as a spring near East Grinstead and flows east where it is joined by the Eden. The river continues to flow east through the Leigh Barrier and Tonbridge. In the centre of the catchment the Bourne, Beult and Teise join the Medway. The main river then flows north through Maidstone and into the Medway Estuary from Allington Lock. The Medway flow supports three large reservoirs at Bough Beech, Weir Wood and Bewl Water which operates independently of flood management.

The catchment has a range of topographies and diverse underlying soils. This creates relatively high gradient watercourses in the upper catchment to the south and west (Upper Medway and Teise), and very low gradient watercourses in the east (Beult) and in the centre (Middle Medway). The east west band of impermeable weald clay, from which the Eden and Beult rise, means surface run-off can play a significant part in the Medway drainage. The Teise, Beult and Bourne tributaries converge with the Medway near Yalding, forming a large flat floodplain area. Downstream of Maidstone, the River Medway becomes tidal beyond Allington Lock. Here the main source of flood risk is tidal, affecting communities at Aylesford, Halling, Wouldham and the Medway Towns. The coastline along the tidal estuary holds significant economic and strategic importance, including energy providers (e.g. power stations and inter-continental electricity connections) and transport infrastructure (e.g. Thames Port).

The management catchment is split into the following sub-catchments:-

- River Eden – from Lingfield to Penshurst
- Upper Medway – from Forest Row to Penshurst
- Middle Medway – including Tonbridge, Yalding and Maidstone
- River Teise, from Tunbridge Wells to Yalding
- River Beult – from Bethersden to Yalding
- Medway Estuary- from Allington to Isle of Grain
- tidal Thames – including the North Kent Marshes

In general, the mechanisms of flooding are complex and interdependent but the main cause is posed by rivers and surface water, tidal and to a lesser extent groundwater. Risks to people, property and infrastructure are dispersed throughout the catchment. The fluvial main risk is concentrated in Edenbridge, Tonbridge, the confluence of the tributaries near East Peckham and Yalding, and at Maidstone. The key tidal flood risk areas are at Aylesford, Halling, and the Medway Towns frontages. Surface water and ordinary watercourse flooding affects Paddock Wood, Collier Street, Marden, Staplehurst and Headcorn. This flooding often occurs when the main river levels are high.

The Medway is home to one of the largest flood storage reservoirs in the UK, the Leigh Barrier that stores up to 5.6million m³ and regulates flow in response to high rainfall.

Elsewhere on the river a series of sluices regulate flow during high and normal flow conditions to allow navigation and improve flora and fauna. Flood walls and earth embankments offer towns and villages further flood protection such as at Tonbridge and Edenbridge.

The Medway Estuary and Marshes is a large area of internationally designated habitat of particular importance to wildfowl. It lies in the outer mouth of the Medway Estuary from Gillingham, through to the Isle of Grain and Isle of Sheppey. Within this area there is a combination of 'hold the line' and 'managed realignment' policies to maximise the benefits of a more sustainable line of coastal defences, protecting the most important assets and infrastructure. A network of surface water outfalls which drain lowland marsh areas will also need to be renewed and replaced to reduce the risk in localised areas.

In the future, there will be an increased risk to people and property in the area, driven by changes in sea level, more extreme weather patterns, and an increase in coastal erosion. Policy decisions in the catchment and shoreline management plans have identified significant lengths of coastal defences that in the future have been designated for managed realignment. This will ensure that tidal flood risk is managed in a more sustainable way over the next 100 years, while ensuring the diversity and strategic importance of the designated habitat.

There has been significant flooding within the Medway catchment in recent years with serious consequences to people, properties and the environment. The events in 1960, 1968, 2000 and December 2013 have been the most severe over the rivers Medway, Beult and Teise. Hundreds of properties have been affected in each of these events as the Leigh Flood Storage Area (FSA) reached its capacity on Christmas Eve in 2013, after over 70mm of rain fell over a 24 hour period. Although record flows of 342 m³/s into the Leigh FSA were recorded the outflow was reduced to 160m³/s; greatly reducing the impact of the flood in Tonbridge.

Following on from the Christmas 2013 floods significant contributions have been offered by Kent County Council toward flood management measures to benefit Yalding and Tonbridge. Investigations are underway to accelerate improvements to the Leigh FSA and to seek appropriate measures to reduce the risk of Yalding flooding from the River Beult.

We maintain our assets on the Medway so that they deliver the best standard of protection for their design. Assets such as the Leigh Barrier, Allington Sluice, flood walls, earth embankments, flood gates and the flood warning system are regularly maintained. Removing debris from culverts and bridges and clearing weeds in natural channels is part of our channel maintenance.

Linking with the River Basin Management Plan

We are working collaboratively with other members of the Medway Catchment Partnership to develop plans to improve the ecology of the rivers in the Medway catchment. We are working to better understand human impacts on the water environment and working with partners to resolve the issues we have identified. The priorities in the Medway catchment are; to reduce pollution from waste water as well as from agricultural activities and make modified rivers more natural. Wherever possible through delivery of this FRMP we will seek improvements to the water environment through our work to manage flood risk.

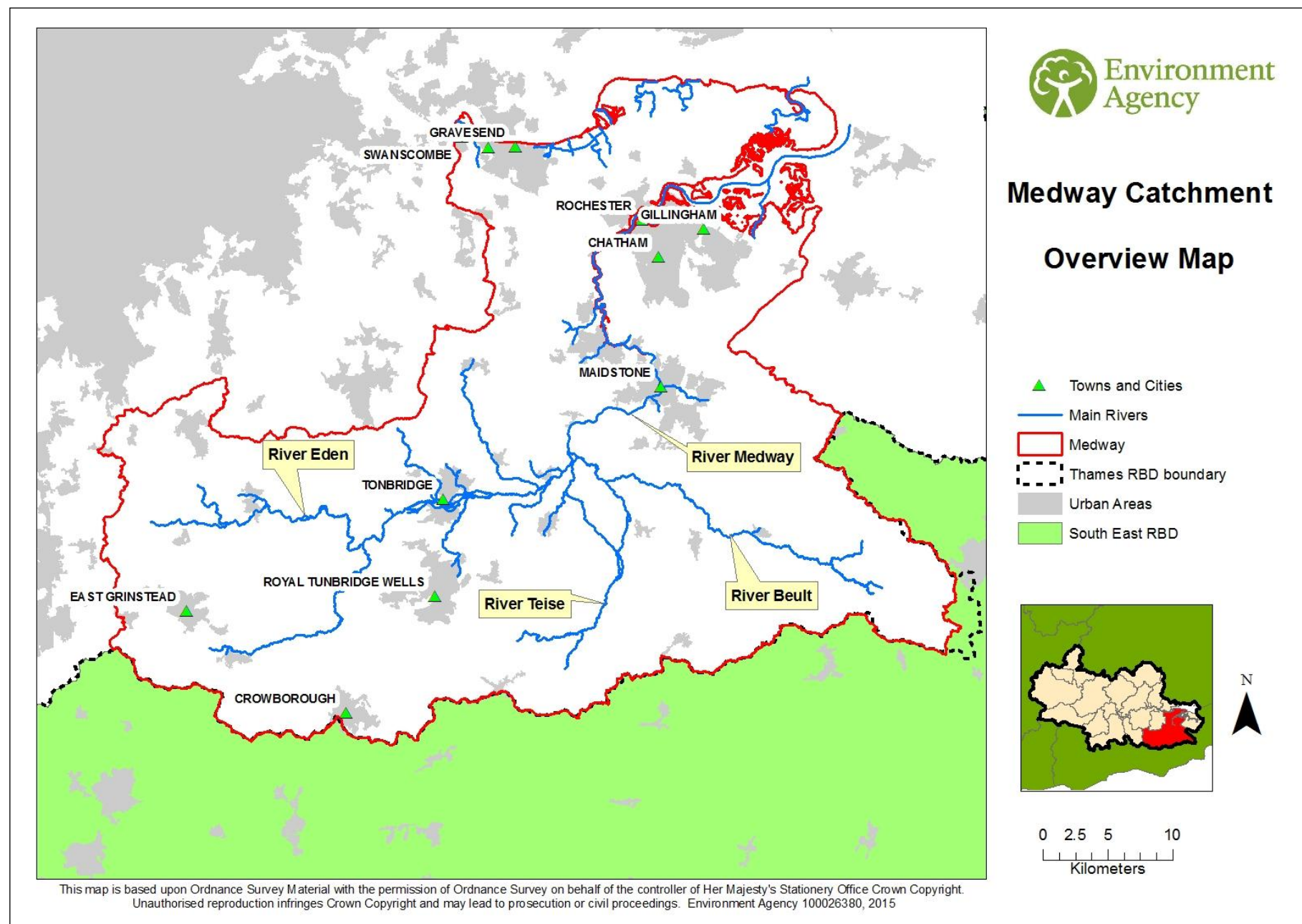


Figure 14 – The Medway catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 22: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Medway catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	877,350	5,500	10,550	19,700	100
Number of services:	1,410	50	40	60	0
Risk to economic activity:					
Number of non-residential properties:	98,150	2,150	1,800	5,200	<50
Number of airports:	0	0	0	0	0
Length of main roads (km):	430	<10	<10	<10	<10
Length of railway (km):	310	10	10	30	<10
Agricultural land (ha):	133,550	7,000	2,950	4,400	<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:2,480	33	4	0	12	0
Area of SAC within area (ha):	2,500	<50	<50	<50	0
Area of SPA within area (ha):	5,650	1,450	600	850	<50
Area of RAMSAR site within area (ha):	3,800	1,450	600	1,600	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	10,000	1,750	650	1,650	0
Area of Parks and Gardens within area (ha):	4,050	150	50	<50	<50
Area of Scheduled Ancient Monument within area (ha):	350	<50	<50	<50	<50
Number of Listed Buildings within area:	8,280	220	170	200	<10
Number of Licensed water abstractions within the area:	660	200	60	50	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

Table 23: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Medway catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	877,350	17,000
Number of services:	1,410	70
Risk to economic activity:		
Number of non-residential properties:	98,150	4,800
Number of airports:	0	0
Length of roads (km):	430	10
Length of railway (km):	310	30
Agricultural land (ha):	133,550	8,850
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	33	7
Area of SAC within area (ha):	2,500	0
Area of SPA within area (ha):	5,650	<50
Area of RAMSAR site within area (ha):	3,800	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	10,000	350
Area of Parks and Gardens within area (ha):	4,050	200
Area of Scheduled Ancient Monument within area (ha):	350	<50
Number of Listed Buildings within area:	8,280	410
Number of Licensed water abstractions within the area:	660	150

Note:

SAC - Special Area of Conservation, SPA - Special Protection Area

SSSI - Site of Special Scientific Interest, RAMSAR - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the Medway catchment

We have set out the following for the Medway catchment:

Conclusions

The sources of flood risk in the Medway catchment include tidal, river, surface water, and groundwater flooding.

The primary source of risk across the catchment is from fluvial flooding in the Eden, Medway, Bourne, Beult and Teise; and tidal flooding in the Tidal Medway Estuary. The fluvial mechanisms of flooding are complex and interdependent but the main cause is posed by rivers and surface water, and to a lesser extent groundwater. Risks to people, property and infrastructure are dispersed throughout the catchment. The main risk is concentrated in Edenbridge, Tonbridge, the confluence of the tributaries near East Peckham and Yalding, and at Maidstone.

Flood defence assets on the Medway are maintained the best standard of protection for their design. Future schemes are currently in progress to reduce the fluvial risk of flooding, which

includes a larger Leigh flood storage area and a Lower Beult scheme which will significantly reduce the number of properties at risk.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible by delivering the schemes within the Middle Medway Strategy, and developing the Medway Estuary and Swale Strategies.
- Encourage the take-up of flood resilience measures by people living within the floodplain.
- Adapt to climate change and its impacts by creating more sustainable coastal flood defences, such as developing managed realignment schemes

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Review privately owned/maintained structures.
- Investigate surface water flood risk in urban areas.
- Remodel the River Medway with improved hydrological and hydraulic information and considering the recent flood events.
- Investigate surface water flooding risk.

Environmental

- Seek opportunities to work with landowners to create wetlands habitat.
- Protect and enhance biodiversity through flood risk management schemes.
- Restore naturally functioning river systems where possible.
- Investigate soil erosion and land management to provide recommendations for catchment wide measures to improve land management.

Measures across the Medway catchment

Across the Medway catchment there are 75 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 17 prevention measures in the Medway. Within the wider catchment we are managing risk through sustainable drainage with new development and working closely with local councils on their surface water plans. This includes flood management investigations on internal drainage board's watercourses and other non-main rivers. Actions are also relating to the profile of blockages in key flood hotspots, and developing better drainage infrastructure in urban areas.

Preparing for risk

We are improving preparedness in the catchment through 27 measures, including working with communities to improve flood resilience (emergency flood plans) and improving flood warning systems and procedures. In addition to this, adapting to the risks associated with climate change and sea level rise will drive the Medway Estuary and Swale Strategies. These will also look at options for creating more sustainable coastal flood defence lines, through managed realignment.

Protecting from risk

There are a total of 26 measures to protect the catchment through developing new flood defence schemes or improving existing ones such as the Leigh FSA. We will continue to progress new schemes and improve maintenance of the channel as funding allows. We are also working closely with local councils and the internal drainage boards to develop schemes and practices to reduce risk from surface water and ordinary watercourse flooding.

Recovery and review of risk:

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

Other:

In total there are 5 other measures within this Medway catchment which includes Water Framework Directive actions on the Beult, wetland creation in the North Kent Marshes and working in partnership with the Medway Valley Partnership.

3.11 The Mole catchment

Introduction to the Mole catchment

The Mole catchment extends from the south of Crawley through the Surrey/Sussex Border to the River Thames at Molesey and includes two tributaries of the River Thames, the River Mole and The Rythe. **Figure 15** illustrates an overview of the Mole catchment.

The River Mole is approximately 79km long and drains a 479km² catchment. It flows from the south of Crawley, through Gatwick (under the airport runway in a culvert) and the urban areas of Horley, Reigate, Dorking, Leatherhead, Cobham and Esher to its confluence with the River Thames at Molesey.

The Rythe is a small stretch of river which rises in Oxshott and passes through Claygate, Hinchley Wood and Thames Ditton on its way to the River Thames. It is approximately 9km long, draining a 25km² catchment.

Linking with the River Basin Management Plan

We are working collaboratively with other members of the River Mole Catchment Partnership to develop plans to improve the ecology of the rivers in the Mole catchment. We are working to better understand human impacts on the water environment and with partners to resolve the issues we have identified. The priorities in the Mole catchment are; to reduce point and diffuse source pollution, make modified rivers more natural and tackle invasive non-native species. Wherever possible through delivery of this FRMP we will seek improvements to the water environment through our work to manage flood risk.

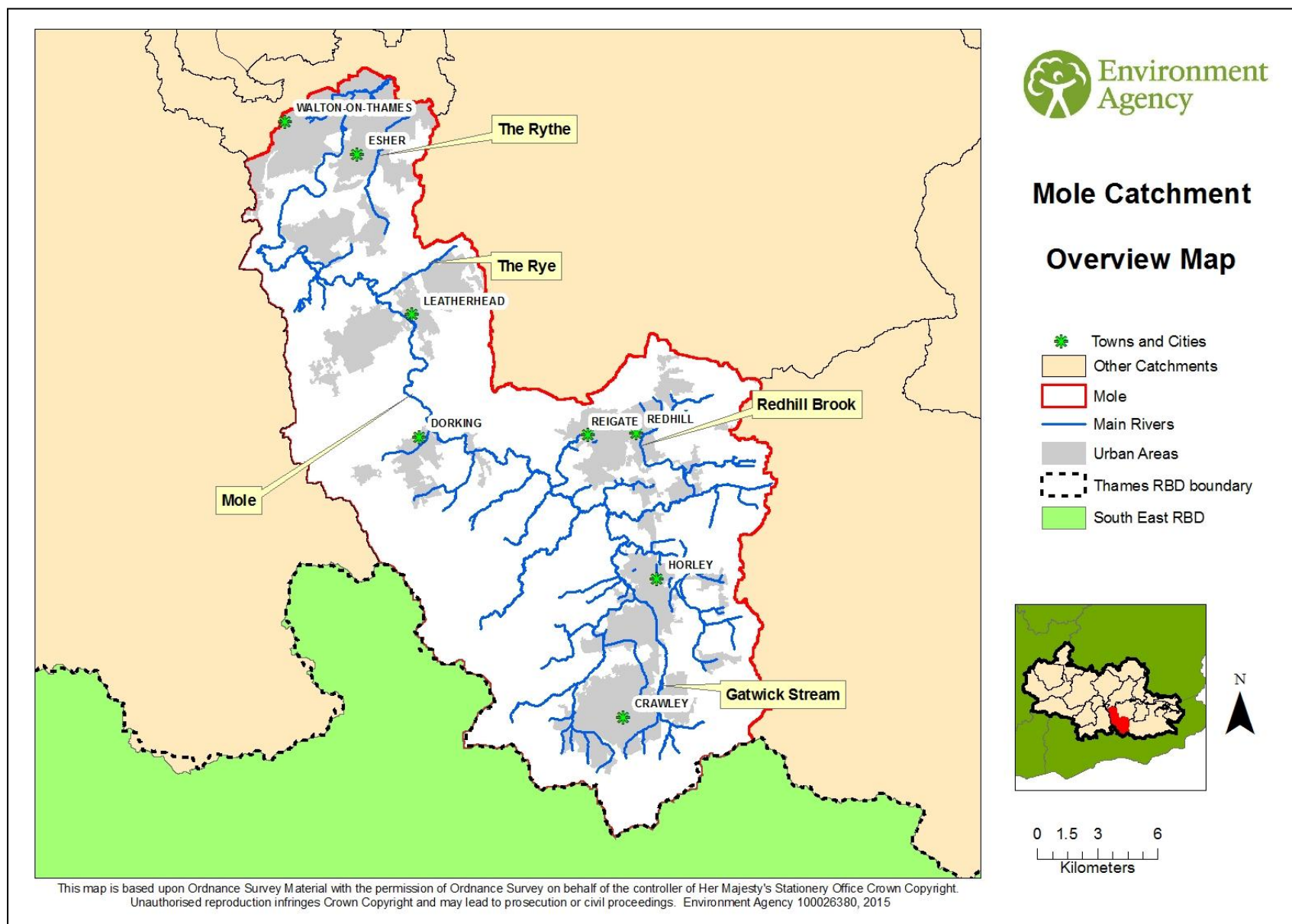


Figure 15: The Mole catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 24: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Mole catchment

River and Sea	Total in RBD	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	384,200	2,700	7,500	28,300	250
Number of services:	560	10	20	40	0
Risk to economic activity:					
Number of non-residential properties:	36,350	600	1,050	2,300	<50
Number of airports:	1	0	1	0	0
Length of main roads (km):	220	<10	<10	10	<10
Length of railway (km):	120	<10	<10	<10	<10
Agricultural land (ha):	14,450	600	300	650	<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:	7	1	0	0	0
Area of SAC within area (ha):	900	<50	<50	<50	0
Area of SPA within area (ha):	50	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	2,350	<50	<50	<50	<50
Area of Parks and Gardens within area (ha):	800	<50	<50	<50	<50
Area of Scheduled Monument within area (ha):	<50	<50	<50	<50	<50
Number of Listed Buildings within area:	1,770	20	20	140	<10
Number of Licensed water abstractions within the area:	60	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

Table 25: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Mole catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	384,200	42,850
Number of services:	560	50
Risk to economic activity:		
Number of non-residential properties:	36,350	2,750
Number of airports:	1	1
Length of roads (km):	220	<10
Length of railway (km):	120	<10
Agricultural land (ha):	14,450	350
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	7	2
Area of SAC within area (ha):	900	<50
Area of SPA within area (ha):	<50	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	2,350	<50
Area of Parks and Gardens within area (ha):	800	<50
Area of Scheduled Monument within area (ha):	<50	<50
Number of Listed Buildings within area:	1,770	70
Number of Licensed water abstractions within the area:	60	0

Conclusions and objectives for the Mole catchment

We have set out the following for the Mole catchment:

Conclusions:

Generally the Mole catchment is susceptible to rapid flooding from thunderstorms, but there are four distinctive areas with very different floodplain characteristics.

- **Upper Mole** (from south of Crawley to Horley): A large part of the Upper Mole catchment is semi-rural but it is characterised by newer and expanding urban areas often towards the headwaters of river catchments, such as Crawley and Horley. Gatwick Airport is situated in the Upper Mole and is at risk of flooding.
- **Middle Mole** (from Horley to Cobham): The Middle Mole contains mainly natural floodplain, with market towns and villages. 90% of the Middle Mole catchment is rural and it passes through Mole Gap to Reigate Escarpment Special Area of Conservation which is also a Site of Special Scientific Interest.
- **Lower Mole** (from Cobham to Thames confluence): The Lower Mole is characterised by areas of urban development with river flood defences. Almost the entire length of the watercourse has been modified with raised defences, flood relief channel and control structures.

- **The Rytte:** This small river flows through a partly wooded catchment with a number of towns along its course. There are no major flood defences.

There are urban areas already at risk of flooding from multiple sources such as fluvial, surface water and sewer. The proposals for further expansion may increase the risk even more, depending on where they are located.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities
- Improve community resilience and resistance to flooding and preparedness to act on receipt of flood warning information
- Raise awareness of riparian responsibility and residual risk given climate change impacts

Economic

- Provide strategic and site-specific flood risk advice in line with the National Planning Policy Framework and sustainable development
- Make best use of development opportunities to reduce flood risk to neighbouring communities
- Improve evidence-base through upgrades and improvements to modelling datasets, asset inspection information and observed flood data
- Use all available evidence and data to prioritise spending on maintenance activity
- Operate flood warning service throughout the Mole catchment

Environmental

- Make best use of development opportunities to improve the environment
- Safeguard natural floodplains

Measures across the Mole catchment

Across the Mole catchment there are 18 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

- There are 5 measures across the Mole catchment to prevent flood risk. These measures are primarily concerned with continuing to work closely with the local planning authorities within the catchment to influence spatial planning, supporting them with regular updates to strategic flood risk assessments and local development plans.

Preparing for risk

- There are 4 measures across the Mole catchment to prepare for flood risk. These measures are primarily concerned with continuing to provide flood warnings and refine flood warning service where necessary, and supporting local authorities and communities in improving preparedness through emergency planning and community flood plans.

Protecting from risk

- There are 9 measures across the Mole catchment to protect from flood risk. These measures are primarily concerned with on-going asset management and targeted maintenance to ensure that existing schemes continue to operate effectively. The Upper Mole Flood Alleviation Scheme is an on-going project in Crawley area and will provide flood storage areas to protect the local communities from flood risk. There are also measures to identify potential third party contributors to future flood risk management schemes through strategic planning.

The provision of flood alleviation schemes are also mentioned within these measures. These include:

- **Redhill Flood Alleviation Scheme:** This scheme aims to reduce the risk of flooding to communities along the Redhill Brook in Redhill and Earlswood. It will formalise storage already provided at wetland sites through working with landowners.
- **Ifield Flood Alleviation Scheme:** This scheme will focus on local scale measures to reduce the risk of flooding to residential properties, a nursing home and an important road route through Ifield Green. Other risk management authorities will be contributing to the scheme, and further contribution will be sought from other potential beneficiaries.
- **Lower Mole:** Short-term (10 year appraisal period) works are proposed to maintain the standard of protection provided by the Lower Mole Flood Alleviation Scheme which protects a large number of properties in Esher, Hersham and Molesey. The measures will also increase the efficiency of operating this major asset during flood incidents.
- **Lower Mole:** Longer-term (year 10-100) planning and assessment are proposed to identify capital investment to ensure the protection afforded by the Lower Mole Flood Alleviation Scheme to communities in Esher, Hersham and Molesey is extended into the future. Opportunities will be taken in the plan to identify where third party landowners/beneficiaries may be in a position to contribute to the longer-term maintenance of the assets, particularly where these fall into third-party ownership.
- **River Rythe:** Upgrading works are proposed to screen at Littleworth Common to reduce frequency of blockage which leads to risk of flooding to properties in Thames Ditton and improve health and safety. Opportunities will be taken to identify contributions from the landowner (Elmbridge Borough Council) and work will be done in consultation with Thames Water who own the flood relief culvert downstream.
- **Leatherhead and Middle Mole:** A wide range of options will be identified for a flood risk management scheme to provide an improved standard of protection to communities throughout the Middle Mole catchment and achieve greater outcome

measures. Potential contributions from partner local authorities and potential beneficiaries will be established.

These schemes are in the early stages of development, and work will be starting in future years to achieve flood risk management objectives and contribute towards environmental outcomes.

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.12 The North Kent catchment

Introduction to the North Kent catchment

The North Kent catchment, within the Swale District, is diverse in its physical form, human usage and natural environment. The area covers over 40,000 hectares with a resident population of some 125,000 people. **Figure 16** illustrates the catchment overview.

The principle water feature in the borough is The Swale, which is a strip of sea, separating the Isle of Sheppey from the rest of the borough. Although the area is predominantly rural, there are a few sizable towns; including Sittingbourne and Faversham south of the Swale, and Sheerness, Queenborough and Minster on the Isle of Sheppey. The area also includes a large area of nationally and internationally important habitat, from freshwater grazing to salt marshes and mudflats. In addition the coastline holds significant economic and strategic importance, including energy providers, transport infrastructure and a locally important tourist industry on the Isle of Sheppey.

The management catchment is split between the wider Medway and Swale Estuary to the west, and the North Kent operational catchment to the east. The main source of flood risk is tidal, centred on the main settlements of Sheerness, Queenborough, Minster, Sittingbourne and Faversham. To manage this risk the Environment Agency and other third party authorities maintain a variety of flood defence assets from earth embankments and flood walls, to beachfronts. Many of these coastal assets have been improved upon over time in different stages, but particularly in response to the two largest east coast tidal surge events in 1953 and 1978. These defences are therefore in varying states of condition and currently offer different standards of protection, dependant on the type of land use that is protected. However, some of the key assets are approaching the end of their design life so significant capital investment will be required over the next 10-30 years.

At the end of January 1953, overtopping and breaches to the tidal defences occurred at Sheerness and all along the western boarder of the Isle of Sheppey, either side of the Swale near Sittingbourne, at Warden, and around the Isle of Harty (although the Island itself was not flooded). Extensive flooding of property is known to have occurred.

In January 1978, the tidal defences along the western marshes (Barksore, Chetney and Horsham) were overtopped, as were the defences north of Faversham. In addition, the defences were breached on the Isle of Harty, Conyer Creek and Faversham Creek.

The main watercourse in the North Kent catchment is White Drain watercourse, which drains into the Graveney Marshes, discharging into the Estuary at Seasalter Pumping Station. The fluvial flood risk here is mainly to arable land with only a few properties in Seasalter affected.

Most of the catchment area lies over Chalk bedrock, covered with clay-with-flint deposits. Following periods of prolonged rainfall, groundwater flooding is a localised problem when the chalk becomes saturated and the water table rises to the surface. Areas around Sittingbourne are particularly noteworthy, as in recent years, the local paper industry closed reducing the demand for water in the underground aquifer. The concern is that over time, this could cause more issues with elevated groundwater levels and flooding.

More locally in the Medway and Swale Estuary, there are some small fast responding catchments including the Iwade Stream, Scrapsgate Drain and Warden Bay Drain, which all pose a local flood risk to smaller communities. More intense rainfall events, as well as the continual maintenance of trash screens and tidal outfalls are the critical measures manage this risk. Surface water flooding is also a problem in all of the urban centres.

In the future, there will be an increasing risk to people and property in the area, driven by changes in sea level, more extreme weather patterns, and an increase in coastal erosion. Policy decisions in the Shoreline Management Plan have already identified significant lengths of coastal defences that in the future have been designated for managed realignment. This will ensure that tidal flood risk is managed in a more sustainable way over the next 100 years, while ensuring the diversity and strategic importance of the designated habitat.

Linking with the River Basin Management Plan

We are working collaboratively with other members of the North Kent Catchment Partnership to develop plans to improve the ecology of the rivers in the North Kent catchment. We are working to better understand human impacts on the water environment and with partners to resolve the issues we have identified. The priorities in the North Kent catchment are; to reduce pollution from waste water as well as from agricultural activities and make modified rivers more natural. Wherever possible through delivery of this FRMP we will seek improvements to the water environment through our work to manage flood risk.

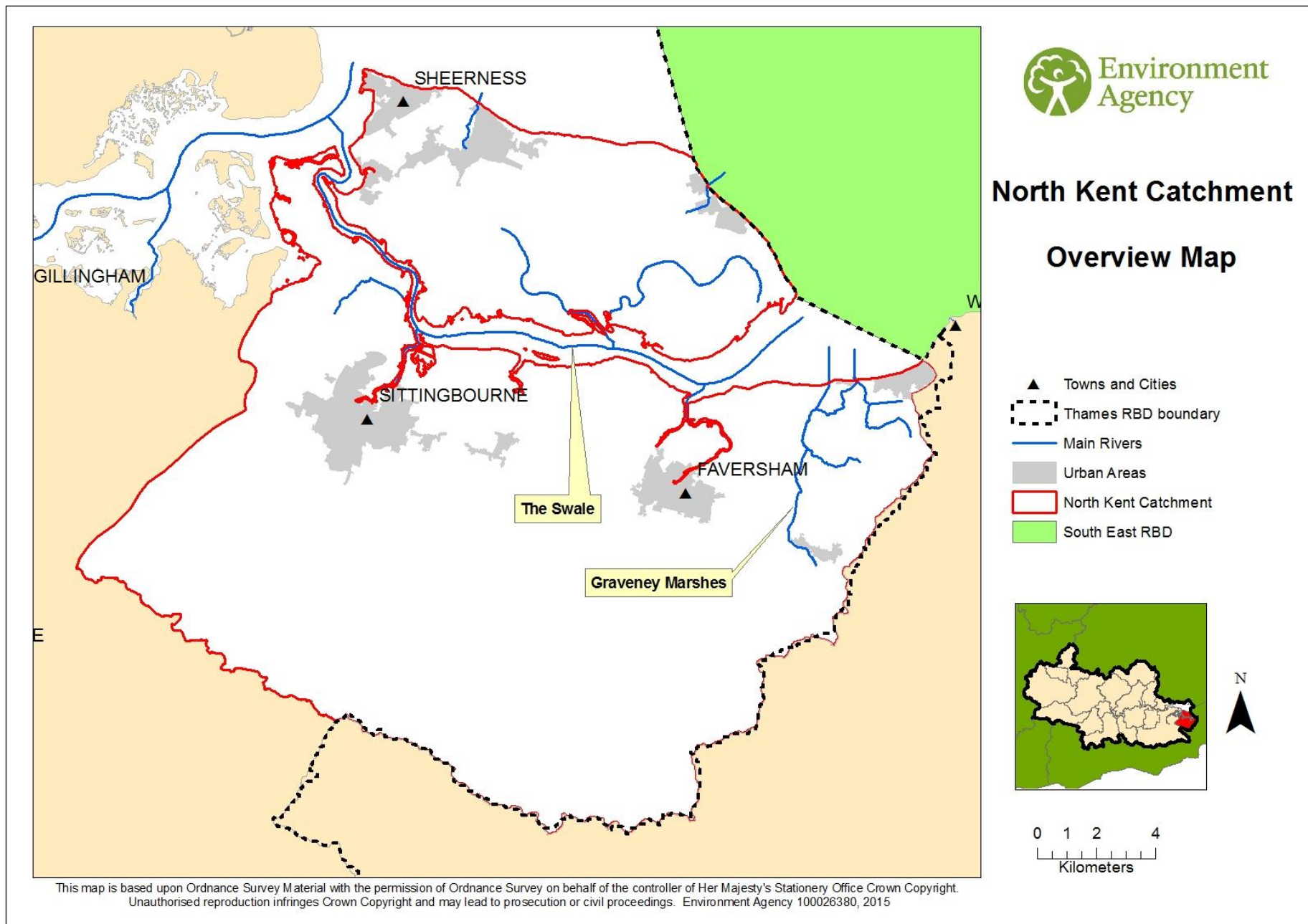


Figure 16: The North Kent catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 26: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the North Kent catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	137,000	5,850	11,850	12,400	0
Number of services:	260	20	20	40	0
Risk to economic activity:					
Number of non-residential properties:	18,550	1,050	900	1,900	<50
Number of airports:	0	0	0	0	0
Length of main roads (km):	110	<10	<10	10	0
Length of railway (km):	40	<10	<10	<10	0
Agricultural land (ha):	30,900	1,050	700	850	<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:	10	2	0	3	0
Area of SAC within area (ha):	<50	0	0	0	0
Area of SPA within area (ha):	4,250	1,950	850	1,400	0
Area of RAMSAR site within area (ha):	4,250	1,950	850	1,400	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	4,400	1,950	850	1,400	0
Area of Parks and Gardens within area (ha):	300	0	0	0	0
Area of Scheduled Ancient Monument within area (ha):	50	<50	<50	<50	0
Number of Listed Buildings within area:	1,500	50	40	70	0
Number of Licensed water abstractions within the area:	160	50	20	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

Table 27: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the North Kent catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	137,000	400
Number of services:	260	0
Risk to economic activity:		
Number of non-residential properties:	18,550	<50
Number of airports:	0	0
Length of roads (km):	110	<10
Length of railway (km):	40	<10
Agricultural land (ha):	30,900	<50
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	2	0
Number of EPR installations within 50m:	10	1
Area of SAC within area (ha):	<50	0
Area of SPA within area (ha):	4,250	100
Area of RAMSAR site within area (ha):	4,250	100
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	4,400	100
Area of Parks and Gardens within area (ha):	300	0
Area of Scheduled Ancient Monument within area (ha):	50	0
Number of Listed Buildings within area:	1,500	<10
Number of Licensed water abstractions within the area:	160	0

Conclusions and objectives for the North Kent catchment

We have set out the following for the North Kent catchment:

Conclusions

The sources of flood risk in the North Kent catchment include tidal, river, surface water, and ground water flooding.

The primary source of risk across the catchment is from tidal flooding in lowland areas. Many of the populated areas are currently protected by various coastal defences and frontages. Over time, we are moving towards developing a more sustainable way to manage tidal flood risk over the next 100 years, through re-aligning defences and creating compensatory habitat to best adapt to climate change and sea level rise.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible by developing the Medway Estuary and Swale Strategy.
- Encourage the take-up of flood resilience measures by people living within the floodplain.
- Adapt to climate change and its impacts by creating more sustainable coastal flood defences, such as developing managed realignment schemes.
- Develop Beach Management plans around the Faversham Creek to Seasalter coastlines.
- Develop exit strategies for Shell Ness, Minster slopes and Funton to Raspberry Hill (Lower Halstow).

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Review privately owned/maintained structures.
- Investigate surface water flooding risk in urban areas.

Environmental

- Seek opportunities to work with landowners to create wetland and intertidal habitat.
- Protect and enhance biodiversity through flood risk management schemes.
- Investigate coastal erosion to provide recommendations for catchment wide measures to improve land management.

Measures across the North Kent Catchment

Across the North Kent catchment there are 38 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 3 prevention measures on Swale Estuary. Within the wider catchment we are managing risk through sustainable drainage with new development and working closely with local councils on their surface water plans. This includes flood management investigations on the Iwade Stream and other non-main rivers.

Preparing for risk

We are improving preparedness in the catchment through 17 measures including working with communities to improve flood resilience and improving flood warning systems and procedures. In addition to this, adapting to the risks associated with climate change and sea level rise will drive the Medway Estuary and Swale Strategies. These will also look at options for creating more sustainable coastal flood defences through managed realignment. The creation of special protection area (SPA) adoptable freshwater compensatory habitat at

Great Bells Farm will assist in the medium and long term management of risk for managed realignment.

Protecting from risk

The 18 measures to protect the catchment from flood risk include numerous coastal defence schemes to increase the standard of protection of coastal defences, as well as maintaining and improving the condition of existing defences. We are also working closely with local councils to develop schemes to reduce risk from surface water flooding. We will continue to review and improve maintenance of the channel as funding allows.

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.13 The Roding, Beam and Ingrebourne catchment

Introduction to the Roding, Beam and Ingrebourne catchment

The Roding, Beam and Ingrebourne catchments cover around 520km² extending from the Thames to Epping in the west, Brentwood and Thurrock in the east and Stansted in the north. This is illustrated in **Figure 17**.

The upper reaches of the catchments comprise rural farmland. Here, some stretches of the rivers have been modified for mills and agriculture. Further downstream, the rivers encounter highly urbanised areas such as Ilford, Barking, Dagenham and Romford. Here, rivers have been modified to accommodate major transport infrastructure such as motorways, other major roads, railways and flood defences.

The impermeable geology within the catchments influences the rivers' base flows, how they behave to rainfall events and the amount and type of sediment. Generally, the rivers have a 'flashy' response to any rainfall, meaning water reaches the rivers quickly due to urbanisation and the limited amount of water that can be stored within the soils. This is particularly noticeable when the ground is already saturated.

Linking with the River Basin Management Plan

We are working collaboratively with the Roding, Beam and Ingrebourne catchment partnership to develop plans to improve the ecology of the rivers in the catchment. We are working to better understand human impacts on the water environment and working with partners to resolve the issues we have identified. The priorities in the Roding, Beam and Ingrebourne catchment are; to reduce pollution, make modified rivers more natural and tackle invasive non-native species.

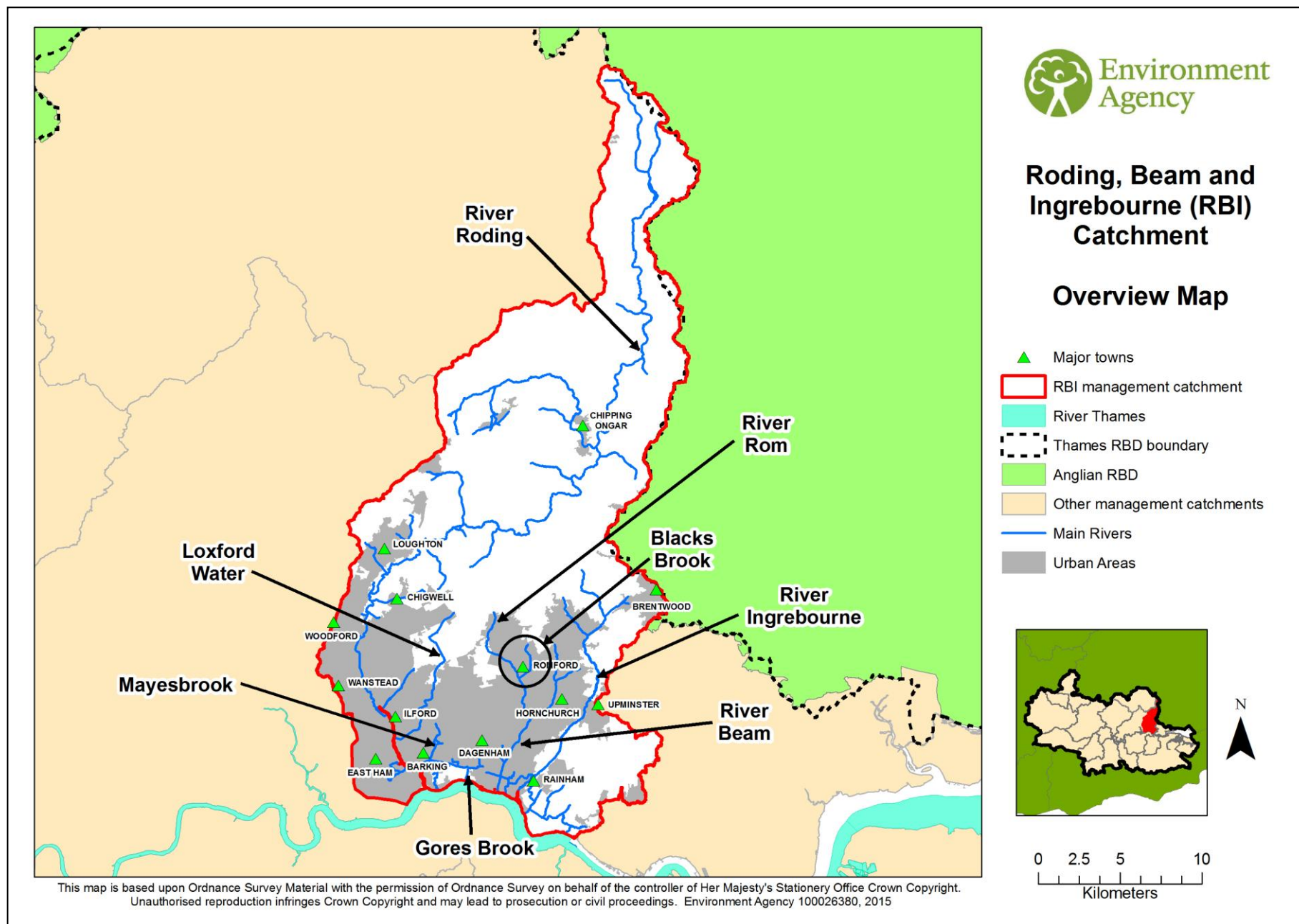


Figure 17: The Roding, Beam and Ingrebourne catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 28: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Roding, Beam and Ingrebourne catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	853,150	2,600	11,350	52,800	650
Number of services:	740	20	10	60	0
Risk to economic activity:					
Number of non-residential properties:	46,700	300	850	4,150	50
Number of airports:	0	0	0	0	0
Length of main roads (km):	250	<10	20	40	<10
Length of railway (km):	80	<10	<10	20	0
Agricultural land (ha):	32,850	1,050	350	550	<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:	19	3	1	8	0
Area of SAC within area (ha):	850	0	0	0	<50
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	1,750	300	200	100	<50
Area of Parks and Gardens within area (ha):	750	<50	<50	<50	<50
Area of Scheduled Monument within area (ha):	50	<50	<50	<50	0
Number of Listed Buildings within area:	1,670	10	20	40	<10
Number of Licensed water abstractions within the area:	160	60	<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

Table 29: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Roding, Beam and Ingrebourne catchment

Reservoirs	Total in RBD	Maximum extent of flooding
Risk to people:		
Number of people in area:	853,150	22,050
Number of services:	740	30
Risk to economic activity:		
Number of non-residential properties:	46,700	1,150
Number of airports:	0	0
Length of main roads (km):	250	10
Length of railway (km):	80	10
Agricultural land (ha):	32,850	450
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	19	1
Area of SAC within area (ha):	850	<50
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	1,750	<50
Area of Parks and Gardens within area (ha):	750	<50
Area of Scheduled Monument within area (ha):	50	0
Number of Listed Buildings within area:	1,670	10
Number of Licensed water abstractions within the area:	160	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

Conclusions and objectives for the Roding, Beam and Ingrebourne catchment

We have set out the following for the Roding, Beam and Ingrebourne catchment:

Conclusions:

The Roding, Beam and Ingrebourne catchment encompasses the three aforementioned river systems which are considered individually below:

Roding:

The Upper Roding flows through undeveloped countryside as a predominantly natural river system. The Middle and Lower Roding stretches are much more developed flowing through the heavily urbanised areas of Woodford, Wanstead, Ilford and Barking.

At the confluence of the Roding and the Thames, the Barking Barrier protects the Roding catchments from tidal flooding, operating in conjunction with the Thames Barrier.

Flood risk on the Middle Roding is primarily a combined surface water and fluvial risk while the Lower Roding is susceptible to the potential impacts of climate change. Sea levels are gradually rising, which will result in the need for the Barking Barrier to be closed more frequently and for longer durations. This can increase the risk of fluvial flooding upstream as the river is prevented from discharging into the Thames due to the high tide levels.

Recommendations for the management of the River Roding are identified in the [River Roding Flood Risk Management strategy](#) which we adopted in July 2012.

Beam:

The upper reaches of Beam and its tributaries flow through some highly urbanised areas such as Romford and Hornchurch. Further downstream, the Beam flows through established residential areas in a semi-natural channel. Flood risk is typically from the rivers with some surface water risk, whilst in the lower part of the catchment, where there are large concentrations of residential and industrial properties, there is the added risk of flooding from the tidal River Thames.

Ingrebourne:

The Ingrebourne catchment includes a number of tributaries such as Paines Brook and Weald Brook and flows into the Thames through Barking Creek. For most of its length the Ingrebourne flows in a semi-natural channel through undeveloped areas. Flooding in the catchment can come from three main sources.

The first is intense rainfall which falls on the upper catchment (which has a steep gradient) which can cause surface water flooding. This is exacerbated by the impermeable areas of land along the tributaries. Secondly, prolonged rainfall in the catchment can also cause widespread flooding. Finally, flooding can occur where high river flows occur at the same time as very high tides. Although the chance of this occurring is low, it is increasing with climate change and could potentially cause serious and widespread flooding.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible
- Raise awareness and understanding of all sources of flooding amongst communities.
- Ensure communities are aware of resilience measures that can be taken to be prepared for flooding.
- Improve the quality of flood risk data.

Economic

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

- Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks.
- Work in partnership to with developers to deliver capital schemes at redevelopment opportunities.

Environmental

- Protect and enhance biodiversity through flood risk management schemes.
- Restore naturally functioning river systems where possible.
- Promote sustainable land use management to reduce flood risk.

Measures across the Roding, Beam and Ingrebourne catchment

Across the Roding, Beam and Ingrebourne catchment there are 47 measures to manage risk. These measures are listed in full in Part C and include:

Preventing risk

There are 27 measures for preventing flood risk across the Roding, Beam and Ingrebourne catchment. These measures include;

- reducing flood risk through development opportunities and influencing the planning process
- safeguarding land
- investigating flood risk through modelling studies
- recommendations made in the River Roding Flood Management Strategy such as the Woodford Flood Alleviation scheme and Shonks Mill Flood Storage Area
- working with councils to develop maintenance regimes (including the recommendations made in the River Roding Flood Risk Management Strategy)
- future flood alleviation schemes

Preparing for risk

There are 11 measures for preparing for flood risk in the Roding, Beam and Ingrebourne catchment. These measures aim to;

- increase community awareness of flood risk
- ensure communities at risk are signed up to receive flood warnings
- improve the accuracy of the flood warnings by installing a new gauging station

Protecting from risk

There are 9 measures relating to protecting people from risk. These relate primarily to;

- reducing flood risk by the restoration of and naturalisation of flood plain and the de-culverting of watercourses - this means taking watercourses out of enclosed underground tunnels and creating an open channel
- river restoration
- upgrading of existing flood defences

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.14 The South Essex catchment

Introduction to the South Essex catchment

The South Essex catchment is a relatively small catchment of 232 Km² and encompasses the Mardyke river system to the west and a stretch of the north bank of the River Thames estuary to the south. Canvey Island and Two-tree-island are located in the east of the catchment.

Essex has a long history of flooding from the sea. Following the tragedy of the 1953 tidal surge, when 58 people lost their lives on Canvey Island, a significant sea wall was built along the Essex coast which has provided protection and reduced the impact from subsequent events.

Canvey Island was historically an area of tidal flats and marshland that was reclaimed over time by the construction of sea defences. This means it is a very low lying island which is separated from the mainland by a network of tidal creeks. The defences also create an enclosed water catchment. As a result, its drainage network is dominated by artificial drains and dykes to manage the water within the defences.

There are a significant number of current and historic landfill sites in South Essex that were former quarries for clay, chalk and gravel. Historically, these have taken a large amount of waste from London and South East England. The landfill sites along the coast and near Aveley and Ockendon on the River Mardyke are at flood risk and can cause a pollution issue if they are affected by flooding.

The underlying geology in the catchment is dominated by London clay, with some underlying chalk in the area around Tilbury and Thurrock. Where the underlying rock is clay, there is a higher rate of rainfall run-off which flows directly into the watercourses. There is also a risk from surface water flooding in these areas. Where there is chalk bedrock, run-off may infiltrate the rock delaying the response of rivers to rainfall and reducing peak flood flows. There is also a risk from groundwater flooding in these areas.

Linking with the River Basin Management Plan

The South Essex catchment is characterised by low rainfall, low gradients and slow flows. A lack of riparian shade and slow flowing water in some locations exacerbates the impact of nutrient enrichment. Intensive arable production also contributes significant Phosphorus and sediment loads. There are several active abstraction licences in South Essex taking water from the rivers for irrigation, commercial and public services and food and drink production.

Waste water from industrial activities and sewage from domestic sources is collected and treated at Waste Water Recycling Centres. After treatment, this effluent is returned to rivers or coastal waters. There are 71 such discharges in the catchment, and this can provide a significant proportion of river flow in drier months.

The main rivers have been historically managed with deepened, straightened, widened channels to improve flood protection and land drainage. A lot of fenland has been drained, which has removed water storage capacity of the catchment. Arable fields with low permeability clay soils are also drained. There are also significant urban areas with impermeable surfaces. Consequently base flows in the Mardyke are low, but the catchment responds quickly to rainfall which can lead to large changes in flow rates in a relatively short space of time.

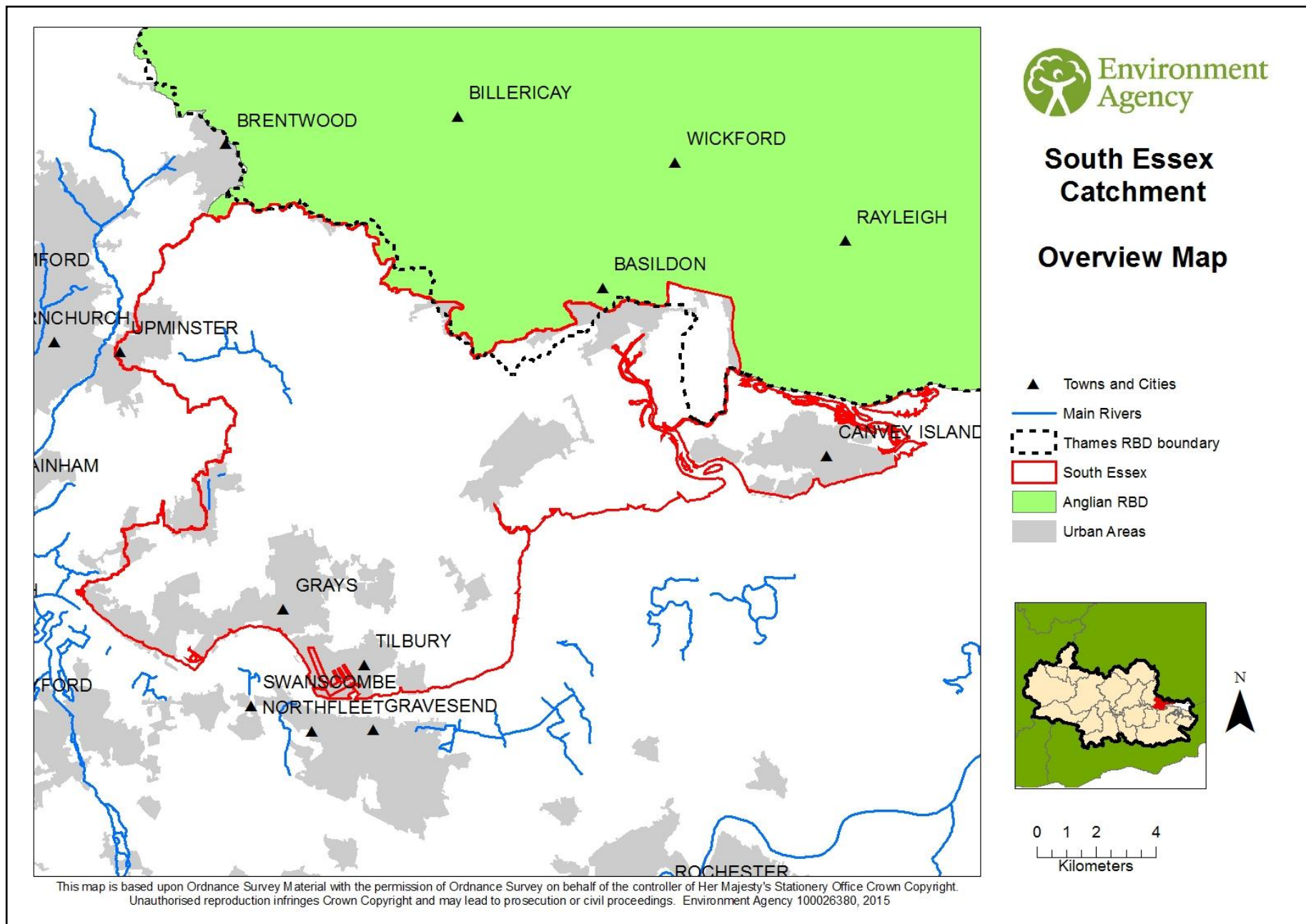


Figure 18: The South Essex catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 30: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the South Essex catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	218,550	2,700	3,600	24,500	37,150
Number of services:	250	<10	<10	30	40
Risk to economic activity:					
Number of non-residential properties:	16,800	450	500	2,950	2,800
Number of airports:	0	0	0	0	0
Length of main roads (km):	120	<10	<10	<10	<10
Length of railway (km):	70	<10	<10	20	<10
Agricultural land (ha):	13,450	900	550	1,150	600
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:	23	9	3	7	2
Area of SAC within area (ha):	0	0	0	0	0
Area of SPA within area (ha):	200	150	0	0	0
Area of RAMSAR site within area (ha):	200	150	<50	<50	<50
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	850	300	<50	200	100
Area of Parks and Gardens within area (ha):	400	0	0	0	0
Area of Scheduled Monument within area (ha):	100	<50	<50	<50	<50
Number of Listed Buildings within area:	320	<10	<10	20	20
Number of Licensed water abstractions within the area:	70	20	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

Table 31: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the South Essex catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	218,550	9,700
Number of services:	250	10
Risk to economic activity:		
Number of non-residential properties:	16,800	400
Number of airports:	0	0
Length of roads (km):	120	<10
Length of railway (km):	70	<10
Agricultural land (ha):	13,450	950
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	23	2
Area of SAC within area (ha):	0	0
Area of SPA within area (ha):	200	<50
Area of RAMSAR site within area (ha):	200	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	850	<50
Area of Parks and Gardens within area (ha):	400	0
Area of Scheduled Monument within area (ha):	100	<50
Number of Listed Buildings within area:	320	<10
Number of Licensed water abstractions within the area:	70	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

Conclusions and objectives for the South Essex catchment

We have set out the following for the South Essex catchment.

Conclusions

Much of this catchment is urban and an estimated 31% of the population are considered to be at risk from flooding from rivers and the sea. Just over 40% of non residential properties are at risk of flooding from rivers and the sea along with 10% of main roads and 35% of rail links. Of the 23% of agricultural land at risk from rivers and the sea in the catchment the majority is considered to be a low risk. Because much of the catchment is urban most of the licensed water abstraction points are for industry and public water supply rather than agricultural use and 68% of these licensed abstraction points are considered to be at flood risk. There are a considerable number of landfill sites in this catchment and 91% of the Environmental Protection Regulation (EPR) registered sites are at risk from flooding. These must be monitoring and managed very carefully due to the risk of pollution leachate. An estimated 53% of designated sites along with 11% of the listed buildings are at risk of flooding from rivers and the sea.

Tidal Flooding

The catchment suffered significantly from tidal flooding in 1953. Subsequently the defences have been raised overtime, and substantial defences, with a 1 in 1000 standard of protection (0.1% chance of flooding in any year) exist all the way from Purfleet in the West to Canvey Island in the east. The defence line is made continuous by four large gates, operated by the Environment Agency and known as the Thameside barriers. They are located at the Port of Tilbury, Easthaven, Fobbing and Benfleet. Behind these walls 29,500 properties are located in the tidal floodplain.

River Flooding

The western side of the catchment is dominated by the River Mardyke. A flood warning area for the lower reaches (downstream of Stifford Bridge) provides a service for 250 properties.

There is low risk to people and property, in the area around Cranham, West Horndon and Bulphan which are scattered in isolated towns throughout the northern part of the catchment. The majority of the properties at risk are located in the River Mardyke and Horndon catchments. There is also some grade two and three agricultural land, the A129, A176, A128 and one Sewage Treatment Works (STW) at risk.

The Stanford-le- Hope area is mostly urban and has a high population density with little open land. This area is at flood risk from high flows in the Horndon Brook. Impermeable surfaces in this area can lead to rapid run-off and lead to surface water and sewer flooding to people and properties.

The areas around Purfleet, Tilbury and Canvey Island are also urban. There are no formal river flood defences in this catchment. There is some agricultural land; the A1090 and the A1306 are at risk from river flooding.

Reservoirs

There are 9 large raised reservoirs that hold at least 25,000m³ of water above natural ground level within the catchment. An estimated 4% of people are considered to be within the maximum extent of flooding from reservoirs in the catchment. Only 2% of non- residential properties and 2% of services are within the maximum extent of flooding from reservoirs. An estimated 3% of rail and road are within the maximum flood risk extent from reservoirs. Of the agricultural land in the catchment 7% is within the maximum extent of flood risk from reservoirs. An estimated 15% of licensed abstraction points are within the maximum extent of flooding from reservoirs. Only 3% of designated sites along with 2% of listed buildings in the catchment are considered within the maximum extent of flooding from reservoirs.

Surface water

The catchment is predominantly drained marshes. Consequently there are significant geographical challenges to drainage. Furthermore, south of the A13 trunk road, significant urbanisation has taken place. This combination of low lying land and impermeable urban areas leads to surface water flooding and substantial rainfall overwhelms the local drainage systems, particularly in Tilbury (1968), Bowers Gifford (2001), Bulphan (2001), Stanford le Hope (2001) and Canvey Island (2013 and 2014).

Canvey Island is very low lying as it is historical reclaimed marshes and lies at an elevation below sea level. In some places the land can be as much as 2 metres below sea level. Consequently, a network of drainage channels is used to take surface water to the coast where there are 8 Environment Agency pumping stations. These pumps lift the water over the walls into the Thames estuary. In 2013 and 2014, extreme rainfall overloaded the complex drainage system on the island, leading to extensive surface water flooding.

Essex County Council (ECC), the Environment Agency and Anglian Water (AW) are working together to develop an Integrated Urban Drainage (IUD) model for Canvey Island. This will give us

a detailed representation of the drainage network on the island by considering the sewer network, the main river network and the highway drainage system together.

The aims of the IUD model are to improve our understanding of the extent of flood risk, enhance ECC's understanding of surface water flood risk and to identify the performance of assets on Canvey Island which are currently designated as main rivers or public sewers.

Objectives

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible.
- Raise community awareness and understanding of all sources of flooding.
- Enhance recreation and general amenity across the catchment.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Promote the use of sustainable drainage systems in development to help reduce pressure on existing drainage networks.

Environmental

- Protect and enhance biodiversity through flood risk management schemes.
- Restore naturally functioning river systems where possible.
- Promote sustainable land use management to land owners across the catchment to achieve reductions in flood risk.

Sustainable Management

For much of the catchment the preferred approach is to manage the probability of river flooding by storing water on the floodplain upstream.

Within the towns the urban environment needs to be adapted to make it more resilient to flooding, for example as commercial sites are redeveloped, the location and layout of buildings could be designed to help reduce flood risk.

Organisations must work together to provide an integrated approach to urban drainage issues and surface water flooding.

The risk of flooding cannot be completely removed and other measures need to be taken to manage the consequences of flooding. A flood warning service for river flooding should be developed for Stanford -le- Hope and flood awareness plans produced to encourage people to sign up to and respond to the flood warnings.

Measures to manage risk across the South Essex catchment

Across the South Essex catchment there are 58 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 25 measures across the South Essex catchment to prevent risk. These include;

- working with a range of organisations to find solutions to fund flood risk schemes
- engaging with agricultural land owners to ensure they use appropriate land management practices
- developing an Integrated Urban Drainage Plan for Canvey Island
- working with partner risk management authorities to develop a flood risk study for Stanford-le-Hope
- adaptation of spatial planning to reflect local flood risk, and development of a SuDS design guide for use across the catchment
- improving drainage on Canvey Island
- de-silting, ditch clearance and upgrade of overflow systems on the Mardyke
- Anglian Water investment in reduction in flood risk, partnership funding opportunities, maintenance and their Keep it Clear campaign

Preparing for risk

There are 12 measures across the South Essex catchment to prepare for flood risk. These measures focus on;

- improving ours and other authorities' understanding of local flood risk
- increasing community awareness of flood risk and available resilience measures
- establishing a working framework between risk management authorities to manage risk across the catchment
- implementing surface water flood forecasting and warning systems where appropriate
- Anglian Water's commitment to contribute to surface water management plans and develop sewerage management plans

Protecting from risk

There are 20 measures across the South Essex catchment to protect from flood risk. These include;

- our work with Essex County Council to;
 - improve policies for consenting works on ordinary watercourses
 - adopting sustainable drainage systems (SuDS) at the individual development scale
 - managing overland flow paths in urban areas
- understanding the flood risk function of structures
- habitat management and river restoration to achieve water framework directive targets at the same time as reducing flood risk
- developing SuDS schemes
- Anglian Water flood resilience measures to their most susceptible water and water recycling assets

Recovery and review of risk

There is 1 measure to address contaminated land and erosion risk at Two Tree Island.

3.15 The Thame and South Chilterns catchment

Introduction to the Thame and South Chilterns catchment

The main rivers in the Thame and South Chilterns catchment include the Thame, Thames, Wye and Pang and their numerous tributaries. The principal towns are Aylesbury, Thame, High Wycombe, Henley-on-Thames and Wallingford. **Figure 19** provides an overview of the catchment.

The River Thame is a relatively slow-flowing river with occasional in-channel runs and riffles. Although it meanders for much of its length, many of its tributaries have been extensively modified by straightening and dredging and are relatively narrow, shallow streams. The river itself supports fisheries and several still waters have high fish populations. The Thame catchment is predominantly rural in character, the majority of its land being agricultural in use and its floodplain given over to livestock grazing. Most of the catchment is underlain by impermeable clays in which there is little significant groundwater flow.

By contrast, the South Chilterns area has numerous Groundwater Safeguard Zones and chalk springs give rise to the River Wye north-west of High Wycombe. Flowing through the town, the river has been heavily modified and culverted in places and is urban for the majority of its length. It is nevertheless an important chalk stream where trout can be seen in its urban reaches.







Watercourses in this catchment are used for a variety of activities, including recreation, public water supply, fisheries and conservation. The area is rich in landscape and wildlife heritage, including the Chilterns and North Wessex Downs Areas of Outstanding Natural Beauty.

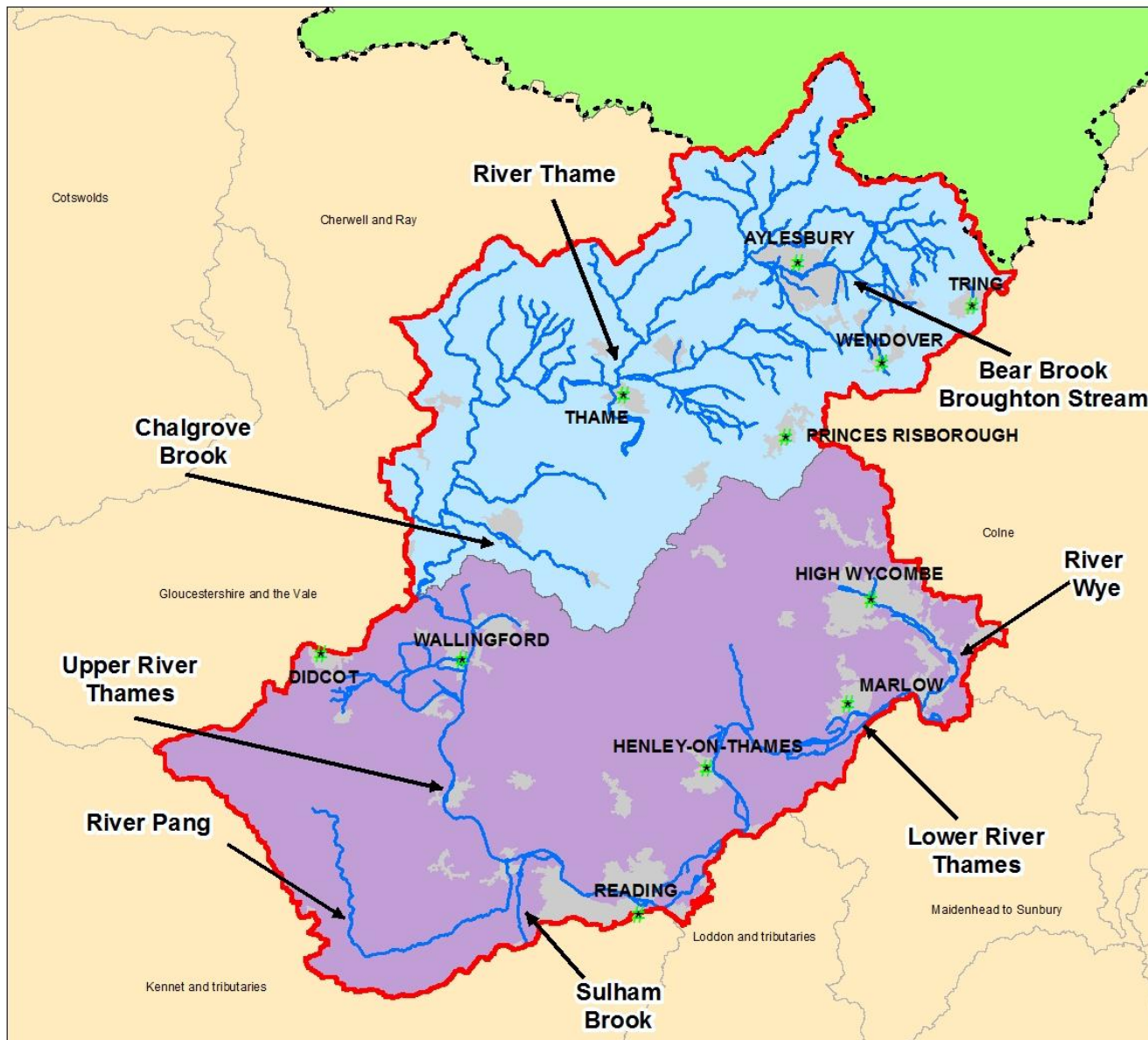
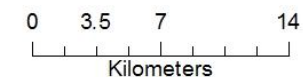
Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Thames and South Chilterns catchment include action to gain Water Framework Directive improvement through proposed development and taking the catchment approach to enhance and expand the floodplain.

Thame and South Chilterns Catchment

Overview Map

-  Towns and Cities
-  Thame and South Catchment
-  Thames RBD boundary
-  Anglian RBD
-  Other Catchments
-  Main Rivers
-  Urban Areas
- WFD Operational Catchments**
 -  South Chilterns
 -  Thame



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Figure 19: The Thame and South Chilterns catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 32: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Thame and South Chilterns catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	523,500	6,550	8,200	20,200	100
Number of services:	990	30	20	40	0
Risk to economic activity:					
Number of non-residential properties:	63,950	1,750	900	3,050	<50
Number of airports:	0	0	0	0	0
Length of main roads (km):	280	<10	<10	<10	<10
Length of railway (km):	130	<10	<10	<10	0
Agricultural land (ha):	117,250	2,600	1,150	1,650	<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:	9	0	0	0	0
Area of SAC within area (ha):	800	<50	<50	<50	0
Area of SPA within area (ha):	0	0	0	0	0
Area of RAMSAR site within area (ha):	0	0	0	0	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	2,750	50	<50	<50	0
Area of Parks and Gardens within area (ha):	3,300	150	<50	50	<50
Area of Scheduled Monument within area (ha):	500	<50	<50	<50	<50
Number of Listed Buildings within area:	6,840	270	160	260	<10
Number of Licensed water abstractions within the area:	350	100	10	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

Table 33: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Thame and South Chilterns catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	523,500	8,000
Number of services:	990	30
Risk to economic activity:		
Number of non-residential properties:	63,950	1,400
Number of airports:	0	0
Length of roads (km):	280	<10
Length of railway (km):	130	<10
Agricultural land (ha):	117,250	1,100
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	9	0
Area of SAC within area (ha):	800	0
Area of SPA within area (ha):	0	0
Area of RAMSAR site within area (ha):	0	0
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	2,750	<50
Area of Parks and Gardens within area (ha):	3,300	50
Area of Scheduled Monument within area (ha):	500	<50
Number of Listed Buildings within area:	6,840	100
Number of Licensed water abstractions within the area:	350	30

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the Thame and South Chilterns catchment

We have set out the following for the Thame and South Chilterns catchment:

Conclusions:

The Thame and South Chilterns is mainly at risk of flooding from rivers, however, some areas are also at risk from surface water and groundwater flooding.

Existing defences in Aylesbury reduce the risk of flooding to the community. The Environment Agency are currently investigating whether defences may also be viable in Pangbourne, Purley and Bisham and will be investigating partnership funding to ensure we can take the preferred option for reducing flood risk in these areas. The Marlow flood alleviation scheme is also being progressed. We are proposing to develop detailed modelling at locations around the catchment to better understand the risk of flooding in certain areas.

In key areas, the Environment Agency will help communities to prepare for flooding by raising awareness, promoting resilience and by encouraging appropriate redevelopment. We will aim to safeguard natural floodplains to reduce the consequences of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the impact of flooding through community awareness and flood response.
- To have a better understanding of the flood risk from rivers in certain areas in the catchment.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- To reduce the risk of flooding where possible through the delivery of the 6 year programme

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Thame and South Chilterns catchment

Across the Thame and South Chilterns catchment there are 28 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 16 prevention measures which include reducing flood risk through redevelopment. The Environment Agency is working with the planning authorities to steer development to areas with the least risk of flooding and also developing detailed hydraulic modelling along the River Thames from Hurley to Teddington to improve our understanding of flood risk. There are planned measures for location-specific modelling at Benson and Ewelme, Stanford Dingley and Bradfield, and Dorchester and Drayton St Leonard. This is in addition to catchment modelling along the River Wye, River Thames from Sonning to Hurley, and on the Chalgrove Brook. This is to understand the risk of flooding in more detail. There are measures to continue the effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan.

Preparing for risk

There are 5 preparation measures. These are:

- working with local resilience forum partners to improve the multi-agency response to flooding
- encouraging communities to produce flood plans
- reviewing flood warning and flood alert areas across the catchment
- to improve resilience of flow and level gauges, on the River Thames at Purley

- to investigate the benefits of an additional river level gauge at Burghfield and Stanford Dingley

Protecting from risk:

There are 6 measures including progressing the initial assessments to investigate what can be done to reduce flood risk in Pangbourne, Purley and Bisham. We are also maintaining existing defences in Aylesbury and constructing a bund in Purley.

Recovery and review of risk

There is 1 measure to deliver the recovery programme following the winter floods in 2014.

3.16 The Upper Lee catchment

Introduction to the Upper Lee catchment

There are over 320km of rivers within the Upper Lee catchment. An overview of the catchment is illustrated in **Figure 20**. The distribution of water bodies means that not one of the catchment's 700,000 residents is further than 5km from a river. This extensive blue infrastructure is recognised in the area's status as a locally determined Nature Improvement Area, where local groups have committed to significant landscape-scale environmental improvement.

Across the catchment, the character of the rivers varies considerably. In urban areas like Luton and Stevenage, rivers typically run in man-made channels and culverts and only make an appearance as they flow through parks and green spaces. Some towns like Harlow, Hertford and Bishops Stortford, have historic navigations and modified rivers running near or through them, often providing a focal point for recreation, and a valued link between town and country. In more rural areas, picturesque rivers, including internationally rare chalk streams, run through marked valleys and wind their way through small settlements. As a result, the way the rivers are perceived by local people, and the value they place in them, varies widely across the catchment.

The catchment is an area of water stress, which means its average daily water use is amongst the highest in the country. Groundwater and rivers supply water for local people, and 90% of water abstracted is used for this purpose. This groundwater abstraction directly impacts on the amount of water available in the environment. In particular, this impacts the chalk streams in the catchment, which depend on an adequate supply of groundwater.

As well as the main River Lee itself this management catchment includes:

- The River Stort, which is the largest river in the catchment, apart from the Lee. The Stort flows from its source in rural Essex, becoming a navigable river at Bishops Stortford. The Stort continues as a heavily modified watercourse until it meets the River Lee at Fieldes Weir;
- Several smaller tributaries to the north of the Upper Lee catchment. The Rivers Mimram, Beane, Rib, Ash and their tributaries all flow through predominantly rural areas.

Linking with the River Basin Management Plan

We are working with seven rivers groups and catchment partnerships in the Upper Lee catchment. These groups have helped a better understanding of problems and their impacts on the health of the water environment in the catchment. Together we have started to address a number of issues. These include low flows in rivers, pollution from waste water and from rural and urban areas, and the extent of modifications, structures and changes to the natural form of our rivers.

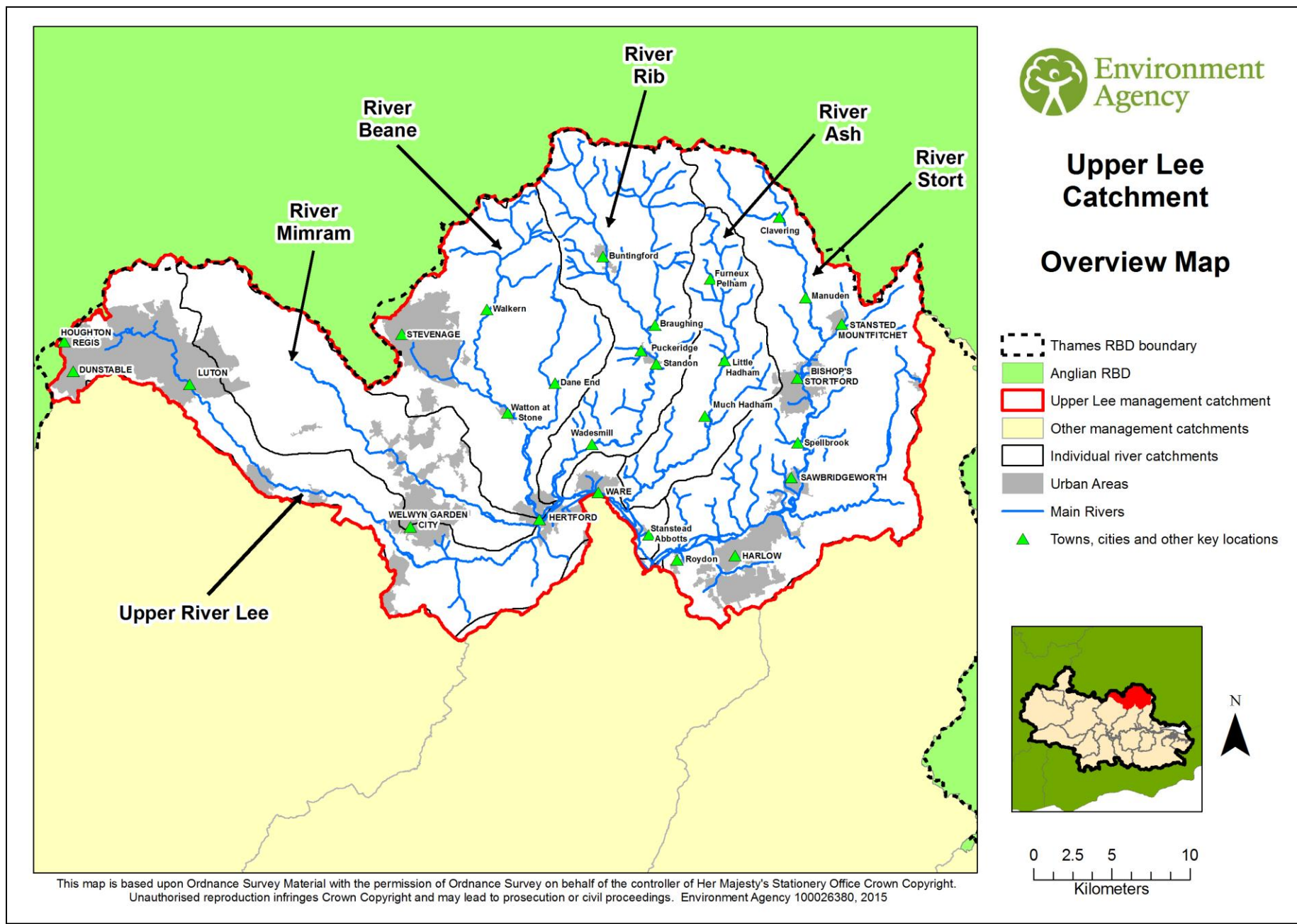


Figure 20: The Upper Lee catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 34: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Upper Lee catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	645,450	2,200	3,450	13,700	<50
Number of services:	1,030	10	10	40	0
Risk to economic activity:					
Number of non-residential properties:	51,600	600	350	2,200	<50
Number of airports:	2	0	0	0	0
Length of main roads (km):	270	<10	<10	10	<10
Length of railway (km):	90	<10	<10	<10	<10
Agricultural land (ha):	84,900	1,400	1,000	1,450	<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:	24	1	1	3	0
Area of SAC within area (ha):	<50	0	0	0	0
Area of SPA within area (ha):	100	50	<50	<50	0
Area of RAMSAR site within area (ha):	100	50	<50	<50	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	1000	100	<50	50	0
Area of Parks and Gardens within area (ha):	3,150	150	50	100	<50
Area of Scheduled Monument within area (ha):	250	<50	<50	<50	0
Number of Listed Buildings within area:	5,410	160	70	230	0
Number of Licensed water abstractions within the area:	280	40	20	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

Table 35: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Upper Lee catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	645,450	3,600
Number of services:	1,030	20
Risk to economic activity:		
Number of non-residential properties:	51,600	650
Number of airports:	2	0
Length of roads (km):	270	<10
Length of railway (km):	90	<10
Agricultural land (ha):	84,900	750
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	24	1
Area of SAC within area (ha):	<50	0
Area of SPA within area (ha):	100	<50
Area of RAMSAR site within area (ha):	100	<50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	1000	<50
Area of Parks and Gardens within area (ha):	3,150	100
Area of Scheduled Monument within area (ha):	250	<50
Number of Listed Buildings within area:	5,410	80
Number of Licensed water abstractions within the area:	280	30

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the Upper Lee catchment

We have set out the following for the Upper Lee catchment:

Conclusions:

The sources of flood risk in the Upper Lee catchment include river, surface water and groundwater flooding. The primary source of risk varies across the catchment.

The Upper Lee catchment is characterised by narrow floodplains towards the headwaters of the catchment with wide downstream floodplains. It is predominately a rural catchment with a few significant urban areas that include Stevenage, Harlow, and Luton. Within these large towns the rivers flow through well-defined flood plains with relatively few properties at risk from fluvial, or river, flooding. These urban areas are highly impermeable and there are known risks from surface water flooding.

Outside of the major towns, properties at risk from fluvial flooding are widely distributed, and there are several small communities at risk on each of the major tributaries. Flooding events in the Upper Lee catchment are often short in duration and the impacts are highly localised.

Due to the dispersed nature of flood risk in the catchment, options to reduce the level of risk need to be considered at a local scale; there are no opportunities for strategic scale flood risk intervention. As flood risk cannot be reduced to all properties in the catchment area, flood resilience measures at a property level could become increasingly important.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the risk of flooding to communities where possible.
- Raise community awareness and understanding of all sources of flooding.
- Enhance recreation and general amenity across the catchment.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces risk wherever possible.
- Promote the use of sustainable drainage systems to help reduce pressure on existing drainage networks.

Environmental

- Protect and enhance biodiversity through flood risk management schemes.
- Restore naturally functioning river systems where possible.
- Promote sustainable land use management to reduce flood risk.

Measures across the Upper Lee catchment

Across the Upper Lee catchment there are 28 measures to manage risk. These measures are listed in full in Part C and include:

Preventing risk

There are 18 measures across the Upper Lee catchment to prevent risk. These measures include;

- preventing risk through influencing the planning process, to ensure development and redevelopment in areas at risk is appropriate
- modelling to help better understand the risk, and to assist in the future development of potential new flood alleviation schemes
- work to adapt spatial planning policy to reflect local flood risk in Essex County Council - through this measure the council will develop and publish sustainable drainage systems (SuDS) design guides, include assessment of local flood risk in

strategic flood risk assessments (SFRAs) and develop guidance to ensure all local planning authorities (LPAs) adopt similar standards

- promoting property level resilience measures
- identifying where a flood risk alleviation scheme could be of benefit
- addressing skills gap in local councils
- reviewing asset management and maintenance methods and achieve wider environmental benefits through innovative management of flood risks

Preparing for risk

There are 4 measures across the Upper Lee catchment to prepare for flood risk. These measures are related to;

- working with key stakeholders to better understand and manage flood risk (improving understanding of local flood risk and improving community awareness of flooding)
- improved surface water forecasting and warning systems
- establishing a working framework between risk management authorities within Essex County Council

Protecting from risk

There are 6 measures already in place across the Upper Lee catchment to protect from flood risk. These measures relate to;

- improving the policy for regulation of works on ordinary watercourses
- implementing sustainable drainage systems (SuDS) and management of overland flood flow paths
- a proposed flood storage area at Houghton Regis to reduce the level of risk in Luton - this scheme will incorporate a flood storage area into the new development at Houghton Regis and will provide flood alleviation benefits to Luton
- construction of flood storage areas to reduce the level of flood risk in Little Hadham - this scheme is in the early stages of development and is reliant upon the construction of the A120 bypass which has been proposed by Hertfordshire County Council

Recovery and review of risk

No measures over and above existing flood risk work which is set out in the Thames RBD scale measures in Part A.

3.17 The Wey and tributaries catchment

Introduction to the Wey and tributaries catchment

The River Wey and tributaries catchment lies within the counties of Hampshire and Surrey, in the south east of England. An overview of the catchment is illustrated in **Figure 21**. The River Wey and its tributaries drain a catchment of total area of approximately 900km². The River Wey has two branches in the upper catchment. These are the North Wey flowing through Alton and Farnham and the South Wey flowing through Haslemere. The two branches join at Tilford and continue as a single river to the confluence with the Thames at Weybridge.

The geology of the Wey and tributaries catchment varies with upstream being formed of permeable Lower Greensand and Downstream of the North Downs being formed of impermeable London clay and Bagshot Sands.

The River Wey and tributaries catchment is predominantly rural. However, different reaches and tributaries of the River Wey pass through the urban centres of Farnham, Godalming, Guildford, Old Woking, Byfleet and Weybridge. The river is navigable from Godalming to the Thames at Weybridge on both natural and man-made sections.

A high proportion of the Wey and tributaries catchment consists of statutory nature conservation designations. These include Special Areas of Conservation (SAC); Special Protection Areas (SPA); Ramsar sites, Sites of Special Scientific Interest (SSSI), National Nature Reserves and Local Nature Reserves. In addition, a significant area of the catchment is designated as an Area of Outstanding Natural Beauty (AONB).

Eighteen weirs and associated flood channels were completed in 1935 under the River Wey Improvement Scheme (RWIS) by Surrey County Council, designed to provide flood relief to a 1 in 2 (50%) chance flood. Through the transfer of land drainage and flood risk management roles, the Environment Agency is responsible for the continued operation and maintenance of this scheme.

Linking with the River Basin Management Plan

We are working collaboratively with partners to understand the catchment and to develop plans to improve the local water environment and ecological status. The priorities in the Wey and tributaries catchment include action to gain Water Framework Directive improvement through proposed development.

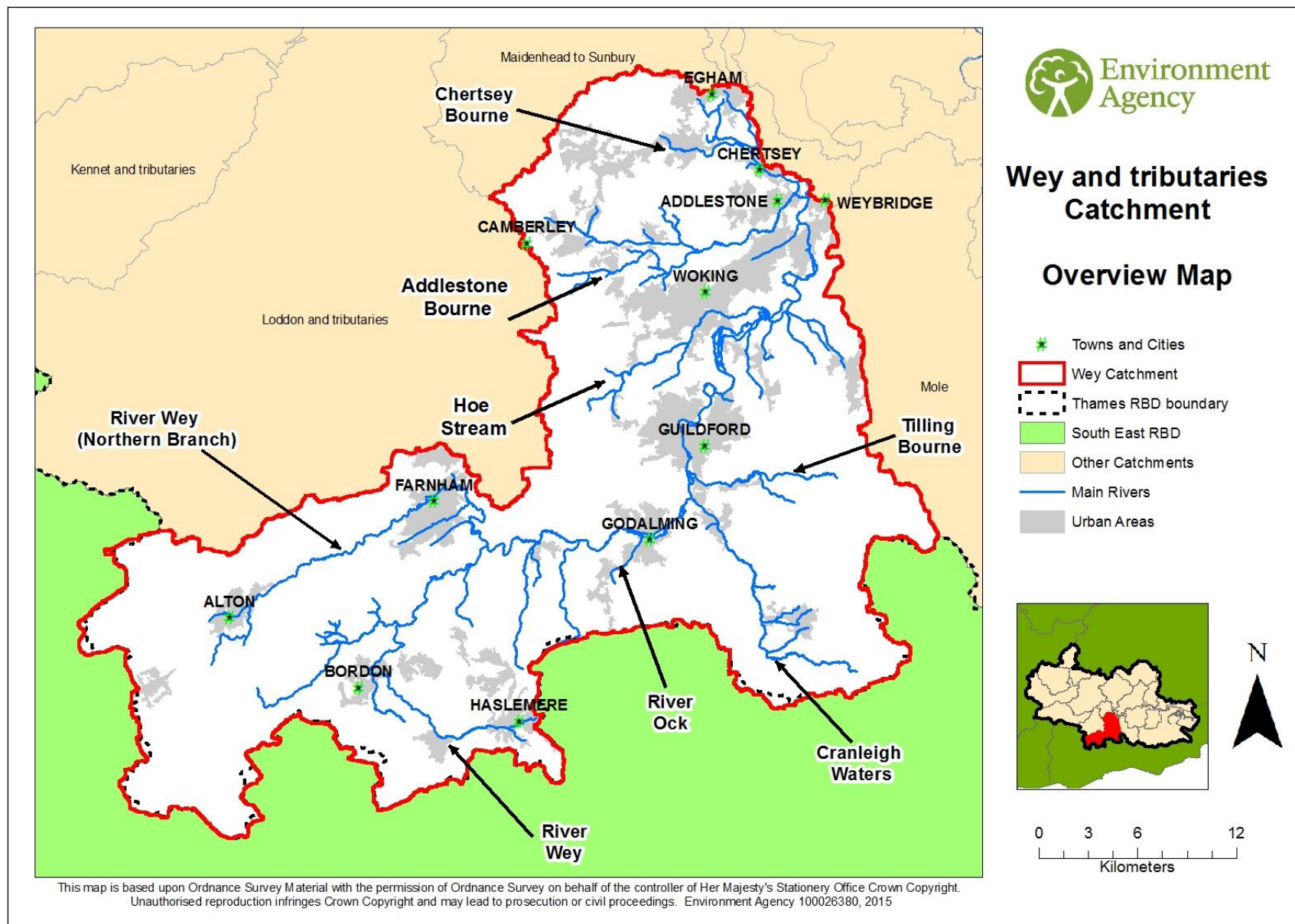


Figure 21: The Wey and tributaries catchment overview map

Flood risk statistics

The information contained in these tables has been calculated using the [rivers and sea flood map](#) and the [reservoirs flood map](#) which have been developed and published by the Environment Agency.

Table 36: Summary of flood risk from rivers and sea to people, economic activity and the natural and historic environment across the Wey and tributaries catchment

River and Sea	Total in catchment	High risk	Medium risk	Low risk	Very low risk
Risk to people:					
Number of people in area:	513,900	11,950	9,700	18,900	50
Number of services:	1,020	40	30	60	0
Risk to economic activity:					
Number of non-residential properties:	64,250	1,350	1,200	2,600	<50
Number of airports:	0	0	0	0	0
Length of main roads (km):	250	<10	<10	30	<10
Length of railway (km):	140	<10	<10	<10	<10
Agricultural land (ha):	45,850	600	400	550	<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:	15	1	1	0	0
Area of SAC within area (ha):	6,150	50	50	<50	0
Area of SPA within area (ha):	7,450	100	50	<50	<50
Area of RAMSAR site within area (ha):	300	<50	<50	<50	0
Area of World Heritage Site within area (ha):	0	0	0	0	0
Area of SSSI within area (ha):	9,750	300	50	50	<50
Area of Parks and Gardens within area (ha):	3,550	150	50	50	<50
Area of Scheduled Monument within area (ha):	250	<50	<50	<50	<50
Number of Listed Buildings within area:	3,950	80	60	180	0
Number of Licensed water abstractions within the area:	300	70	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

Table 37: Summary of flood risk from reservoirs to people, economic activity and the natural and historic environment across the Wey and tributaries catchment

Reservoirs	Total in catchment	Maximum extent of flooding
Risk to people:		
Number of people in area:	513,900	22,350
Number of services:	1,020	50
Risk to economic activity:		
Number of non-residential properties:	64,250	2,150
Number of airports:	0	0
Length of roads (km):	250	10
Length of railway (km):	140	<10
Agricultural land (ha):	45,850	800
Risk to the natural and historic environment:		
Number of EU designated bathing waters within 50m:	0	0
Number of EPR installations within 50m:	15	0
Area of SAC within area (ha):	6,150	100
Area of SPA within area (ha):	7,450	150
Area of RAMSAR site within area (ha):	300	50
Area of World Heritage Site within area (ha):	0	0
Area of SSSI within area (ha):	9,750	250
Area of Parks and Gardens within area (ha):	3,550	200
Area of Scheduled Monument within area (ha):	250	<50
Number of Listed Buildings within area:	3,950	110
Number of Licensed water abstractions within the area:	300	30

Note:

SAC - Special Area of Conservation, **SPA** - Special Protection Area

SSSI - Site of Special Scientific Interest, **RAMSAR** - wetland site of international importance

EPR installations - those registered under the Environmental Permitting Regulations

Conclusions and objectives for the Wey and tributaries catchment

We have set out the following for the Wey and tributaries catchment:

Conclusions:

The rivers are the main source of flood risk in the Wey and tributaries catchment; however other sources include surface water and groundwater.

Flood defences on the Hoe Stream protect the local community from the risk of flooding. The Environment Agency is investigating possible flood risk reduction measures that could be put in place along the River Wey at Godalming, Guildford, Old Woking, Byfleet and Weybridge and will

be investigating partnership funding to ensure we can take the preferred option to reduce the risk.

In key areas, we will support communities to prepare for risk through raising awareness of flooding, improving resilience and ultimately redevelopment. We want to safeguard natural floodplains to reduce the consequences of flooding.

Objectives:

These objectives are specific to this catchment and complement the objectives set out for the whole river basin district set out in Part A.

Social

- Reduce the impact of flooding through community awareness and flood response.
- To have a better understanding of the fluvial flood risk along the River Wey through detailed modelling.

Economic

- Ensure development and redevelopment in areas at risk of flooding is appropriate, does not increase flood risk and reduces the risk wherever possible.
- To reduce the risk of flooding where possible through the delivery of the 6 year programme.

Environmental

- Where practicable we will seek to re-establish and enhance natural river corridors through new development in line with the Water Framework Directive.

Measures across the Wey and tributaries catchment

Across the Wey and tributaries catchment there are 19 measures to manage flood risk. These measures are listed in full in Part C and include:

Preventing risk

There are 10 prevention measures to manage risk. These include:

- reducing flood risk through redevelopment
- working with the planning authorities to steer development to areas with the least risk of flooding
- support Guildford Borough Council in reviewing their Flood Risk Reduction Measures document as a reference document and develop Guildford Town Centre Master Plan
- continue effective maintenance of rivers through the regime of inspections and clearance set out in the system asset management plan

- developing detailed hydraulic modelling along the River Wey
- to improve the accuracy of the flood warning service by adding an additional river level gauge in Godalming

Preparing for risk

There are 4 preparation measures. These include:

- working with local resilience forum partners to improve the multi-agency response to flooding
- encouraging communities to produce flood plans
- reviewing flood warning and flood alert areas across the catchment

Protecting from risk

There are 4 protection measures, one to continue maintaining existing defences along the Hoe Stream and another to progress with the Initial Assessment of options to reduce flood risk in Godalming while exploring partnership funding opportunities for any schemes proposed.

Recovery and review of risk

There is 1 measure to deliver the recovery programme following the winter floods in 2014 through delivering the River Wey Channel Capacity Restoration Works.

Conclusions, objectives and measures to manage risk for other strategic areas in Thames river basin district

The following section considers the measures for the tidal Thames strategic area, which is the only Strategic Area identified in the Thames RBD:

4.1 The tidal Thames strategic area

Introduction to the tidal Thames strategic area

The tidal Thames strategic area covers the tidal Thames from Teddington in West London, through to Sheerness and Shoeburyness in Kent and Essex (see **Figure 22**). All of the measures contained within this section are recommendations taken from the [Thames Estuary 2100 Plan](#) (TE2100).

The TE2100 project, led by the Environment Agency, was formed in 2002 to develop a comprehensive action plan to manage tidal flood risk for the tidal Thames. Following many years of development and consultation, the plan was approved by Defra in 2012. The TE2100 Plan will ensure we continue to protect 1.25 million people and £200 billion worth of property at risk of tidal flooding in London and the Thames estuary, today and in the future.

Communities in London and along the Thames estuary benefit from world-class flood defences. The existing defences, which are already of a higher standard than anywhere else in the country, provide even greater protection to London and the Thames estuary than originally anticipated. Engineers planned for 8 millimetres a year sea-level rise, but sea-levels are currently rising by about 3 millimetres a year. However, increasing pressures mean that flood risk is increasing. The project undertook over 300 studies and investigations to look at how tidal flood risk is increasing in the Thames estuary due to: ageing flood defence structures; climate change and sea level rise; as well as more people living and working in the floodplain.

Our investigations have shown that we are unlikely to see major changes to the existing system for the next 25 years. But from 2035 we may need to upgrade the current tidal defence system, which will give opportunities to landscape the riverside so it's ready for the impacts of climate change.

Climate Change

The plan is based on current guidance on climate change, but is adaptable to changes in predictions for sea-level rise and climate change over the century. It was based on a relative sea level rise estimate of 90cm by 2100 but is adaptable to differing rates of sea level rise up to 2.7m, and an increase of 40% in peak river flood flows.

Habitats

The Environment Agency and Natural England identified that up to 1000 hectares of inter-tidal habitat will be lost due to 'coastal squeeze'. This is when habitat is squeezed between a flood defence and rising sea levels. We will be working with our partners and communities to find the best locations for habitat replacement.

Working with others

It's been a long journey since we started to develop the TE2100 plan in 2002. Our strong collaboration with partners and communities has been vital in developing a plan that will help people make the right flood risk management decisions for the future.

We are now looking at the most cost-effective way to implement the recommendations in the TE2100 Plan, starting with the first 10 years. But we can't manage future flood risk alone and will be working with partners and communities to find the best way to meet the future demands for flood risk management on the Thames estuary.

Thames Estuary Phase 1 Programme

The TE2100 plan covers the maintenance and improvement of tidal flood risk management structures and assets up to the end of the century. It has pioneered an adaptive approach that can be flexed depending on sea-level rise over the century. This is a world first that other countries are looking to learn from.

We will continue to maintain and improve the excellent standard of flood protection in the Thames estuary in accordance with the TE2100 plan. We are looking at the most cost-effective way to implement the recommendations in the plan - starting with the first 10 years. The first 10 year programme of work is the Thames Estuary Phase 1 (TEP1) programme.

Linking with the River Basin Management Plan

We are working collaboratively with other members of the Your Tidal Thames Catchment Partnership to develop plans to improve the ecology of the tidal Thames. We are working to better understand human impacts on the water environment and working with partners to resolve the issues we have identified. The priorities in the tidal Thames catchment are to make the estuary function more naturally, in particular through managed realignment and provision of intertidal habitat and to reduce diffuse and point source pollution as our understanding of pollutant origins improves. Wherever possible through delivery of this FRMP and our TE2100 plan we will seek improvements to the water environment through our work to manage flood risk.

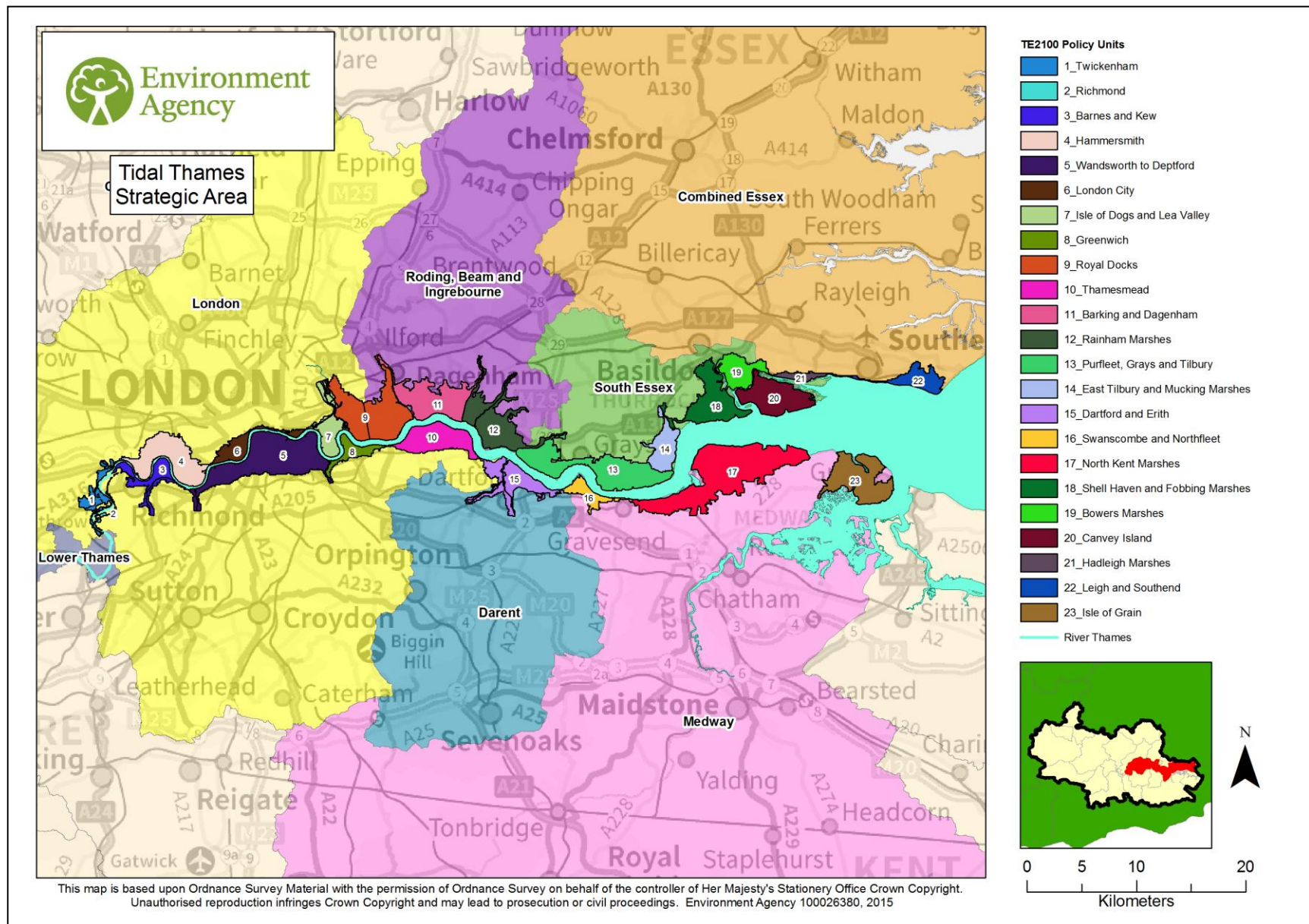


Figure 22: The tidal Thames strategic area showing the bordering management catchments and the TE2100 policy units

Conclusions and objectives for the tidal Thames strategic area

We have set out the following for the tidal Thames:

Conclusions:

The Thames tidal floodplain forms a corridor which passes through London and eastwards through north Kent and south Essex towards the North Sea. In addition to the large number of people who live and work on the floodplains, there are vital institutional and business centres and heritage sites in this area. These include the Houses of Parliament, central and local government buildings, the Canary Wharf business district, the Tower of London and the National Theatre. There are also major transport links and numerous schools, hospitals, power stations and other key sites.

The Thames estuary is the meeting place of the freshwater River Thames, its many tributaries and the North Sea. Every day, twice a day, the freshwater Thames which flows across Teddington Weir in west London is met by the incoming tide from the North Sea. The Thames estuary has an average daily rise and fall of water levels of 7m. In addition to the daily tides, the Thames estuary is prone to an increase in water levels caused by a North Sea surge. A surge tide entering the Thames estuary can increase water levels by 1 to 3 m and can be a major flood threat especially if this happens during a 'spring' tide when normal tide levels are higher.

Objectives:

The overarching objectives of TE2100 are:

- to adapt to the challenges that we will face from climate change
- to support and inform the land use planning process to ensure appropriate, sustainable and resilient development in the tidal Thames floodplain
- to protect the social, cultural and commercial value of the tidal River Thames, its tidal tributaries and its floodplain

Measures to manage risk across the tidal Thames strategic area

The TE2100 plan contains a total of 97 recommendations to manage tidal flood risk on the Thames to 2100. These recommendations are subdivided into 23 policy units which share similar flooding characteristics and assets at risk (see **Figure 22**).

Below we have set out how the plan recommendations fit into the categories of preventing, preparing for, protecting from and recovery and review of risk. These measures are set out in full in Part C.

Preventing risk

There are currently 8 recommendations which we will implement across the estuary to prevent risk. These are mainly concerned with preventing risk through development of a land strategy, riverside

strategies and floodplain restoration. There is also a significant focus on influencing the planning system to ensure new development is safe.

Preparing for risk

There are 35 recommendations to be implemented across the estuary to prepare for flood risk. These include preparing for flooding through improvements to the flood warning service, raising public awareness of flooding and emergency planning.

Protecting from risk

There are 42 recommendations to be implemented across the estuary to protect from flood risk. These are related to maintaining and improving tidal defences, including the Thames Barrier, as well as managing flooding from other sources.

Recovery and review of risk

There are 3 recommendations to be implemented across the estuary to recover from flooding and review the risk. These measures are around monitoring and maintaining the plan.

Other

There are 9 recommendations concerned with compensatory habitat creation. This is required to replace the habitat that will be lost over the life of the plan due to coastal squeeze. There is also one recommendation relating to the investigation of contamination issues.

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