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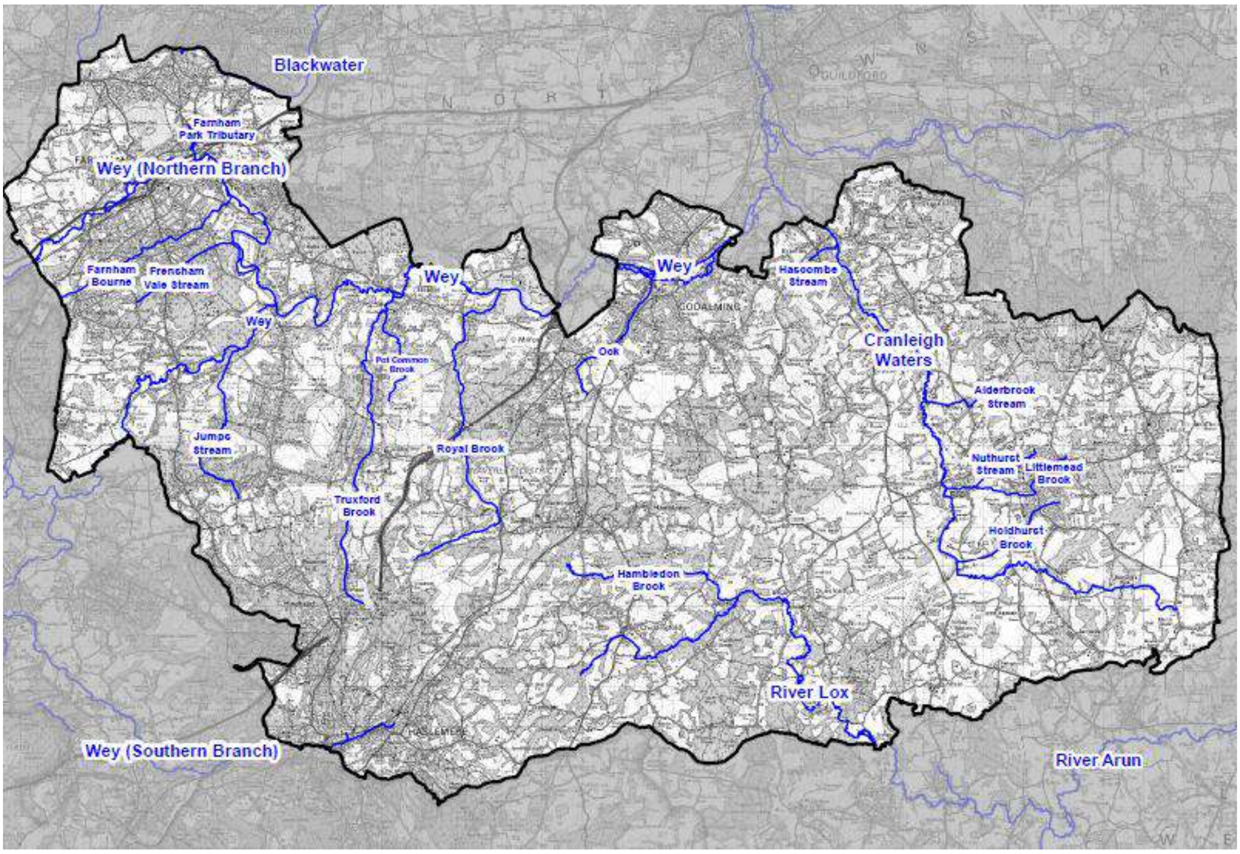
Waverley BOROUGH COUNCIL

Waverley Borough Council Strategic Flood Risk Assessment Final Draft Volume 1 Decision Support Document

July 2015



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Executive Summary

Introduction

This report is an update of the Strategic Flood Risk Assessment (SFRA) for Waverley Borough Council (WBC). The existing SFRA was produced in 2010, in line with the now superseded Planning Policy Statement 25 (PPS25). The updated report has been prepared in accordance with current best practice, the updated National Planning Policy Framework (NPPF) and its accompanying Flood Risk and Coastal Change Planning Practice Guidance (PPG). A number of new datasets, made available since the 2010 report, have also been used to update this SFRA. Based on the assessment of present and future flood risk in the Borough from all sources, the updated SFRA will assess the impact that development will have on flood risk. The SFRA enables WBC to select and develop sustainable site allocations away from vulnerable flood risk areas.

The new SFRA will also form a key evidence document to support the vision and approach the Borough's new Local Plan. This document has been created in response to the changes in guidance within the National Planning Policy Framework (NPPF) and its Planning Practice Guidance (PPG), which states that a sequential risk based approach should be applied to decision making at all levels of the planning process.

Structure of the SFRA

Volume 1	Volume 2	Volume 3	
Decision Support Document	**Technical Summary**	**Map Series**	
How to interpret the SFRA results and inform planning decisions	Provides the data and strategy to assess flood risk within Waverley	Provides a full suite of maps to support SFRA decisions	
Introduction	Introduction	Figure 1	Study Area
Flooding in Waverley	Catchment Summary	Figure 2	Flood Warning, Flood Alert and Flood Defences
Policy Context	Asset and Structure Data	Figure 3A	Historic Flooding from Rivers
The Sequential Test	Flooding from Rivers	Figure 3B	Historic Flooding from Surface Water
The Exception Test	Flooding from surface water	Figure 4	EA Flood Maps
Using the SFRA in development control	Flooding from Sewers	Figure 5	Hydraulic Model Outlines
Drainage of Development Sites	Flooding From Groundwater	Figure 6	Climate Change
Future Flood Risk Management Practices	Flooding From Artificial Sources	Figure 7	SFRA Flood Zones
SFRA Maintenance and Management	Uncertainties in Flood Risk Assessment	Figure 8A	Flood Risk for Surface Water (extent)
Recommendations	Summary	Figure 8B	Flood Risk for Surface Water (hazard)
References		Figure 9	SuDS Suitability
Glossary		Figure 10	Flood Risk from Sewers
		Figure 11	Susceptibility to Groundwater Flooding
Appendix A – Data Register		Figure 12	Flood Risk from Artificial Sources

Summary of Flood Risk in Waverley

Type of Flood Risk	Discussion of key areas at risk	Further Information in this SFRA
From rivers	Within Waverley, much of the floodplain is rural and remains undeveloped. Within Farnham, Godalming, Tilford, Milford and Cranleigh, there is development that extends to the maximum outlines of areas identified as high risk. It is important that development remains out of the high risk functional floodplain. Developed areas that have been identified as high risk from previously reported flood incidents and the SFRA Flood Zones are: • Milford: Station Lane, Jubilee fields, Lower Millhouse Lane. • Witley: Oxted Green, Haslemere road, Gasden Lane, New Road, Middlemarch; • Farnham: Light industrial areas between the A325 and A31; • Bramley: Station Road; • Cranleigh: B2130 at Rye Farm, Cranleigh CofE Primary and Glebelands Schools, Rowland Road, Summerlands and The Riding; • Millbridge: A287 at Millbridge Court.	Volume 1 – Chapter 2 Volume 2 – Chapter 4 Volume 3 – Figures 3A, 4, 5, 6 and 7.
From surface water	There are very few areas at medium to high risk of surface water flooding (depth and velocity) within the Waverley Borough Council area. The areas that are identified are mostly located along the natural watercourses, but in certain places, road junctions and development is expected to exacerbate surface water flood risk. These locations include: • Areas adjacent to the railway line at Godalming station; • The junction between A3100 and Bridge street; and • The A287 at Millbridge Court.	Volume 1 – Chapter 9 Volume 2 – Chapter 5 Volume 3 – Figures 3B and 8
From sewers	The urban areas of Godalming, Farnham and Cranleigh are at an increased risk of sewer flooding, due to the increased density or the sewer network and proportion of culverted channels and combined sewer drainage systems. This aligns with historic data that shows properties within GU7, GU9 and GU6 reporting the most incidents of internal and external sewer flooding. Smaller settlements may be at a medium risk of sewer flooding, depending largely on the maintenance of the drains and influence of surface water runoff. The more rural areas across the Borough are at low risk of sewer flooding.	Volume 2 – Chapter 6 Volume 3 - Figure 10
From groundwater	In the south east of the Borough, there is a very low risk of groundwater flooding due to the underlying relatively impermeable clays and mudstones. Along the north western boundary, groundwater flood risk is also likely to be very low. In the predominantly rural areas to the west of Haslemere and to the north of Hambledon and Wormley, there is a low risk of flooding away from the river valleys, where underlying geology is mostly Lower Greensand Formations. Along the river channels, fluvial deposits and high water tables mean that the areas in the north of	Volume 2 – Chapter Volume 3 - Figure 11

	Godalming, Elstead and through Farnham town centre, there is likely to be a high risk of groundwater flooding, as indicated by the BGS groundwater susceptibility datasets. Large areas of impermeable surfaces in urban areas may affect the occurrence of groundwater flooding.	
From artificial sources	The Environment Agency Reservoir Inundation Maps show the following areas at risk of reservoir flooding • Jumps stream and Wey South Branch at Millbridge,downstream of the Frensham Great and Little Ponds • River Wey at Elstead, downstream of the Frensham Little Pond • River Wey in northern Godalming, downstream of the Enton upper Lake • River Ock at Mousehil, downstream of Johnson's Lake • Length of the Cranleigh Waters downstream of Vachery Pond Although the extents of areas at risk are large, most of the areas are at low risk Due to predominantly rural land and a low probability of occurrence.	Volume 2 – Chapter 8 Volume 3 – Figure 12

Objectives of the SFRA

The main objectives of the Waverley SFRA are to:

- Provide an evidence base for the application of the risk based Sequential Test to support planning decisions, in line with NPPF;
- Be strategic by covering a wide spatial area and looking at flood risk today and in the future;
- Support sustainability appraisals of the under development local plan;
- Identify what further investigations may be required in flood risk assessments for specific development proposals.

This SFRA is a live document that is intended to be updated as new information and guidance become available. The outcomes and conclusions of the SFRA may not be valid in the event of future changes to the data or the baseline flooding situation. Decisions also require the inclusive assessment of wider planning issues and the user should be aware that changes to decision making principles affecting other planning issues can potentially affect the outcome of the risk based Sequential Test. It is the responsibility of the user to ensure they are using the best available information.

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1 Introduction

1.1 Background

A Level 1 Strategic Flood Risk Assessment (SFRA) was prepared on behalf of Waverley Borough Council (WBC) in 2010. The information in the 2010 SFRA was used at the time to inform the Local Development Framework (LDF), land allocations, and policies regarding catchment wide flooding issues. The 2010 SFRA also provided information required to apply the Sequential Approach and Sequential Test on the Local Development Document scale. The SFRA was developed in line with the now superseded Planning Policy Statement 25 – Development and Flood Risk (PPS25) (DCLG, 2006)[1].

Capita Property and Infrastructure were commissioned in December 2014 to update the Level 1 SFRA document. This updated decision support document provides information on how to interpret the Waverley SFRA results to inform land use planning, flood warning and emergency planning and development control. The document also provides guidance for site-specific Flood Risk Assessment (FRA). The document requires the user to refer to technical information and flood maps contained in Volumes 2 and 3 of this SFRA.

The 2010 SFRA information was largely retained although several updates and reviews were carried out. The following summaries the scope of works for this updated document:-

- Identify policy updates since 2010 in particular the introduction of National Planning Policy Framework (NPPF)[2] and the Planning Practice Guidance (PPG) for Flood Risk and Coastal Change[3]
- Review any post 2010 flood incident data;
- Identify updates related to new datasets, including the Updated Flood Map for Surface Water (uFMfSW) and the risk from groundwater flooding;

The release of Planning Policy Statement 25 (PPS25): Development and Flood Risk in December 2006 (DCLG, 2006) emphasised the responsibility that LPAs have to ensure that flood risk is understood and managed effectively using a risk-based approach as an integral part of the strategic planning process. PPS25 encourages Local Planning Authorities (LPAs) to undertake SFRAs and to use their findings and those of other studies to inform strategic land use planning. The NPPF replaced the suite of Planning Policy Statements, including PPS25, on 27 March 2012.

The NPPF states that, *"A Strategic Flood Risk Assessment is a study carried out by one or more planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of climate change, and to assess the impact that changes or development in the area will have on flood risk".*

The NPPF and PPG maintain the requirement to apply a risk-based, sequential approach to the location of development in order to avoid flood risk to people and property. The key difference for flood risk policy compared to PPS25 is that the NPPF gives local authorities a wider remit to interpret and implement local policies. This makes the SFRA process all the more important in establishing suitable, reasonable and practical local development policies to manage local flood risk. Chapter 3 of this document contains further discussion on the introduction of NPPF and its implications for the management of flood risk.

The PPG for Flood Risk and Coastal Change recommends that SFRAs are completed in two consecutive stages. This provides the LPA with tools throughout the Local Plan and SFRA process sufficient to inform decisions regarding development sites. The two stages are: -

[1] Planning Policy Statement 25: Development and Flood Risk, March 2010.

[2] National Planning Policy Framework, March 2012

[3] Planning Practice Guidance Flood Risk and Coastal Change, March 2014

- Level 1 SFRA – Study Area Flood Source Review & Sequential Test
- Level 2 SFRA – Development Site Assessments for Exception Testing

The results of the Level 1 SFRA should enable WBC to identify where development is appropriate according to NPPF. The Level 1 SFRA should therefore enable a prompt start to the commencement of Level 2 SFRA (where required). The data review element of Level 1 enables a robust specification and programme to be developed for a Level 2 SFRA. At the time of writing WBC were currently preparing Part 1 of their Local Plan (Strategic Policies and Sites) which will set out the vision and approach to development to 2031. Following the completion of Part 1, WBC will be in a position to understand if there is a requirement to undertake a Level 2 SFRA to support Part 2 of the Plan (Development Management and Site Allocations).

1.1.1 Level 1 – Study Area Flood Source Review and Sequential Test

A Level 1 SFRA presents sufficient information to enable the LPA to apply the Sequential Test to determine potential development sites. The Level 1 SFRA is based on existing published information held by local stakeholders. It provides background information, a review of local policies, and guidance for site specific flood risk assessment and the potential for application of Sustainable Drainage Systems (SuDS). The review of policies is aligned to guidance on the requirements for site-specific FRAs throughout the study area.

The outcomes from the Level 1 SFRA should be used by the LPA to identify the most suitable locations for development in line with NPPF and other planning drivers. Where sites cannot be allocated in accordance with NPPF, they should not be promoted as site allocations. Only where there are no other reasonably available sites should development be considered in areas at higher risk of flooding. This report presents the information that has been generated during this Level 1 of the SFRA.

1.1.2 Aim of the SFRA

The aim of the SFRA is to present sufficient information to enable WBC to apply the Sequential Test (explained further in Section 4). In addition the SFRA should form a reference document for use by WBC in determining planning applications on windfall and allocated sites.

1.2 SFRA Objectives

In keeping with guidance presented in the NPPF and its accompanying Technical Guidance (Flood Risk and Coastal Change Planning Practice Guidance (PPG) the objectives of the WBC Level 1 SFRA are:

1. Identify the extent of all Flood Zones;
2. Identify areas at risk of flooding from all flood sources present in the study area, providing WBC with the tools required to apply the Sequential Test;
3. Provide evidence-based report which inform WBC's Local Plan and other Development Plan Documents about managing potential flood risk which are also suitable to inform the Sustainability Appraisal of related documents;
4. Advise WBC on suitable policies to address flood risk management in a consistent manner across its administrative area;
5. Advise WBC on the requirements of site specific flood risk assessments based on local conditions and policy recommendations;
6. Advise WBC on the principles, objectives and applicability of Sustainable Drainage Systems (SuDS) throughout the study area; and
7. Present information to inform WBC of the flood considerations necessary in developing and progressing flood emergency planning.

Note, the objectives outlined above remain the same as the 2010 Level 1 SFRA, but have been updated to account for policy changes.

2 Flooding In Waverley

2.1 Description of the Study Area

The Waverley SFRA covers the administrative area of Waverley Borough Council, an area of 344km² as shown in Volume 3 Figure 1 and below in Figure 2-1.

The study area covers three main river catchments, primarily that of the River Wey (including the north and south branches of the River Wey, and Cranleigh Waters), secondarily the River Lox tributary of the River Arun and, the upper reaches of the River Blackwater form part of the northern boundary.

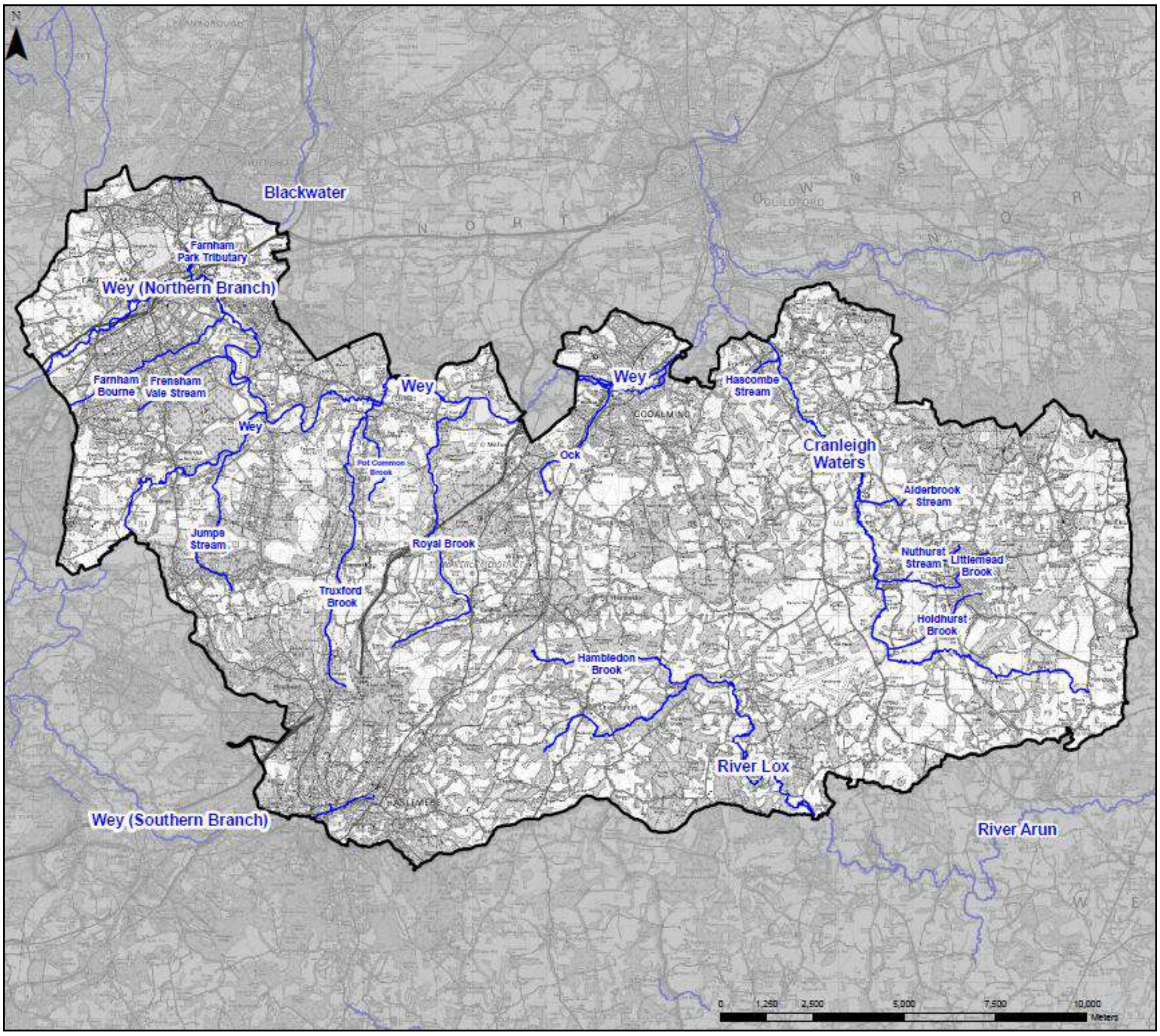

Figure 2-1: Waverley Study Area

The River Wey catchment covers the majority of the study area to the south of Guildford and Aldershot, incorporating the main urban areas of Godalming, Farnham, Haslemere and Cranleigh. The Wey drains into the River Thames at Weybridge to the north of Waverley, having passed through Guildford and Byfleet. The

River Lox is located within the study area to the east of Haslemere, draining the central-southern study area that includes the villages of Hambledon, Chiddingfold and Dunsfold. The River Lox drains into the River Arun at Drungwick, due south of Cranleigh external to the borough. The Blackwater catchment is located to the south west of London and bounds Waverley between Badshot Lea and Aldershot, draining a small part of the borough in the Badshot Lea and Weybourne area. The Blackwater drains into the River Loddon to the south of Reading. The River Loddon flows into the River Thames to the east of Reading.

The study area is predominantly rural but with a number of well defined settlements, the largest of which are Farnham, Godalming, Haslemere and Cranleigh. However, there are also a significant number of large and small villages throughout the study area.

The topography is variable across the catchment, ranging from 250m to 40m AOD. Elevated areas include Haslemere and Hindhead in the south west of the study area, and low areas are associated with watercourse corridors within Cranleigh, Dunsfold, Bramley, Wonersh, Shamley Green and Farncombe. Volume 2, Section 2.2 provides further details on the topography of the area.

Two main rock types characterise the catchment; the north and northeast is underlain by Lower Greensand sandstone formations, with several sub groups of mudstone, limestones and chalk bands. The Farnham Bourne and Frensham Vale stream tributaries define the boundary between these units and the Wealden Clay formations in the south and south west of the study area. Volume 2, Section 2.3 discusses the geology of the area in more detail.

There are a number of important transport links located within the Waverley SFRA area. These include the A3 and A31 A-roads and the London – Guildford – Portsmouth and Farnham – Aldershot - London railway lines. The London – Guildford – Portsmouth line has five stations within the study area at Haslemere, Milford, Witley, Godalming and Farncombe. These transport links cross main rivers in several places within the upper and middle reaches.

Additional features of the study area are the artificial water bodies of the Frensham Great Pond and Broadwater Lake reservoirs (registered under the Reservoirs Act 1975) and the Wey and Arun Canal. The Frensham Great Pond is located approximately 6.5km south of the centre of Farnham and Broadwater Lake approximately 2km north of Godalming. The Wey and Arun Canal is located between the River Wey and the River Arun, trending south, crossing the study area within close proximity to the villages of Bramley, Cranleigh and Dunsfold. There is an ongoing project to restore and rebuild parts of the canal, including locks and aqueducts, although stretches remain discontinuous. Volume 2, Chapter 8 discusses the canal and reservoirs in more detail.

The 2009 River Basin Management Plans have been used to identify the ecological status of the main river channels. The Ock has a good ecological status. The Wey North Branch through Farnham and the Oackhanger Stream have a moderate ecological status. The Wey branch from Tilford to Shalford has a poor ecological status. The Cranleigh Waters have a bad ecological status

2.2 Sources of Flooding

SFRAs are used to refine information on areas that may flood, taking into account flooding from rivers and all other sources of flooding and the impacts of climate change, in addition to information on the Flood Map (NPPF, 2012). Volume 2 of this SFRA is a technical assessment of the flood risk in Waverley. Below are summaries of the different types of flood risk within the borough, although the relevant chapters and associated risk maps in Volumes 2 and 3 should be referred to for more detail.

Flood Risk from Rivers – Volume 2, Chapter 4

Flooding from rivers occurs when the volume of water in a river exceeds the capacity of the channel. The two largest rivers in the study area are the Wey, specifically the south and north branches and Cranleigh Waters tributary, and the River Lox. The catchments of the main rivers through the study area are predominantly rural however, a number of the Wey tributaries flow through the urban areas of Haslemere, Farnham, Godalming and Cranleigh. All the main rivers within the study area have been known to have flooded in the past, (most recently in Winter 2013/14) although the extent and implications of the flood events are variable depending on the location of flooding. The areas at notable flood risk from rivers are within northern Farnham, including sections of the railway and A31, central Godalming, Milford, Elstead and Cranleigh.

Flood Risk from surface water – Volume 2, Chapter 5

Flooding from surface water runoff can result from under capacity of drainage systems and blockage of pipes, or alternatively due to the presence of saturated ground after prolonged wet periods, reducing infiltration and increasing runoff. The urban drainage issue is most prevalent in the major urban centres and has been known to lead to flooding within towns in the study area including Farnham and Godalming. The second issue is more likely to happen in rural areas where, following prolonged rainfall, water ponds on the surface. This can happen across the study area but is more likely to occur within the lower lying topography regions of the study area. Where rainwater is drained into surface water sewers or combined sewers flooding can result when the volume of water received by the sewer exceeds its capacity. This can be due to under capacity, blockage or the occurrence of an event greater than the design event for the sewer network. Areas of steep ground have the potential to generate runoff which can present a flood source. The steep topography in parts of the study area may present a flood source to areas down slope of them. The majority of Waverley is shown at low risk of surface water flooding, with the south eastern, lower lying areas and northern more developed areas being at medium to high risk. This includes parts of Farnham, Godalming, Cranleigh, Ewhurst and to a lesser extent Chiddingfold and Haslemere within the southeast; and Farnham, Badshot Lea and Godalming in the more urbanised north.

Flood risk from sewers – Volume 2, Chapter 6

When flooding occurs from combined sewers there is a high risk of the flood water being contaminated with raw sewage. In the study area this type of flooding is more likely to occur in dense urban areas, which could include Farnham, Godalming, Haslemere and Cranleigh.

Flood risk from groundwater – Volume 2, Chapter 7

Groundwater flooding occurs when the groundwater table rises to levels, which causes emergence at the surface. This is most likely to occur within the central, northern and north west parts of the study area where the bedrock geology is predominantly sandstones, mudstones and siltstones. Therefore, groundwater has the potential to affect a moderate area of the catchment. Areas identified at high likelihood are generally to the north and west of the borough and include Godalming, Farnham, Badshot Lea, Elstead and Hambledon. External to this trend, Cranleigh, towards the east of the borough, is also shown as having a higher potential for groundwater flooding to occur at the surface.

Flood risk from Artificial Sources – Volume 2, Chapter 8

Artificial sources of flooding include reservoirs, canals or lakes that are above the natural ground level. Flooding may occur as a result of any impoundment structure (such as a dam, sluice or raised bank) being overtopped or failing. This can cause significant threat to life and property as flooding can occur very quickly with little warning and can result in deep fast flowing floodwaters. In the study area this risk comes from several artificial water bodies and reservoir sites, these include the Frensham Great Pond, Frencham Little Pond and Broadwater Lake. Other privately owned artificial water bodies in the borough include The Tarn, Enton Upper Lake, Thursley Lake, Enton Lower Lake, Vachery Pond, Upper Lake, Rowe’s Flashe Lake, Lower Busbridge Lake, Frensham Little Pond and Johnson’s Lake. The Wey and Arun canal which runs through the east of the borough presents flood risk at sections where it is raised above the surrounding topography and therefore embanked. The probability of a breach in the embankments of these artificial flood sources is considered very low.

Maps outlining the expected areas of flooding for each type can be found in Volume 3.

2.3 Historic flooding

Historic flooding records indicate that the study area has been affected by several major storms that have caused several watercourses to burst their banks. This includes the River Wey and River Blackwater, and the major tributaries, River Lox and Cranleigh Waters. Notable periods of catchment-wide flooding include 1968, 1990 and Winter 2013/2014. The extent of these floods are shown in Volume 3, Figures 3A and 3B, which further includes Wetspot data from Surrey County Council and fluvial flood events recorded by local Parish Councils and recorded flood outlines from the Environment Agency. A significant proportion of the historical flood cases have occurred in rural areas where little risk to people or property exist, however, some have resulted in damage to property, infrastructure and inundation of roads.

Areas within the study area which have experienced recurring fluvial-source flood events include Badshot Lea, from the River Blackwater, Farnham, Elstead and Godalming, from the River Wey, Chiddingfold from the River Lox and Bramley from Cranleigh Waters. More recently, significant winter flooding occurred during 2013/2014. Seven areas were identified as 'hotspots' for flooding during the Christmas period[4] (24th December 2013 to 6th January 2014). These include:

- Clappers Meadow, Alford
- Loxwood Road, Alford
- Nightingales, Cranleigh
- The Ridgeway, Cranleigh
- Dunsfold Road, Dunsfold
- Gasdon Lane (Webb Road) Witley
- Fisher Rowe Close, Bramley
- High Street, Bramley
- Ridgley Road, Chiddingfold
- Gasden Lane, Witley
- Catteshall, Godalming
- Elstead Mill and Spring Haven area
- Springfield Way, Elstead

Groundwater related flooding is an issue in this catchment due to the significant area of permeable Lower Greensands (sandstone, mudstone and siltstone) bedrock geology in the central, northern and north west areas of the study area. The 2010 SFRA reviewed records that indicated groundwater flooding has occurred historically in Upper Hale, Godalming, Elstead, Churt, Shottermill, Wormley, Witley, south of Busbridge, and Cranleigh. Very few groundwater flood incidents are reported (often reported as surface water flooding). No information on groundwater flooding since 2010 was provided as part of this update.

Flooding from land and sewers occurs periodically in the catchment. Under capacity or blocked drainage is often the cause and it has been recorded as happening primarily within urban environments but also, to a lesser extent, within rural environments. Across the study area surface water runoff is potentially an issue with the more developed areas and due to the impermeable soil and geology in the south and east of the catchment. Frequent surface water flooding occurs in the urban areas of Farnham and Haslemere due to surface water drainage systems becoming overwhelmed. The limited capacity of the drainage network is further reduced due to blockages in the network. Information has also been provided by the Town and Parish Councils regarding historic surface water flooding incidents, represented in Volume 3, Figure 3A and 3B. Areas of note are Milford, Witley, Elstead, Bramley and Ewhurst, with high levels of reports on surface water flooding.

Wetspot data from Surrey County Council and WBC highlight potential inadequacies in the capacity of sewage systems during times of intense rainfall and surface water runoff sewers that are unable to contain the flow. Certain roads, which do not intersect rivers can be identified as hotspots for this, and include

[4] Review of Flooding in Waverley, Community overview and scrutiny committee, June 2014

Petworth Road, the B2130, Hambledon Road and Thursley Road. This is also particularly notable in the urban areas of Farnham, Godalming, Haslemere and Cranleigh.

Areas within the catchment with the most documented flooding problems (from any of the sources of flooding) include Godalming, Cranleigh, Chiddingfold, Farnham and Bramley. Flooding is not restricted to these areas and a more detailed review of historic flooding in the study area is provided in Volume 2 for each source of flooding.

2.4 Probability of flooding

The probability of fluvial (river) flooding is described in this SFRA using the Annual Exceedance Probability (AEP). This is sometimes known as the 'annual probability' of flooding. A flood event described as a 1% AEP has a 1% (or 1 in 100) chance of occurring in any given year. This could alternatively be described as a 100 year return period flood event, that is, it is an event that is likely to occur, on average, once every 100 years. A flood with a 1% AEP is a larger (but less frequent) event than a flood with a 5% AEP.

The assessment of risk from fluvial sources in this SFRA is focused on four different probability flood events summarised below in Table 2-1.

Table 2-1: Fluvial flood events considered in this SFRA

Annual Exceedance Probability (AEP) of flood event	Return Period of flood event	Use in this assessment
0.1 % AEP	1 in 1000 years	Used in the assessment of the risk of fluvial flooding for the • Lower Wey (2009)
1%+CC AEP	1 in 100 years plus Climate Change	Used in the assessment of the risk of fluvial flooding for the • Lower Wey (2009) • River Blackwater (2007) • Upper Wey (2006)
1% AEP	1 in 100 years	Used in the assessment of the risk of fluvial flooding for the • Lower Wey (2009) • River Blackwater (2007) • Upper Wey (2006)
5% AEP	1 in 20 years	Used in the assessment of the risk of fluvial flooding for the • Lower Wey (2009) • River Blackwater (2007) • Upper Wey (2006)

Note, the year indicates when the detailed modelling along these main watercourses was carried out.

2.5 Functional Floodplain Definition

The Functional Floodplain comprises land where water has to flow or be stored in times of flood. In line with NPPF, all new development should be kept outside of the Functional Floodplain, with the exception of certain ‘water compatible’ land uses (e.g. recreational and conservation uses), as well as essential transport/utilities infrastructure that have no viable alternative location. The Exception Test must be passed for essential infrastructure developments to take place within all or part of this zone. For the purpose of this SFRA the 5% AEP flood outline has been used across the whole study area as an indication of those areas which may be acting as Functional Floodplain. Not all watercourses within the Study Area have been modelled in detail and, where the 5% AEP flood outline is unavailable, the Environment Agency flood zone 3 outlines have been used to define the functional floodplain.

Table 2-2 – Model results and outlines used to define SFRA Flood Zones

SFRA Flood Zone	Outlines used for definition
SFRA Flood Zone 3b	Modelled 1 in 20 year event; if unavailable - EA Flood Zone 3
SFRA Flood Zone 3a	Modelled 1 in 100 year event minus the modelled 1 in 20 year event
SFRA Flood Zone 3	Modelled 1 in 100 year plus Climate Change event; if unavailable - EA Flood Zone 3
SFRA Flood Zone 2	Modelled 1 in 1000 year event; if unavailable - EA Flood Zone 2

2.6 Fluvial Flood Risk Maps

Three principal sets of flood risk maps showing river flooding are included in this SFRA. It is important to understand the differences between the three sets of maps.

1. Firstly, Volume 3 Figure 4 contains the “Environment Agency Maps for Planning”. The EA Maps provide a broad indication of areas that may be at risk of fluvial flooding. The Flood Maps for Planning are provided to Local Authorities by the EA, are updated on a regular basis, and provide a good starting point for the assessment of flood risk. The Flood Zone Maps show areas that may be within the 1 in 100 year (flood zone 3) and 1 in 1000 year (flood zone 2) return period fluvial flood extents. They do not consider the impacts of climate change and they do not sub-divide Flood Zone 3 (the high risk zone based on the 1 in 100 year return period floodplain) into Flood Zones 3a and 3b (the Functional Floodplain) as this breakdown is set by local planning authorities based on local appropriate evidence. Consequently the definition can vary from borough to borough.
2. The second set of fluvial flood risk maps can be found within Volume 3 Figure 5 and are titled “Detailed Hydraulic Model Flood Outlines”. These maps are based on detailed river modelling event outlines for the River Blackwater (2007), the Lower Wey (2009) and the Upper Wey (2006), as set out in Table 2-1. The legend identifies the year that the modelling was completed and whether the defended[5] or undefended[6] outlines are shown. Further information on the modelling packages is available in Volume 2, Chapter 4.
3. The third set of fluvial flood risk maps detail the Flood Zone definitions for use in the SFRA. According to the definition set out in Table 2-2 of this document, these maps show the SFRA Flood Zone 3b, SFRA Flood Zone 3a where possible and SFRA Flood Zone 2. These maps can be found within Volume 3, Figure 7, and provide detailed information to assist WBC in applying the Sequential Test. **These maps should be used as the starting point for the Sequential Test, as they include the definition of Flood Zone 3b.**

[5] Modelling scenario including the presence of defences along the watercourse

[6] Modelling scenario discounting the presence of defences along the watercourse

Volume 2, Chapter 4 provides further information and analysis of the flood risk across the Borough.

2.7 Climate Change

There is increasing concern about the impacts of climate change on the global environment. The nature of climate change at a regional level will vary. In the UK projections indicate more frequent, short duration, high intensity rainfall and more frequent periods of long duration rainfall of the type responsible for the summer 2000 and winter 2013 floods. These changes are likely to result in the more frequent occurrence of all types of flooding, including fluvial, surface water, sewer and groundwater flooding. All are relevant to the Waverley SFRA study area.

The potential impacts of climate change are an important aspect of uncertainty relevant to flood risk estimation. NPPF and PPG suggests that the impacts of climate change can be managed by either monitoring change in risk and adapting in the future as the need arises (Managed Adaptive Approach) or acting now to manage the eventuality (Precautionary Approach).

NPPF requires that climate change is considered as part of the spatial planning process, and as such is considered as part of this SFRA. Where detailed modelling is available, the 1% AEP plus climate change outline has been mapped to show increased flood risk from climate change. These results were produced within the modelling by adding 20% of the inflows of the 1% AEP event. These are shown in Volume 3, Figure 6.

3 Policy Context

This section provides an overview of the roles and responsibilities of those involved with water management and the planning policy framework relevant to the WBC study area for flood and/or water management.

3.1 Role and Responsibilities

3.1.1 Environment Agency

The Environment Agency has an overarching objective is to protect and enhance the environment in England. Their role involves issues such as flood risk, water quality, water resources, biodiversity and mineral and waste regulators. With regards to water management the Environment Agency has a statutory duty to:

- Maintain or improve any watercourses which are designed as Main Rivers;
- Install and operate flood warning equipment and provide flood warning services;
- Provide Flood Warning Services where appropriate;
- Issue Flood Defence Consents[7];
- Control actions by riparian owners and occupiers which might interfere with the free flow of watercourses; and,

Statutory powers mean that the Environment Agency has powers to maintain watercourses and other activities listed above. *They are not required by law to provide a flood warning service but they do have powers to do this on a best endeavour basis. The Environment Agency maintain their assets but are not required by law to maintain privately owned defences.*

The Development Management Procedure Order 2015 (DMPO) and Environment Agency's Flood Risk Standing Advice (FRSA) has been revised (April 2015). The FRSA for planning authorities[8] and FRSA for developers[9] provides substantive responses to councils on lower risk planning applications in regards to flood risk issues only. Bespoke comments on other non flood related issues may also be provided.

3.1.2 Lead Local Flood Authority – Surrey County Council

Surrey County Council (SCC) is the Lead Local Flood Authority (LLFA) for Waverley and it has the 'lead' role in managing flood risk from surface water, groundwater and ordinary watercourses across the county. This involves close working with key partners involved in flood and water management for this geographic area, known as Risk Management Authorities. As the LLFA, SCC has powers to maintain Ordinary Watercourses. Ordinary Watercourses are all river channels not defined as Main Rivers, as set out in the EA "Living on the Edge" document[10]

As the LLFA, the main duties and responsibilities of SCC include:

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[7] Any proposed developments or works within 8 meters of a watercourse designated as a main river requires flood defence consent from the environment agency

[8] https://www.gov.uk/flood-risk-assessment-local-planning-authorities

[9] https://www.gov.uk/flood-risk-assessment-for-planning-applications

[10] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/403435/LIT_7114.pdf

- Applying and monitoring the Local Flood Risk Management Strategy. This will be guided by the Environment Agency's National Flood and Coastal Risk Management Strategy.
- Cooperating with other Risk Management Authorities within SCC, including the 11 other districts and boroughs, water utility companies, the Environment Agency and others.
- Maintain a register of local structures and features that are likely to have a significant effect on flood risk.
- In the event of a significant flood, investigate to an appropriate level whether the relevant flood risk management functions were exercised correctly.
- Contribute towards sustainable development when exercising a flood risk management function.
- Statutory consultee on planning applications from 15th April 2015 for 10 houses or more (or equivalent other types of development) with regard to surface water management

The Environment Agency will only provide high level advice on surface water flooding. Woking Borough Council has an informal agreement with Surrey County Council to review and provide comments on major planning applications in relation to surface water drainage designs. Woking Borough Council will also provide guidance on the maintenance and adoption of drainage schemes.

3.1.3 Local Planning Authority – Waverley Borough Council

WBC is responsible for determining planning applications, requiring consultation with the Environment Agency in areas of flood risk.

Following changes in National Planning Policy (outlined in Section 3.3.3), WBC as the LPA are responsible for local planning policies and decisions on planning applications relating to major development. WBC will also have to ensure that sustainable drainage systems for the management of run-off are put in place, unless demonstrated to be inappropriate. The LLFA acts as a statutory consultee and WBC should consult SCC on the management of surface water and satisfy themselves that the proposed minimum standards of operation are appropriate. It should be ensured through the use of planning conditions or planning obligations that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

The Environment Agency may provide high level advice on surface water flooding. WBC will provide guidance on the maintenance and adoption of drainage schemes.

WBC also maintains sections of the main river, following responsibilities as the riparian owner, along parts of Hell’s Ditch which passes through Lammas Land in Godalming.

The flow chart below outlines how the relationship with the LLFA and the LPA will work in practice.

SCC will provide a technical assessment of the proposed surface water drainage system (including any proposed SuDS) to WBC within 21 days

WBC will consult with SCC if WBC identifies there are any surface water drainage implications for the proposed major development

WBC will consider SCC's response as part of determining the planning application and will put in place robust and sustainable arrangements for the maintenance of SuDS

3.1.4 Sewerage Undertakers

Sewerage undertakers are responsible for surface water and foul drainage from developments, where this is adopted via adopted sewers. Thames Water is the sewerage undertakers within the study area.

The Flood and Water Management Act 2010 is set to remove the automatic right to connect to public surface water sewers. This may require developers to provide more justification than is currently required in order to connect to the Thames Water. It may in future be necessary to provide evidence that surface water runoff cannot be appropriately managed within the site through the use of soakaways or direct discharge to surface water in order to gain approval for connection to the public surface water sewer. Additionally, they have a role of providing information to LPAs so that an SFRA takes into account any areas of critical drainage problems.

Updates to the Planning Practice Guidance in April 2015 highlight that sewerage undertakers are not statutory consultees, however WBC are advised to consult with Thames Water on all planning applications that are proposing to discharge to their network.

The consultation states that the "Strategic Flood Risk Assessment would be expected to include consideration of the provision and suitability of sustainable drainage systems across the local area". Volume 2 provides details of the Infiltration SuDS Map (detailed) developed by the British Geological Survey (BGS). The dataset provides subsurface information enabling preliminary assessment of the ground for infiltration SuDS. This dataset will assist developers, planners and WBC who need to assess the properties of the ground directly, or assess planning applications for SuDS.

3.1.5 Highways England

Highways England is responsible for maintaining motorways and major (trunk) roads throughout England. This includes the upkeep of the surface water drainage infrastructure associated with the road network. Waverley contains no motorways, but major roads within the study area include the A3 and the A31.

3.1.6 Landowners

A riparian owner is someone who owns land adjacent to a watercourse. By law, it is the riparian owner who is responsible for maintaining a watercourse. These responsibilities are outlined in the Environment Agency's **'living on the edge'** document[11]. The key responsibilities associated with flood risk are set out online, which can be found through the following hyperlink:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/403435/LIT_7114.pdf

3.2 European Policies (EU)

3.2.1 Water Framework Directive

The EU Water Framework Directive (WFD) seeks to restore and improve water quality in rivers, coastal waters and groundwater in an integrated way. It also seeks to achieve 'good ecological status' of water bodies through integrated river basin management. The implications of the WFD on flood risk are likely to include controls on the type of flood alleviation schemes that can be implemented ensuring that any flood alleviation scheme should contribute to achieving 'good ecological status' through deculverting, increasing fish passage and restoration of floodplains to their natural state and purpose.

3.2.2 Floods Directive

The European Directive on the Assessment and Management of Flood Risks (European Union, 2007) came into force on the 26th November 2007, and was transposed into English and Welsh law as the Flood Risk Regulations in December 2009. It requires EU Member States to consider the potential impacts that domestic policies might have on flood risks and the management of flood risks to neighbouring member states. It recognises that objectives regarding the management of flood risk should be determined by the Member States themselves and should be based on local and regional circumstances.

The directive requires Member States to designate competent authorities to implement the directive; for England, this is the Environment Agency. The directive requires the following elements to be undertaken:

- Preliminary Flood Risk Assessments to identify areas that are at potentially significant flood risk, to be completed by 20 December 2011;
- Flood hazard maps (showing the likelihood and flow of the potential flooding) and flood risk maps (showing the impact), to be completed by 20 December 2013;
- Flood risk management plans (showing measures to decrease the likelihood or impact of flooding), to be completed by 22 December 2015; and
- Updates every six years thereafter that take into account the impact of climate change.

The Surrey Preliminary Flood Risk Assessment (2011) confirmed that part of the County Council's administrative area is in a significant Flood Risk Area (The London Indicative Flood Risk Area) and is therefore required to deliver flood hazard / risk maps and a flood risk management plan under the Regulations.

[11] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/403435/LIT_7114.pdf

3.3 National Policies

3.3.1 Flood and Water Management Act, 2010

The Flood and Water Management Act 2010 places significantly greater responsibility on Local Authorities to manage and lead on local flooding issues. The Act and Regulations together set out the requirements and targets Local Authorities need to meet, including:

- Taking an active role leading flood risk management as Lead Local Flood Authorities (LLFAs)
- Cooperating with other relevant authorities to manage local flood risk
- Duty to investigate flood incidents and report upon them
- Maintain an 'Asset Register' of assets that have a significant influence on local flood risk
- Designate 'features' that have a significant influence on local flood risk
- Regulation of works on 'ordinary watercourses'
- Development and implementation of Local Flood Risk Management Strategies (LFRMS)
- Responsibility for first approval, then adoption, management and maintenance of Sustainable Urban Drainage System (SUDS) where they service more than one property (not currently enacted – expected to be enacted in 2013).

The Flood and Water Management Act also clarifies three key areas that influence development:

1. *Sustainable drainage systems (SuDs)* - the Act makes provision for a national standard to be prepared on SuDS, and developers will be required to obtain local authority approval for SuDS in accordance with the standards, likely with conditions. Of note are recent changes to the planning regime that supersede provisions of the Act. On 18th December 2014 the Department for Communities and Local Government and Department for Environment, Food and Rural Affairs issued Written Statement - HCWS161 (also referred to as the 'SuDS consultation response'). This statement announced that SuDS will not be delivered as described Schedule 3 of the Flood and Water Management Act, 2010, but be delivered through the planning system. As part of this announcement the use of SuDS Approval Bodies (SABs) as the primary mechanism for SuDS review, approval and management was dropped. The Flood and Water Management Act has not yet been revised to reflect these changes, however they should be noted when considering implementation of SuDS on the Proposed Development.

2. *Flood risk management structures* - the Act enables the Environment Agency and local authorities to designate structures such as flood defences or embankments owned by third parties for protection if they affect flooding or coastal erosion**.** A developer or landowner will not be able to alter, remove or replace a designated structure or feature without first obtaining consent.

3. *Permitted flooding of third party land* - In exceptional circumstances, the EA and local authorities have the power to carry out work which may cause flooding to third party land where the works are deemed to be in the interest of nature conservation, the preservation of cultural heritage or people's enjoyment of the environment or of cultural heritage.

3.3.2 National Planning Policy Framework (NPPF)

The National Planning Policy Framework[12] was issued in March 2012 and outlines the national policy including on development and flood risk assessment. This replaced national policy including Planning Policy Statement 25 – Development and Flood Risk.

The NPPF requires Local Plans to be supported by a Strategic Flood Risk Assessment and develop policies to manage flood risk from all sources. Advice should be sought from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities (LLFAs) and Internal Drainage Boards (IDBs). In developing policies, Local Plans should apply a sequential, risk-based approach to prioritising the location of development in order to avoid flood risk to people and property, to manage any residual risk, and to take account of the impacts of climate change.

In general, these requirements will be met by:

- Applying the Sequential Test and allocating development primarily to areas not at flood risk;
- Safeguarding land from development that is required for current and future flood risk management;
- Using opportunities offered by new development to reduce the causes and impacts of flooding; and
- Seeking opportunities to facilitate the relocation of development, including housing, to more sustainable locations where climate change is expected to increase flood risk to existing development.
- Development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding. The SFRA will be the basis for applying this test and a sequential approach should be used in areas known to be at risk from any form of flooding.
- Following application of the Sequential Test, if part of a development site needs to be located in a zone with a higher risk of flooding, the Exception Test can be applied to ensure that development (categorised by vulnerability) is situated in the lowest risk area within the site.
- For the Exception Test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA. It must also be demonstrated within a site specific FRA that the development will be safe for its lifetime without increasing flood risk elsewhere and where possible reducing flood risk.
- When determining planning application, Local Planning Authorities should ensure that flood risk is not increased elsewhere and should only consider development in areas at risk from flooding where it can be demonstrated that a sequential approach has been taken, that the development is appropriately flood resilient, that residual risks can be managed and that priority is given to the use of sustainable drainage systems.

NPPF advocates a Sequential Approach to assessing flood risk. The Sequential Test is the primary decision making tool, which aims to develop sites at lowest risk in preference to sites at higher risk of flooding.

Once the sequential test has been passed, the sequential approach is applied to the potential layout of the development; within the site the development is located in the area at least risk of flooding or that the layout is appropriate, based on vulnerability classifications.

It is also recognised that the information obtained on flood risk must be considered alongside other spatial planning issues such as transport, housing, economic growth, natural resources, regeneration, biodiversity, the historic environment and management of other hazards. However, as highlighted in the Planning

[12] National Planning Policy Framework (DCLG, 2012)

Inspectorate in June 2014 through the Doncaster Examination, the same weighting may not apply to all of these issues.

Accordingly it is assumed that an assessment of flood risk is collected for use alongside other information to facilitate decision-making on the land use. The flood risk information should be prepared using the risk-based, sequential process described in Chapter 4.

3.3.3 National Planning Practice Guidance

The Technical Guidance to the National Planning Policy Framework[13] (PPG) has been superseded by the Planning Practice Guidance Flood Risk and Coastal Change[14] (March 2014) which sets strict tests to protect people and property from flooding. All local planning authorities are expected to follow the PPG. Where these tests are not met, national policy is clear that new development should not be allowed. The main steps to be followed are designed to ensure that if there are better sites in terms of flood risk, or a proposed development cannot be made safe, it should not be permitted.

The PPG provides guidance on how the local planning authorities should:

- Assess flood risk;
- Avoid flood risk; and
- Manage and Mitigate flood risk and coastal change.

There is also information on the requirements to consult the Environment Agency, on the role of lead local flood authorities and on flood risk in relation to minor developments. In addition, NPPF provides information on the application of the Sequential and the Exception Tests in the preparation of a Local Plan.

The April 2015 update to the practice guidance provides additional guidance on SuDS, including:

- The importance of SuDS;
- When SuDS should be considered;
- The SuDS discharge hierarchy;
- Factors a local authority will address when considering SuDS as part of a planning application;
- When SuDS are inappropriate and relevant flood risk consultees;
- Applicability of Defra's Non-statutory Technical Standards for Sustainable Drainage Systems;
- Design and construction cost considerations;
- Operation and maintenance considerations; and
- Where to go for further SuDS advice.

As part of the April 2015 update, the practice guidance provides details on the parties responsible for assessing the suitability of SuDS practices. As per paragraph 084 from the practice guidance:

The decision on whether a sustainable drainage system would be inappropriate in relation to a particular development proposal is a matter of judgement for the local planning authority. In making this judgement the local planning authority will seek advice from the relevant flood risk management bodies, principally the lead local flood authority, including on what sort of sustainable drainage system they would consider being reasonably practicable.

[13] Technical Guidance to the National Planning Policy Framework (DCLG, 2012)

[14] http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

3.4 Other Relevant Policy

3.4.1 Sewers for Adoption 7th Edition (September 2012)

Following the change in responsibility for sewerage services in England and Wales (October 2011), the 7th edition of Sewers for Adoption was issued. This document is the definitive guide for those planning, designing and constructing sewers and pumping stations for subsequent adoption by water companies in England and Wales under Section 104 of the Water Industry Act. This guidance provides best practice on planning, design, construction, operation and maintenance of SuDS to facilitate their effective implementation within developments.

3.4.2 BREEAM New Construction Non-Domestic Buildings Technical Manual (2011)

Similar to the code for sustainable homes there is also a guide for Non-Domestic Buildings. The primary aim of BREEAM New Construction SD5073[15] is to mitigate the life cycle impacts of new buildings on the environment in a robust and cost effective manner.

Policy 03 Surface Water Runoff aims to avoid, reduce and delay the discharge of rainfall to public sewers and watercourse, therefore minimising the risk of localised flooding on and off site, watercourse pollution and other environmental damage.

The guidance is split into three parts;

- Flood Risk – 2 credits
- Surface water runoff - 2 credits
- Minimising water course pollution – 1 credit

There is extensive guidance in the document and it is recommended that the reader is referred to page 373.

3.5 Local Policies

3.5.1 Local Flood Risk Management Strategy

Surrey County Council is the Lead Local Flood Authority for Surrey. SCC is required to develop, maintain, apply and monitor a Local Flood Risk Management Strategy (LFRMS)[11]. The strategy aims to increase awareness of local flood risk issues, and set out how partners are working together to reduce flood risk. The document provides an overview of the ongoing flood risk management work underway across Surrey for 2012-2016. The Surrey Flood Risk Partnership Board oversees the strategy. Reflecting the requirements of the Flood and Water Management Act (2010) and the National Flood and Coastal Erosion Risk Management Strategy (2011) the LFRMS aims to make it easier for management authorities to work together and clarify roles, providing a clear overview of the levels of flood risk throughout the County by considering flooding issues at catchment level. The strategy also aims to reflect the concerns of residents and business, in order to appropriately prioritise the spending of schemes aimed to reduce flood risk. The strategy must cover how and when the flood risk reduction measures will be implemented, how much they cost and how they will be paid for.

The document can be found online at:

http://www.surreycc.gov.uk/__data/assets/pdf_file/0006/393486/Surrey-LFRMS-Final-consultation-draft.pdf

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[15] BRE Global Limited, BREEAM New Construction, Non Domestic Buildings Technical Manual SD5073 – 2.0:2011

[11]Surrey-LFRMS-Final-consultation-draft.pdf

3.5.2 Multi Agency Flood Plan

The Multi Agency Flood Plan for Waverley was last updated in the summer of 2012. However, in light of the flood events that occurred across the Borough through the winter of 2013-2014, work is currently in hand to update the plan. This work is taking place alongside a wider review by the Surrey Local Resilience Forum of the overarching plan for Surrey. Two versions of the report will be available; a 'quick guide', and a 'public version' which will be made available on the Council's website in the future.

3.5.3 Waverley Local Plan

Waverley's new Local Plan will be produced in two parts; Part One: Strategic Policies and Sites; and Part Two: Development Management and Site Allocations. This will replace the Local Plan adopted in 2002. This SFRA will be used as part of the evidence base to support the plan as a whole.

3.5.4 Preliminary Flood Risk Assessment

A Preliminary Flood Risk Assessment (PFRA)[16] was prepared for Surrey County Council in June 2011. The report was prepared to ensure Surrey County Council met their duty to deliver the requirements of the Flood Risk Regulations (2009).

The PFRA is aimed at providing a high level overview of flood risk from all sources of flooding within the local area, including consideration of surface water, groundwater, ordinary watercourses and canals.

3.6 Environment Agency Policies

3.6.1 Catchment Flood Management Plans (CFMP)

Catchment Flood Management Plans (CFMPs) are the Environment Agency's high level strategic plans for the sustainable management of flood risk at a river catchment scale. The documents seek to identify those factors that influence flooding in an area identify broad policies for the long term management of flood risk in a sustainable manner.

The WBC catchment area is covered by the Thames CFMP[17] and the Arun and Western Streams CFMP[18]. Both documents were published in December 2009. Details of the Catchment Flood Management Plan policy recommendations for the Waverley area can be found in Volume 2, Chapter 4.

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[16] http://new.surreycc.gov.uk/__data/assets/pdf_file/0004/16753/PFRA.pdf

[17] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293903/Thames_Catchment_Flood_Management_Plan.pdf

[18] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/293864/Arun_and__Western_Streams Catchment_Flood_Management_Plan.pdf

4 Applying the Sequential Test

4.1 What is the Sequential Test?

The NPPF Sequential Test is a risk based approach to determine the suitability of development according to flood risk from fluvial and tidal flood sources. The NPPF requires LPAs to apply the Sequential Test at all stages of the planning process to ensure that developments are located in areas at least risk of flooding. Through application of the Sequential Test LPAs are required to guide new development towards areas of the lowest flood probability. Only sites at higher risk of flooding can be considered if there are no 'reasonable alternative' sites.

Allied to the Sequential Test, the NPPF also assigns different vulnerabilities to different types of development (Table 2 of the Planning Practice Guidance (PPG) for Flood Risk and Coastal Change). If, when applying the Sequential Test, development in the floodplain is necessary and satisfactorily justified, the LPA should consider the vulnerability classification of the proposed development (Table 4-3). In certain circumstances the LPA may be required to undertake the Exception Test at the site level. NPPF also assigns which vulnerabilities are compatible within each flood zone (Table 3 of the PPG for Flood Risk and Coastal Change).

Following the satisfactory application of the Sequential Test, Table 4-3 should be used to guide potential land uses to areas where the development vulnerability is appropriate to the flooding probability.

Table 4-1 - Flood Zone Definitions (PPG)

PPG Table 1: Flood Zones Definitions		
Zone 1	Low Probability	Land having a less than 1 in 1,000 annual probability of river or sea flooding.
Zone 2	Medium Probability	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding
Zone 3a	High Probability	Land having a 1 in 100 or greater annual probability of river flooding
Zone 3b	The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Across WBC, this is defined as land having a 1 in 20 year or greater annual probability of river flooding, defined using detailed hydraulic modelling. Where no detailed modelling is present the entire designation of flood zone 3 is definition of flood zone 3b unless otherwise satisfactorily demonstrated.

Table 4-2 - Flood Risk Vulnerability Classifications (PPG)

PPG Table 2: Flood Risk Vulnerability Classification	
Essential Infrastructure	• Essential transport infrastructure (including mass evacuation routes), which has to cross the area at risk, and strategic utility infrastructure
Highly Vulnerable	• Police, Ambulance and Fire stations and Command Centres and telecommunications installations required to be operational during flooding and emergency dispersal points • Basement dwellings, Caravans, mobile homes and park homes intended for permanent residential use. • Installations requiring hazardous substances consent.
More Vulnerable	• Hospitals, residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. • Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels. • Non–residential uses for health services, nurseries and educational establishments. • Landfill and sites used for waste management facilities for hazardous waste. • Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	• Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure. • Land and buildings used for agriculture and forestry. • Waste treatment (except landfill and hazardous waste facilities). • Minerals working and processing (except for sand and gravel working). • Water treatment plants and sewage treatment plants (if adequate pollution control measures are in place).
Water-Compatible Development	• Flood control infrastructure and • Water transmission infrastructure and pumping stations and sewage transmission infrastructure and pumping stations. • Sand and gravel workings. • Docks, marinas and wharves and navigation facilities. • MOD defence installations and ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location. • Water-based recreation (excluding sleeping accommodation). • Lifeguard and coastguard stations. • Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms. • Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan.

Table 4-3 - Flood risk vulnerability and flood zone compatibility (PPG)

PPG Table 3: Flood Risk Vulnerability and flood zone 'compatibility'					
Flood Zones	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water-Compatible Development
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test Required	✓	✓	✓
Zone 3a	Exception Test Required	✗	Exception Test Required	✓	✓
Zone 3b	Exception Test Required	✗	✗	✗	✓

NPPF acknowledges that some areas could also be at risk of flooding from flood sources other than fluvial and tidal systems. Consequently all sources of flooding must be considered when looking to locate development. Other sources of flooding requiring consideration when situating new development allocations in the WBC administrative area include:

- Surface Water Flooding;
- Groundwater;
- Sewers; and
- Artificial Sources.

4.2 How should the SFRA be used to apply the Sequential Test?

The Sequential Test is applied at all stages of planning. The SFRA provides the flood risk data to enable the application of the risk based Sequential Test in the process of identifying land that is suitable for development in the Local Plan. It also provides information to inform Flood Risk assessments at particular sites. This level 1 SFRA provides information on flood risk from all sources that should be used to inform the application of the sequential test, as well as the local plan strategy and policies

Waverley Borough Council (WBC) should use the information presented in this Level 1 SFRA to undertake the Sequential Test. This should be accurately documented to ensure that the decision processes followed for the locating of a development are consistent and transparent.

It is recognised that flood risk information must be considered alongside other spatial planning issues. Allocations are thus "tested" on the basis of their flood risk attributes and the outcome used to inform decisions that include other spatial planning issues.

WBC need to sequentially test all sites that have been put forward for consideration. This includes sites submitted through the 'Call for Sites', current records and sites in council ownership. WBC shall allocate sites based on those at least risk of flooding, as set out in Figure 4-1. It is necessary to clearly define "reasonably available" and be able to provide evidence that there are not locations outside of those considered with a lower probability of flooding that could be considered to be "reasonably available" for the type of development proposed.

When applying the Test it will be important for WBC to demonstrate:

- That a transparent process has been formulated and followed;

- That this process has sought to steer new development to areas with the lowest probability of flooding (according to Table 1 PPG; Table 4-1 in this report); and
- That full consideration has been given to reasonably available alternatives on land with a lower probability of flooding.

PPG demonstrates the application of the Sequential Test. A bespoke flow chart has been set out for WBC to easily apply the sequential test methodology for Local Plan preparation. A Flood Risk Matrix has also been developed to record the sequential test process Table 4-4. The flow chart and matrix should be used by WBC to allocate development sites sequentially within the Borough.

The protocols adopted for the Sequential Test should be agreed with the Environment Agency (EA). WBC are presently in discussion with the EA and other key stakeholders regarding in the decision making process.

Additional guidance for WBC to strategically undertake the Sequential Test is provided in Appendix B.

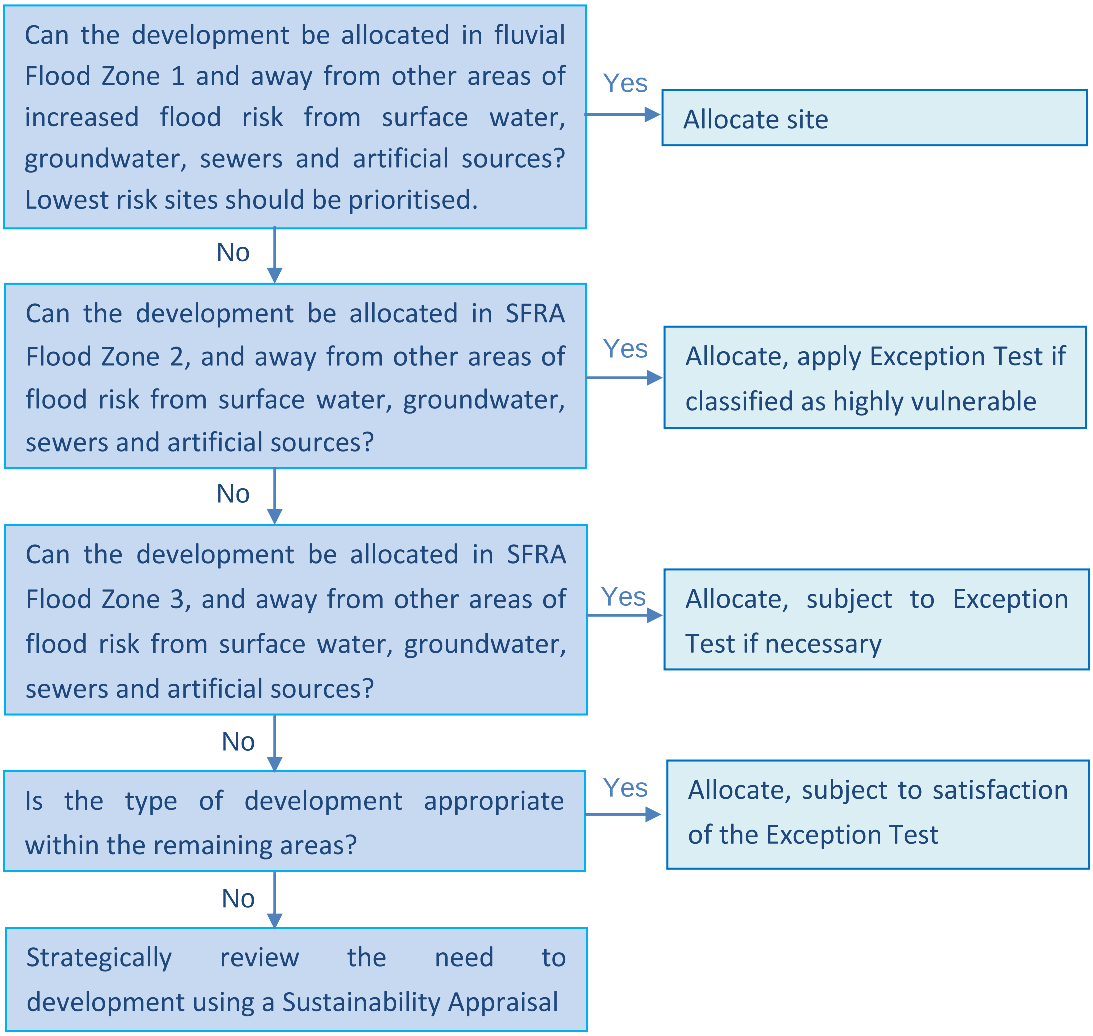

Table 4-4 - Template table for recording Sequential Test process

Site Identified for Potential Future Development	Flood Zone Classification	Risk of Flooding from Rivers & Ordinary Watercourses	Risk of Flooding from Surface Water	Risk of Flooding from Sewers	Risk of Flooding from Groundwater	Risk of Flooding from Artificial Sources	Additional Comments or Other Suitable Sites
	Refer to Volume 1 Table 5-1 and 5-3	Refer to Volume 2, Chapter 5	Refer to Volume 2, Chapter 6	Refer to Volume 2, Chapter 7	Refer to Volume 2, Chapter 8	Refer to Volume 2, Chapter 9	

5 Applying the Exception Test

5.1 What is the Exception Test?

As shown in Volume 3, some areas of Waverley are within Flood Zones 2 and 3 and are predicted to have a medium or high risk of flooding. Following application of the Sequential Test it may not be possible for WBC to steer all new development towards Flood Zone 1, particularly when regeneration objectives are taken into account. The relevant weightings of each objective should be considered; flood risk is an issue that can endanger lives, as recently emphasised by the Planning Inspectorate in June 2014 through the Doncaster Examination.

If, following the application of the Sequential Test, it is not possible for all development to be located in zones of lower probability of flooding, the Exception Test may need be applied to potential sites and proposed development in accordance with PPG. The Exception Test provides a method of managing flood risk while still allowing ‘necessary’ development to occur. The Exception Test should only be applied to a site following the satisfactory application of the flood risk sequential test.

5.2 What is required to pass the Exception Test?

Figure 4-1 highlights the stages in the Sequential Test at which the Exception Test may need to be applied. The Planning Practice Guidance provides additional guidance on the application of the Exception Test.

If, following application of the Sequential Test, it is not possible, consistent with wider sustainability objectives, for some development to be located in zones with a lower probability of flooding, the Exception Test can be applied if appropriate. For the Exception Test to be passed:

- it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and
- a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

The first criteria should be provided, for instance, through the sustainability appraisal. If a potential site allocation fails to score positively against the aims and objectives of the sustainability appraisal, or is not otherwise capable of demonstrating sustainability benefits, Waverley Borough Council should consider whether the use of planning conditions and/or planning obligations could make it do so. Where this is not possible the Exception Test has not been satisfied and the allocation should not be made.

The second part of the Exception Test relates to the “safety” of the development. PPG provides detail on ‘What is safe?’ When considering safety, specific local circumstances need to be taken into account, including:

- The characteristics of a possible flood event, e.g. the type and source of flooding and frequency, depth, velocity and speed of onset;
- The safety of people within a building if it floods and also the safety of people around a building and in adjacent areas, including people who are less mobile or who have a physical impairment. This includes the ability of residents and users to safely access and exit a building during a design flood and to evacuate before an extreme flood;
- The structural safety of buildings, and;
- The impact of a flood on the essential services provided to a development.

Figure 5.1 presents the process that should be followed in the application of the Exception Test.

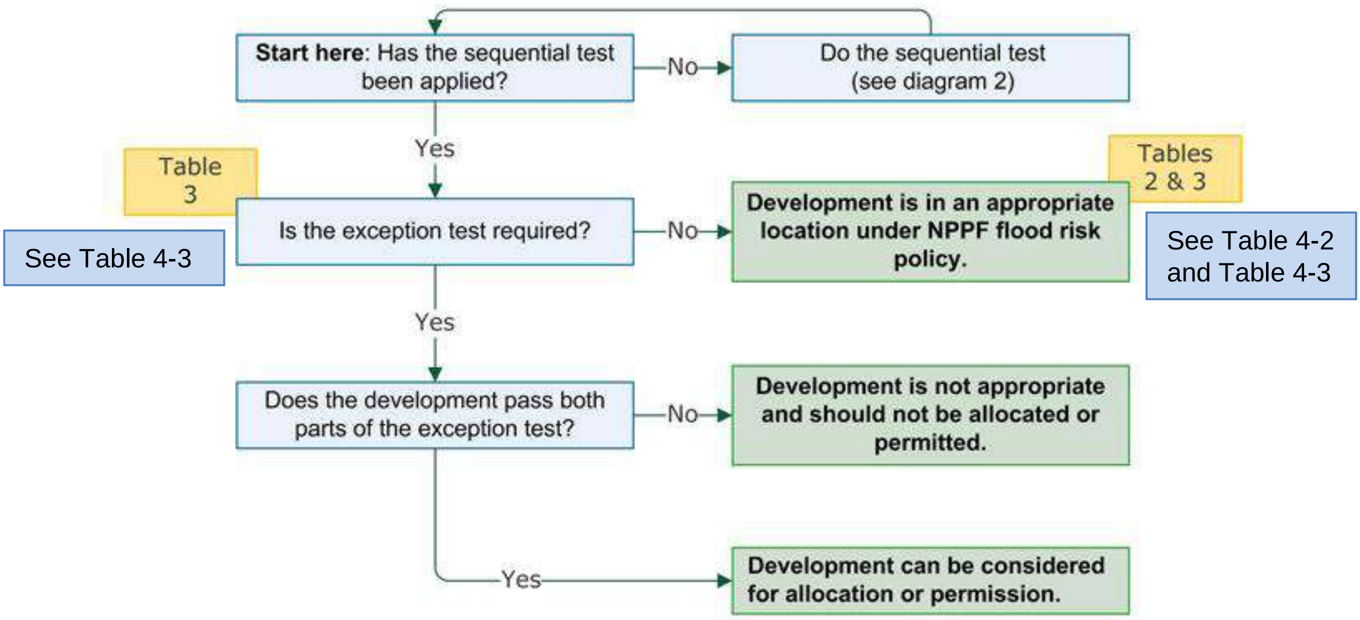

Figure 5-1: An Application of the Exception Test for Local Plan preparation (PPG Flood Risk and Coastal Change)

As well as the safety of people occupying a site, consideration should be given to the safe access and egress arrangements that can be implemented so that during flood events the appropriate level of safety can be maintained.

It is important that WBC retain a record of all their assumptions and decisions with regard to both the Sequential and Exception Tests, in order to demonstrate that they have performed the process. Once the Tests are completed, and WBC are satisfied with the outcome, it is then possible to continue with the development process.

Flood events, more than many other emergencies, can affect a wide number of homes and the time to recover from a flood emergency can be prolonged. Accordingly it should be remembered that the level of 'safety' will vary depending on the vulnerability of the community affected. More vulnerable residents will potentially be more severely affected by the consequences of flooding and levels of safety should be commensurate with the risk.

6 How to Use the SFRA in Development Control

6.1 Possible Users of the SFRA

The information contained within the SFRA is primarily compiled for use by WBC in preparing the Local Plan and in determining planning applications. However, the information on flooding may also be useful to a much wider range of users. These potential users include (but are not limited to):

- Transport and highways team including strategic transport planners – the SFRA can be used to identify flood risk to essential infrastructure, both proposed and existing;
- Education Building Development and Education and Children's teams – the SFRA should be used to ensure flood risk is considered in the allocation of land for new schools and also used to inform emergency plans that make use of school buildings;
- Emergency Services– the SFRA can be used to inform future updates of the Flood Plan. Information within this SFRA on the spatial distribution of flood risk throughout the area should also be used by the emergency services and other developers of critical infrastructure when allocating new developments.

In order to ensure these teams are integrated into the SFRA process, it is recommended that this report is made available for their comment, review and future input as appropriate.

6.2 Guidance for Emergency Planners

Objective 7 of this Level 1 SFRA is *'to present sufficient information to inform WBC of the flood considerations necessary in developing and progressing flood emergency planning'*.

Sir Michael Pitt's Review of the 2007 floods recognises the 'dedicated and quick response' of emergency services which prevented the worsening of many situations. However, he also identified a number of failings and opportunities to improve our preparedness for future flood events. In particular he advises that with 'stronger local leadership of flood risk management, clarification of roles, more effective co-operation between responsible organisations, better protection of infrastructure and wider and deeper public engagement' the impact of flooding on communities could be significantly reduced.

For many of the opportunities identified by the Pitt Review to be achieved, the role local authorities have in planning and responding to flood events must be clearly defined. To assist local authorities in understanding their role it is essential to have a technically sound emergency plan in place to provide clear procedural instructions to the organisations, companies and individuals involved and affected.

The mobilisation and organisation of the emergency services and supporting agencies (for example, Waverley Borough and Surrey County Councils) can be integral to the coordinated rescue, treatment and transport of potentially large numbers of displaced residents or casualties. Similarly, during and after a flood event the role of the local authority can include providing transport for the evacuees and safe rest centres in the event of homes being flooded. Further health and welfare issues are inevitable as a result of serious flood events, which may impact on the ability of people to return to their homes or places of business.

Whilst this SFRA is not designed to fulfil the role of providing an emergency plan, it does contain useful information for WBC and other key organisations to assist them in understanding their risks (direct and indirect) and begin the process of developing an appropriate co-ordinated response.

WBC have a defined role in emergency planning. The role and responsibilities for emergency planning are set out by legislation following the implementation of the Civil Contingencies Act 2004. The Act defines the term 'emergency' as:

- 'an event or situation which threatens serious damage to human welfare;

- an event or situation which threatens serious damage to the environment, or
- war, or terrorism, which threatens serious damage to security'.

6.2.1 Developing an Emergency Flood Plan

Waverley Borough Council Emergency Plan

The Multi Agency Flood Plan (MAFP) for Waverley was last updated in the summer of 2012. However, in light of the flood events that occurred across the Borough through the winter of 2013-2014, work is currently in hand to update the plan. This work is taking place alongside a wider review by the Surrey Local Resilience Forum of the overarching plan for Surrey. Two versions of the report will be available; a 'quick guide', and a 'public version' which will be made available on the Council's website in the future.

In addition to the MAFP, Cranleigh Parish Council Emergency Plan (2008) sets out local procedures for emergency response at a parish level for Cranleigh. No other Parish or Town Councils within Waverley has provided local emergency planning procedures during the production of the SFRA.

These documents describe the roles and responsibilities of the emergency services, various departments within the respective councils, utility companies, Environment Agency, industrial companies and individual property owners.

Consideration should be given by the council to the identification of alternative routes for emergency vehicles if the A3 and A31 are closed due to flooding. The A3 has been known to flood in the past with the area associated with the River Wey between Milford to Shackleford (located outside of the study area) being of particular concern to the Highways Agency. A scheme to improve the drainage of this area of the A3 is currently in progress.

6.2.2 Use of the Emergency Plan in the Planning System

With the appropriate management of flooding taking increasing importance in the planning system, more developments will be required to ensure they appropriately manage their risks and do not exacerbate the risks to surrounding property and residents as a consequence of development.

Whilst much of the impact of development should be mitigated through appropriate proactive planning (through application of the Sequential Test); there will remain some developments that will take place in areas at risk of flooding. In such circumstances, developments should be constructed in such a way as to safeguard them and their residents from flooding; however the impact of the development on the ability of emergency services to maintain current standards of service should also be considered.

Ensuring a robust emergency plan is in place will enable the WBC to establish where a proposed development will place an unreasonable pressure on emergency services and may increase risks to the existing population. Similarly it will enable developers to incorporate appropriate mitigation measures into their developments to minimise the impact it will have on the existing emergency service provision.

In exceptional cases, where land allocation within flood risk areas is unavoidable and flood warning is proposed to complement other measures being utilised to minimise residual risk, the vulnerability of the proposed new development should be considered and appropriate communication of flood warnings employed. When proposing evacuation plans the proposed land use should be considered, for example if occupiers are likely to be transient, repeat communication of evacuation plans will be required (e.g. provided on display boards at a campsite) and the dissemination of flood warnings may need to be through public announcements rather than the Floodline Service to individual properties. Evacuation plans will also need to consider the local knowledge and mobility of occupants. Advice should be sought from emergency services when proposing evacuation plans for new developments and the flood risk to proposed access and egress routes is of key importance.

6.3 A Guide for Developers

The Environment Agency Guide for Developers (May, 2013) provides a tool for developers during each development stage. It provides advice on how a development can be better for people and the environment.

At the pre-application stage, the Environment Agency encourages developers to make enquiries on its website regarding flood risk. This reduces issues at the planning application stage such as a lack of information in the application and flags at an early stage whether the application is likely to be refused. Pre-application enquiries save the developer time and money, and make sure the development is better for the environment (Developers Guide, May 2013). Pre-application enquiries also enable WBC as the LPA to determine applications more quickly and proficiently.

The Environment Agency pre-application enquiry form can be found at:

https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion

In addition to NPPF, the Guide for Developers provides advice on "Managing the risk of flooding" by ensuring the site land use and layout is appropriate to risk of flooding. This section of the guide also details reiterates the government regulations set out by NPPF by stating the need for developers to "avoid causing flooding elsewhere".

The Guide for Developers details the permissions needed for Flood Risk Management. The Water Resources Act 1991 and associated byelaws require the application for formal consent for works in, over, under or adjacent to main rivers. This is to ensure that these activities don't cause flooding or make an existing flooding problem worse, and don't damage the local environment, fisheries, wildlife, and flood defences. Main rivers are watercourses designated by Defra and are usually larger rivers or streams.

The EA Guide for Developers is available at:

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289894/LIT_2745_c8ed3d.pdf

The FRA will be required to demonstrate that flood risk to the development can be managed now and in the future, that the development will not increase the risk of flooding elsewhere and that the proposals are compliant with the SFRA. The requirement for site-specific FRAs is detailed in NPPF and the Planning Practice Guidance where there is a useful Site Specific Flood Risk Assessment Checklist. Planning applications for development proposals of 1 hectare or greater in Flood Zone 1 and all proposals for new development located in Flood Zones 2 and 3 require a FRA. The FRA should consider all sources of flooding, not just river flooding.

The principles and key requirements of a FRA are provided in Section 10 of PPG. Broad guidance on completion of FRAs in Waverley is provided below.

6.3.1 Guidance for Developers – Site Specific FRAs

Before commencement of a detailed site-specific FRA, a broad scale assessment of flood risk should be taken by the developer to ascertain the level of risk to their site. This should utilise SFRA maps, including the SFRA Flood Zones in Volume 3 Figure 7 and records of non-fluvial flood risk, Volume 3, Figures 3A and 3B.

Developers and applicants need to consider flood risk to and from the development site; it is in their interest to do this as early as possible, which should reduce the risk of subsequent, significant costs being incurred. If a detailed flood risk assessment is required, the assessment should be submitted to the local planning authority, showing how flood risk will be managed now and over the developments lifetime, taking into account climate change with regard to the vulnerability of its users.

The objectives of a site-specific flood risk assessment are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- the evidence for the local planning authority to apply (if necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable.

The Environment Agency have detailed guidance on what the scope of a flood risk assessment, and when to consult the EA. This is available through the Flood Risk Standing Advice for planning applications.

Once the level of risk has been ascertained and the developer has passed the Sequential Test and the Exception Test where necessary, a detailed flood risk assessment should be undertaken to address sequential site layout and any necessary mitigation measures necessary for the development to be acceptable. Within Flood Zone 1, all sites are considered to be at a low risk of fluvial flooding. However, all new developments on sites greater than 1 hectare in Flood Zone 1 require a Flood Risk Assessment to ensure that other sources of flooding have been investigated and that surface water is managed effectively. Redevelopments of existing sites should seek to improve surface water drainage and reduce run-off rates and volumes as far as possible, preferably back to Greenfield rates and volumes. Specifically, FRAs need to:

- Assess the existing surface water runoff rates and volumes for the site over a range of return periods, namely the 1 in 1yr, 1 in 30yr and 1 in 100yr storms and whether any flooding issues exist as a result of the existing surface water system;
- Design a surface water drainage system for the proposed development following the SUDS management train and assess the surface water runoff rates and volumes for the 1 in 1yr, 1 in 30yr and 1 in 100yr storms including an allowance for climate change, ensuring that the proposed runoff rates and volumes do not exceed the existing;
- Assess any flooding that may occur from the proposed surface water system up to a 1 in 100 yr storm with allowance for climate change and ensure that the site is designed to safely retain this flooding (low-level flooding of kerbed areas, parking areas, roads, etc. may be acceptable).

Once a planning application, together with an appropriate FRA, is submitted by the developer, it should be assessed to ensure that the applicant has considered flood risk from all sources and demonstrated how flood risk will be managed taking climate change into account.

A critical component of site specific FRAs for new developments is a consideration of the safety of the development and users of the developers. An assessment of the safety of a proposed development must include consideration of the access/egress arrangements from the development in the event of a flood. The safety of people during a flood event depends on the depth and velocity of the floodwaters and guidance on the relative danger of different depth/velocity combinations is provided in the Defra/EA Report FD2320/TR2 "Flood Risk Assessment Guidance for New Development."

6.4 Site Specific Flood Risk Assessment Guidance

Flood risk is a fundamental consideration for any development project regardless of scale or type. Understanding the flood risk to and arising from a development is essential to managing the risk to people and property reducing the risk of injury, property damage or even death. Climate change is of particular concern to flood risk, with current predictions suggesting the UK will experience milder wetter winters and on average hotter drier summers, whilst sea levels will continue to rise. This is likely to lead to an increase in rainfall and therefore flood events in winter months and increase the risk of thunderstorms in the summer months, as well as increasing the unpredictability of our weather.

Evidence collected through this Level 1 SFRA demonstrates flooding in the study area is not limited to just rivers. Flooding is proven to arise from a number of sources, each presenting their own type of risk and requiring management. In addition some areas currently defended from flooding may be at risk in the future as the effects of climate change take hold, as the condition of defences deteriorates with age, as defence strategies change or a combination of these causes.

A failure to adequately consider flood risk in development proposals can have significant implications for the planning and development processes and longer term on the residents of new or existing developments. Issues that may arise through inappropriate consideration of flood risk include:

- Failure to consider wider plans prepared by the Environment Agency or other operating authorities may result in an objection to a proposed scheme.
- Failure to identify flood risk issues early in a development project could result in failure of a development proposal, requiring redesign of the site to mitigate flood risk.
- Failure to adequately assess all flood risk sources and construct a development that is safe over its lifetime could increase the number of people at risk from flooding and/or increase the risk to existing populations.
- If an adverse effect can be demonstrated (i.e. flooding did not occur prior to development) by neighbouring properties or residents.
- Properties may be uninsurable and therefore effectively unable to be sold if flood risk management is not adequately provided for the lifetime of the development.

However, development can work with flood risk if it is accurately understood and managed. Using a sound understanding of flood risk to locate, and design developments enables flood risks to be managed through positive planning. This positive planning needs to consider the risks to a development from local flood sources but also the consequences a development may have on increasing flood risk. Early identification of flood risk constraints can ensure developments maximise development potential whilst achieving the principles of sustainability.

This Level 1 SFRA presents sufficient information to assist WBC to apply the 'Sequential Test' and identify where the Exception Test may be required. However, the scale of assessment undertaken for a Level 1 SFRA is not always appropriate to accurately assess the risks faced by a single development at a given location with the study area. This SFRA has attempted to identify all sources of flood risk at the catchment and borough scale using the best available information. However, the information presented does not necessarily fully address all the flood sources. For example, Flood Zones provided by the Environment Agency are not defined for all watercourses; typically watercourses with a catchment area less than 3km^2 are omitted from Environment Agency mapping unless there is a history of flooding affecting a population. Consequently, there will be some locations adjacent to watercourses where on first inspection it is suggested there is no flood risk. This should be fully investigated to ensure more people are not placed at risk through inappropriate development. More local and site specific sources of flooding may become apparent during a Level 2 SFRA or during the course of a site specific FRA.

Therefore, as part of the planning applications which come forward in future for both allocated and non-allocated sites, site specific FRAs will be required to assess the flood risk posed to individual proposed developments and to ensure that where necessary, and appropriate, suitable mitigation measures are included in the development.

This section presents the recommendations for site specific FRAs, the circumstances under which they should be prepared and their requirements for submission with planning applications.

The site specific Flood Risk Assessment guidance presented in the following sections has been developed based on:

- The recommendations presented in NPPF and its accompanying Planning Practice Guidance;
- The Environment Agency's Flood Risk Standing Advice to LPAs;
- A review of local policies and bye-laws throughout the study area; and
- The information and findings gathered and developed during preparation of this Level 1 SFRA.

6.5 When is a Flood Risk Assessment Required?

When informing developers of the requirements of a Flood Risk Assessment for a development site, consideration should be given to the position of the development relative to flood sources, the vulnerability of the proposed development and its scale.

In accordance with NPPF and the General Development Procedure Order (GDPO)[19] FRAs should always be provided with planning applications in the following situations:

- The development site is located in Flood Zone 2 or 3;
- The development site is equal or greater than 1 hectare in area in Flood Zone 1;
- The development site is located in Flood Zone 1 but the Environment Agency, Internal Drainage Board and/or other bodies have identified critical drainage problems;
- The development is located within 20m of any watercourse regardless of flood zone classification; or
- The development involves any culverting operation or development which controls the flow of any river or stream.

The Environment Agency is a statutory consultee for planning applications that fall into the above situations with the exception of minor developments in Flood Zones 2 and 3. Minor development[20] in relation to flood risk means:-

- Minor non-residential extensions: industrial/commercial/leisure etc. extensions with a footprint less than 250 square metres.
- Alterations: development that does not increase the size of buildings e.g. alterations to external appearance.
- Householder development: for example, sheds, garages, games rooms etc. within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This

[19] The Town and Country Planning (General Development Procedure) (Amendment) (No.2) (England) Order 2006 http://www.legislation.gov.uk/uksi/2006/2375/contents/made

[20] Planning Practice Guidance Flood Risk and Coastal Change, 2014

definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

Minor developments are unlikely to raise significant flood risk issues unless:

- They would have an adverse effect on a watercourse, floodplain or its flood defences;
- They would impede access to flood defence and management facilities; or
- Where the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows.

For minor development in Flood Zones 2 and 3 it is the responsibility of the LPA to determine the suitability of development against flood risk. In addition the LPA is also responsible for determining the suitability of development against other forms of flooding (identified through this Level 1 SFRA). In summary the LPA is responsible for determining the suitability of developments in the following situations:

- Development sites less than 1 hectare;
- Minor developments in Flood Zones 2 and 3; and
- Developments at risk of flooding from flood sources other than fluvial or tidal (i.e. groundwater, surface water and infrastructure failures.

For developments in these situations the LPA must establish the requirements for FRAs and assess their suitability as part of the planning application.

6.6 Flood Risk Assessment Requirements

In general, for all planning applications where a FRA is required it will be necessary to prepare a document to the satisfaction of the Environment Agency.

In scenarios where the LPA is the consultee the requirements of the FRA should be based on the guidance presented in Table 11-1 and discussed with the LPA at the outset of the assessment.

Although not as well defined as in PPS 25, the NPPF states “there should be iteration between the different levels of flood risk assessment”. Using the previous guidance in PPS 25 a staged approach comprised:

- Level 1 FRA - Screening Study
- Level 2 FRA - Scoping Study
- Level 3 FRA - Detailed Study

However it will not always be necessary to prepare each of the documents. In some cases where a site is known to flood it may be appropriate to prepare a Level 2 or 3 assessments directly.

The minimum requirements for FRA at each stage in the process include:

- Considering the risk of flooding arising from the development in addition to the risk of flooding to the development;
- Identifying and quantifying the vulnerability of the development to flooding from different sources and identify potential flood risk reduction measures;
- Assessments of the remaining ‘residual’ risk after risk reduction measures have been taken into account and demonstrate that this is acceptable for the particular development;
- The vulnerability of those that could occupy and use the development, taking account of the Sequential and Exception Tests and the vulnerability classification, including arrangements for safe access;

- Considering how the ability of water to soak into the ground may change with development, along with how the proposed layout of development may affect drainage systems.
- Fully account for current climate change scenarios and their effect on flood zoning and risk.

Where a particular element of the FRA cannot be achieved to the satisfaction of the EA or LPA it will be necessary to advance the next level of FRA.

6.6.1 Level 1- Screening Study

A Level 1 Screening Study is intended to identify if a development site has any flood risk issues that warrant further investigation. This should be based on existing information such as that presented in this Level 1 SFRA. Therefore this type of study could be undertaken by a development control officer in response to the developer query or by a developer where the Level 1 SFRA is available. Using the information presented in the Level 1 SFRA and associated GIS layers a development control officer could advise a developer of any flooding issues affecting the site. This information could then be used by the developer as a basis to further their understanding of how the flood risks could potentially affect their development.

6.6.2 Level 2 – Scoping Study

A Level 2 Scoping Study is predominantly a qualitative assessment designed to further understanding of how the flood sources affect the site and the options available for mitigation. It should be based on existing information to further a developer's understanding of the flood risk and how it affects their development. This type of assessment should also be used to inform site master plans raising a developer's awareness of the flood management elements the proposed development may need to consider.

6.6.3 Level 3 - Detailed Study

Where the quality and/or quantity of information for any of the flood sources affecting a site is insufficient to enable a robust assessment of the flood risks, further investigation will be required. For example, it is considered inappropriate to base a flood risk assessment for a residential care home at risk of flooding from fluvial sources on Flood Zone maps alone. In such cases the results of hydraulic modelling are required to ensure details of flood flow velocity, onset of flooding and depth of flood water is fully understood and that the proposed development incorporates appropriate mitigation measures.

6.7 Consultation with the Environment Agency

To ease the process of WBC knowing when to consult with the EA on receipt of planning applications, the Agency has developed Flood Risk Standing Advice (FRSA) for Local Planning authorities and for developers / planning applicants. This guidance details when to consult the EA, depending on the scale and location of the development

https://www.gov.uk/flood-risk-assessment-local-planning-authorities

https://www.gov.uk/flood-risk-assessment-for-planning-applications

7 Drainage of Development Sites

Objective 6 of this Level 1 SFRA is to *'advise WBC on the principles, objectives and applicability of Sustainable Drainage Systems (SuDS) throughout the study area*'. In keeping with the guidance of NPPF, local authorities should encourage the application of Sustainable Drainage Systems (SuDS). This section presents a summary of surface water policy and practices. Volume 2 should be referred to for additional information on selection of the SuDS techniques available, and a review of the soils and geology of the study area. Together, both sections should enable WBC to identify what type of SuDS techniques could be employed in development schemes within the SFRA study area.

7.1 Background

Traditionally, built developments have utilised piped drainage systems to manage surface water and convey surface water run-off away from developed areas as quickly as possible. Typically these systems connect to the public sewer system for treatment and/or discharge to local watercourses. Whilst this approach rapidly transfers surface water from developed areas, the alteration of natural drainage processes can potentially impact on downstream areas by increasing flood risk and reducing water quality. Receiving watercourses are therefore much more sensitive to rainfall intensity, volume and catchment land uses after a catchment or areas of a catchment have been developed.

Flooding from sewers is typically less well publicised than flooding from rivers or the sea, in part due to the often greater frequency with which sewer flooding can occur but predominately because it typically affects geographically small areas for relatively short periods of time. However, the hazards and nuisance of sewer flooding remain of particular concern in areas of growth.

Due to the difficulties and inconvenience associated with upgrading sewer systems it is uncommon for sewer and drainage systems to keep pace with the rate of development/re-development. As development progresses and/or urban areas expand, the drainage systems become inadequate for the volumes and rates of surface water they receive, resulting in increased flood risk and/or pollution of watercourses. Allied to this the implications of climate change on rainfall intensities, is predicted to lead to flashier catchment/site responses and surcharging of piped systems.

In addition, as flood risk has increased in importance within planning policy, a disparity has emerged between the design standard required of new conventional sewer systems and the return period against which development should be safeguarded from flooding. New sewer systems are typically designed to accommodate the 3.3% annual probability storm without flooding at the ground surface in accordance with Sewers for Adoption[21] whilst new developments are typically required to mitigate against the risks from the 1% annual probability flood. This results in drainage inadequacies for the flood return period developments need to consider. Whilst the risk of flooding from fluvial systems may be managed, an inappropriately designed site drainage system could generate a new flood risk to development and existing property.

A sustainable solution to these issues is to reduce the volume and/or rate of water entering the sewer system and watercourses. The Government's preferred method to achieve this is through the use of SuDS.

7.2 What are Sustainable Drainage Systems (SuDS)?

SuDS are a varied collection of techniques designed to manage surface water in a sustainable manner. They achieve this by seeking to manage surface water from new developments as close to its source as possible and by mimicking the surface water flow regime present on a site prior to development. Typically

[21] Sewers for Adoption , 7th Edition A Design and Construction Guide for Developer, September 2012

this approach involves a move away from conventional piped systems to softer engineering solutions inspired by natural drainage processes.

For SuDS to be fully sustainable they should seek to contribute to each of the following three goals of sustainability (identified below), with the favoured system contributing equally to each goal:

1. Reduce flood risk (to the site and neighbouring areas),
2. Reduce pollution, and,
3. Provide landscape and wildlife benefits.

In addition, SuDS should also be designed to ensure they remain effective for storm events up to and including the 1% annual probability storm event including an increase in peak rainfall intensities to account for the predicted effects of climate change.

7.3 SuDS Policies

Section 3 outlines the policies that govern development and flood risk management in the WBC area. It is widely recognised that SuDS are a useful tool in the management of flood risk and water quality.

As of 6th April 2015, SuDS are a material planning consideration for development of ten dwellings or more, and equivalent non-residential schemes, unless developers can demonstrate that SuDS would not be appropriate.

The changes within NPPF, require the inclusion of SuDS designs with all Major Developments planning applications. Full planning application are required to be accompanied by a detailed SuDS drainage design including simulation modelling of the proposed system, the SuDS pro-forma must be completed and signed by a competent drainage engineer and submitted as part of the planning application. The proposed drainage system shall be designed in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems and the Woking Borough Sustainable Drainage Systems Design and Adoption Guide.

In accordance with PPG paragraph 80, all planning applications must follow the hierarchy for discharge destinations. Where it is not possible to achieve the first hierarchy, discharge through the ground, applicants must demonstrate in sequence why the subsequent discharge destinations were selected.

Where the intention is to dispose to soakaway, these should be shown to work through an appropriate assessment carried out under Building Research Establishment (BRE) Digest 365. All designs shall be based on actual infiltration figures obtained through percolation tests, carried out in accordance to BRE Digest 365.

In accordance with CIRIA Report 156, Infiltration Drainage and SuDS Manual (C697 or latest amended version C753), an adequate factor of safety must be applied to the observed infiltration value. The minimum factor of safety acceptable is 2 and that must be increased to reflect the consequences of failure of the system, the topography of the site and the likelihood of flooding.

Infiltration units must stand the test of half-emptying the provided storage within 24hrs for up to the 1 in 10 year annual probability storm (for al rainfall durations). The proposed infiltration devices shall not intercept the water table and shall have at least 1m of unsaturated ground between the base of the infiltration device and the water table. There should be no infiltration of water into contaminated land.

If infiltration is not viable, subject to evidence being provided to support the choice of discharge destination, proposals to dispose of surface water in to a watercourse, surface water sewer, highway drain or another drainage system, should be accompanied by evidence of the system having spare capacity downstream

All development must aim to achieve pre-development greenfield run-off rates. If this is not proposed evidence must be submitted demonstrating why it has not been possible to achieve the greenfield run-off rate and why it is only possible to achieve the proposed discharge rate.

Based on the geology and soils within the Borough, there is a large region that is highly compatible for infiltration SuDS, including broad areas of the north and west, encompassing the urban areas of Godalming, Farnham and Haslemere. The underlying permeable sandstones and soils, combined with a deeper water table make the areas more suitable to infiltration SuDS. These areas can be seen in Volume 3, Figure 9. In the south and east of the Borough, there are very significant constraints on infiltration SuDS due to less permeable geology and soil types. These areas may be more suitable for attenuation based SuDS, including detention, retention, open channels and wetlands. Areas with shallower gradients may also be suitable for storage based SuDS, including areas around Godalming, Bramley, Cranleigh, Wonersh and Dunsfold. Land use (particularly urban extent) will also need to be addressed when considering the use of attenuation based SUDS.

Developers should consult WBC, the EA and sewerage undertakers at the earliest stage of the development process to establish the best solution for a particular site. The EA advises that widespread adoption of sustainable drainage system techniques would see a long-term improvement in the quality of rivers and the reduction in flood risk.

7.3.1 Building Regulations 2008 H3 Rainwater Drainage

The Building Regulations 2008 (Approved UK Building Regulations 2008) enable the principles of the NPPF to be enforced during construction by stipulating that:

1. Adequate provision shall be made for rainwater to be carried from the roof of the building;
2. Paved areas around the building shall be so constructed as to be adequately drained;
3. Rainwater from a system provided pursuant to sub-paragraphs (1) or (2) shall discharge to one of the following, listed in order of priority:
    - an adequate soakaway or some other adequate infiltration system; or, where that is not reasonably practicable,
    - a watercourse; or, where that is not reasonably practicable,
    - a sewer.

As the EA is the consenting authority for discharges to controlled waters (i.e. groundwater or watercourses), SuDS will be favoured when they incorporate removal of pollutants and attenuation of discharge rates.

7.3.2 Environment Agency Policies

The Thames and Wey and Arun Streams Catchment Flood Management Plans also advocate the following policies relating to SuDS:

- All sites greater than 1 hectare require the following:
    - SuDS,
    - Greenfield discharge rates,
    - Attenuation of the 1 in 100 year storm event including allowance for climate change.
- Allocated land should set-aside space for SuDS.

Volume 2, Chapter 5.9, provides further detailed information on the uses of SUDS in WBC.

8 Future Flood Risk Management Practices

Current flood risk management practices within the WBC SFRA study area have been described in Section 3. This section describes the practices that are planned for the area or can be incorporated into new developments.

8.1 Strategic Flood Defences and Maintenance

Flood defences are typically designed and constructed to protect people and property from a given magnitude of flood. This is referred to as the design standard and may vary depending on the age of the structure, the value attributed to the people and property it is designed to serve and the scale of works necessary to construct the defence. Within Waverley there are only formal defences along the northern River Wey branch through Farnham. There are other defence assets associated with the Farnham Flood Alleviation scheme, including engineered sections and areas of bank protection. Further information on the flood defences within the Borough are detailed in Volume 2, chapter 3.

There are a number of small watercourses across the study area; it is important that a maintenance regime is in place to ensure that there are regular cleaning and debris removal to prevent blockages from occurring. Where blockages do occur flooding can occur quickly and although the disruption caused may be localised, flood depths and hazards can be significant. Across the study area, the responsibility for these watercourses lies with different organisations; but primarily with the Riparian owner (the person owning the banks). Waverley Borough Council and the Environment Agency have powers to maintain watercourses. Thames Water have powers to undertake maintenance of foul or combined sewers.

It is important for Waverley Borough Council where possible to establish good relationships with the other maintaining bodies for these watercourses and then an open forum of discussion can exist, which in turn would lead to the benefit of flood risk across the Waverley Borough. Mapping of, and improved communication between the bodies responsible for surface water drainage infrastructure, is a key recommendation of the Pitt review.

8.1.1 Flood Warning

Ensuring people in areas of flood risk are aware of potential flooding is key to ensuring they are prepared, facilitating the protection of property and evacuation where necessary (refer to Chapter 12 for additional information).

Flood Warning is an essential component of the strategy to reduce flood risk. The Environment Agency seeks to provide a flood warning service in all areas at risk of flooding. It consists of three flood warning codes from 'Flood Alert' to 'Severe Flood Warning' that indicate the level of danger. The flood warnings are disseminated through a variety of mediums that include TV, radio, an automated voice messaging service direct to a phone/fax/pager, the Internet and/or loudhailer. There is also an emergency Floodline number (0345 988 1188) and a quick dial number for individual rivers.

The flood Warning area of the River Wey is situated in a larger geographical area, where the Environment Agency provide a general Flood Alert early notification to possible flooding. However, the flood warning system only operates for fluvial flooding taking into consideration that a significant number of properties within urban areas of the study area at risk from surface water flooding or experience flooding too quickly for current warning systems to be effective, means that most flooding incidents are likely to occur without any warning. The Flood warnings summary webpage, showing areas at risk of flooding can be found at:

http://apps.environment-agency.gov.uk/flood/31618.aspx

This is a four stage warning system and each stage will trigger a set of procedures for various organisations. Definitions and symbols for each warning code are described in Table 8-1.

Volume 3, Figure 2 shows the flood alert and flood warning areas for covering Waverley Borough Council. These include the areas that encompass Cranleigh Waters, the River Lox, the River Blackwater and The Cove Brook, and the Upper River Wey. Additionally Flood Alert Areas include groundwater flooding alerts in the Godalming, Shackleford and Hambledon areas, and the Haslemere and Churt areas.

Table 8-1 - Flood Warning and Flood Alert symbols and Actions

Symbol	Status
	Severe Flood Warning Severe flooding Danger to life
	Flood Warning Flooding is expected Immediate action is required
	Flood Alert Flooding is possible Be prepared

8.1.2 Flood Alleviation Scheme Maintenance

The potential for flooding can be increased in areas where flood alleviation measures are not maintained regularly and/or adequately. Breaches in raised flood defences, for example, are most likely to occur where the defence has been degraded or not maintained to its design standard. Drainage infrastructure in urban areas can also frequently become blocked with debris which, if not removed, can lead to blockages in culverts and backing up of a watercourse resulting in flooding of property and infrastructure.

It is an essential aspect of flood risk management practise that all flood alleviation schemes and hydraulic structures are regularly maintained to a specified design standard. It is the responsibility of the appropriate Risk Management Authority to maintain the watercourses or defences to a suitable standard. The Local Authority or Environment Agency has permissive powers to act should the riparian owner not satisfy their maintenance requirements.

8.1.3 Flood Mitigation on site

Flood mitigation measures can also be incorporated within a development and are usually more appropriate in areas of residual flood risk. The Pitt Review (Sir Michael Pitt, 2008) recognised the importance of flood resilient and resistant techniques and came to an interim conclusion (IC11) that *"no new building should be allowed in a flood risk area that is not flood-resilient, and that Government should work with organisations such as the Royal Institute of British Architects and the building industry to encourage flood-resilient building and development design."*

The Code for Sustainable Homes (CLG, April 2010) also offers credits for developments that consider flood risk. Preference is given to sites located in low flood risk zones, commensurate with policies presented in NPPF. One credit is made available for developments in Flood Zones 2 or 3 that are appropriately flood resilient and resistant.

Similar to the code for sustainable homes there is also a guide for Non-Domestic Buildings (CLG, 2011). One credit is made available for developments in Flood Zone 2 or 3 and 2 credits are available for developments in Flood Zone 1.

When including flood avoidance (which should always be the first consideration through application of the Sequential Test) flood risk mitigation measures that can be employed on individual sites can be split into three categories:

- Flood Avoidance
- Flood Resistance
- Flood Resilience

8.1.4 Flood Avoidance

This is defined as: -

'Constructing a building and its surrounds (at site level) in such a way to avoid it being flooded (e.g. by raising it above the flood level, re-sitting outside flood risk area etc.)'.

These are used to restrict the pathway between the flooding source and the receptor. The preferential option is to locate the building outside a flood risk area through rearranging the site layout if possible, alternatives within this category could include a permanent or temporary defence such as raised kerbs to contain and route flood water through a site or demountable barriers.

8.1.5 Flood Resistance

This is defined as:-

'Constructing a building in such a way to prevent floodwater entering the building and damaging its fabric'.

Floodwaters will enter buildings through the weakest points in the construction which maybe in the brickwork, party walls of terraced or semi-detached buildings, expansion joints between walls where different construction materials meet, vents, door thresholds, seepage from below ground through floors and basements and/or sanitary appliances from backflow from surcharged drainage systems.

Flood resistance techniques can be employed on buildings. These can include raising finished floor levels 300mm above the design flood level including an allowance for climate change and the use of appropriate materials that can withstand periodic flooding. They include the use of low permeability materials in the construction of the building and are likely to only be effective for short duration flood events and of low flooding depths (less than 0.3 m). They may be used in conjunction with flood resilience techniques when the predicted flood level is between 0.3 - 0.6 m.

8.1.6 Flood Resilience/Repairable

This is defined as:-

'Constructing a building in such a way that although floodwater may enter the building its impact is reduced (i.e. no permanent damage is caused, structural integrity is maintained and drying and cleaning is facilitated)'.

Flood resilience techniques are also employed on buildings within the floodplain. This type of approach is often more appropriate when the predicted depth of flooding is greater than 0.3 m or flooding is expected to last for a long time. In these cases the use of more durable materials that will not be easily damaged by floodwaters as well as the use of construction materials that are more effective at draining and drying are recommended.

There is currently no guidance with the UK Building Regulations for appropriate means of construction for properties in flood risk areas. For more information on flood resistant construction refer to the Communities and Local Government publication 'Improving the Flood Performance of New Buildings: Flood Resilient Construction' (May, 2007).

9 SFRA Maintenance and Management

9.1 Introduction

This chapter provides an introduction to the maintenance and management procedures that are required to ensure the Waverley SFRA remains up-to-date and continues to make use of the best available information. Implementing a maintenance and management procedure for the SFRA will assist WBC to regularly review the technical data available and to commission technical updates where necessary.

Throughout this chapter, several key actions are recommended in the implementation of a maintenance and management structure for the SFRA. These actions are highlighted in **blue bold text.**

9.2 Data Collection

This section describes the data collection process, presents the available data and discusses its benefits and limitations. A comprehensive record of all the data collected through the production of the Level 1 SFRA update is presented in a document register in **Appendix A.**

The information presented in this report should not be considered as an exhaustive list of all available flood related data for the study area. The Level 1 SFRA is a presentation of the data collected following consultation with and input from the partnering local authorities and agencies within the timeframe available.

The Level 1 SFRA assessment methodology is based on using available existing information and data where suitable. As a result, there has been no new investigation undertaken for this SFRA.

9.2.1 Stakeholders

The information used in this SFRA has been sourced from a variety of stakeholders including,

- Waverley Borough Council;
- Surrey County Council;
- Environment Agency;
- Wey and Arun Canal Trust;
- Thames Water;
- National Trust; and
- British Geological Survey;

It is recommended that during future iterations of the SFRA, the above organisations are contacted to ensure that the most up-to-date records are included in the SFRA.

All data collected was registered on receipt and reviewed to assess its contribution to the Level 1 SFRA. Details are presented in Appendix A.

9.3 Data Processing

The following data processing was undertaken during the development of the SFRA:

- Various historic records of flooding have been evaluated in GIS to determine source of flooding and to compile new datasets. Maps and figures were produced using map templates designed for the SFRA report.

- All other flood risk datasets and catchment information has been analysed in GIS to fully understand flood risk across Waverley.

9.4 Data Ownership

The datasets obtained for use in the SFRA have come from a number of sources under licence agreement. These cannot be passed to external sources without permission from the owner and those requiring the data should ensure that they possess the appropriate copyrights and access. **WBC should be aware of the Intellectual Property Rights they possess so that they only issue data that is contractually appropriate. Datasets produced during the SFRA are owned by Waverley Borough Council and should only be passed to external parties at their discretion**. Other datasets are the property of the EA and should not be released by WBC.

It is recommended that information on all sources of flooding continues to be collected and that where appropriate more resources are invested in determining the source and pathways of flooding. When more detailed or updated hydraulic modelling becomes available from the EA or other sources this information should be incorporated into the SFRA. More detailed information may also be collected for FRAs carried out by developers and land owners at the local site scale. Information from site level FRAs will be submitted to the LPA and the Environment Agency as part of the development control process and should be used to inform the SFRA in the future.

9.5 SFRA data management system

The data management strategy developed for the SFRA is designed to account for likelihood that external parties will seek to make use of the information within the SFRA in preparing flood risk assessments and assessing sites. The SFRA is also a "live" document, and as such it is necessary to ensure at regular intervals in the future that the information within it remains valid.

The final deliverables of the SFRA are delivered in two forms:

- Digital copies of the SFRA reports – the contents are divided into several volumes and chapters to allow easier update during future iterations.
- Electronic datasets including:
    - Raw GIS data - SFRA flood outlines and additional GIS data layers used to produce the SFRA maps and figures. Some of these were obtained under licence from the Environment Agency. All data is provided in a format compatible with Waverley Borough Councils existing corporate GIS infrastructure.
    - Electronic document management system - PDF versions of all maps and reports produced during the SFRA.

To ensure that the SFRA remains 'live' it is important to nominate a Steering Group with responsibility for monitoring, managing and maintaining the SFRA, as shown in Figure 9-1. It is recommended that the monitoring of the SFRA is linked to the Borough's Annual Monitoring Report.

By following this process of information dissemination and review, the Management Group can ensure a consistent and up to date supply of strategic flood risk information to all levels of planning process.

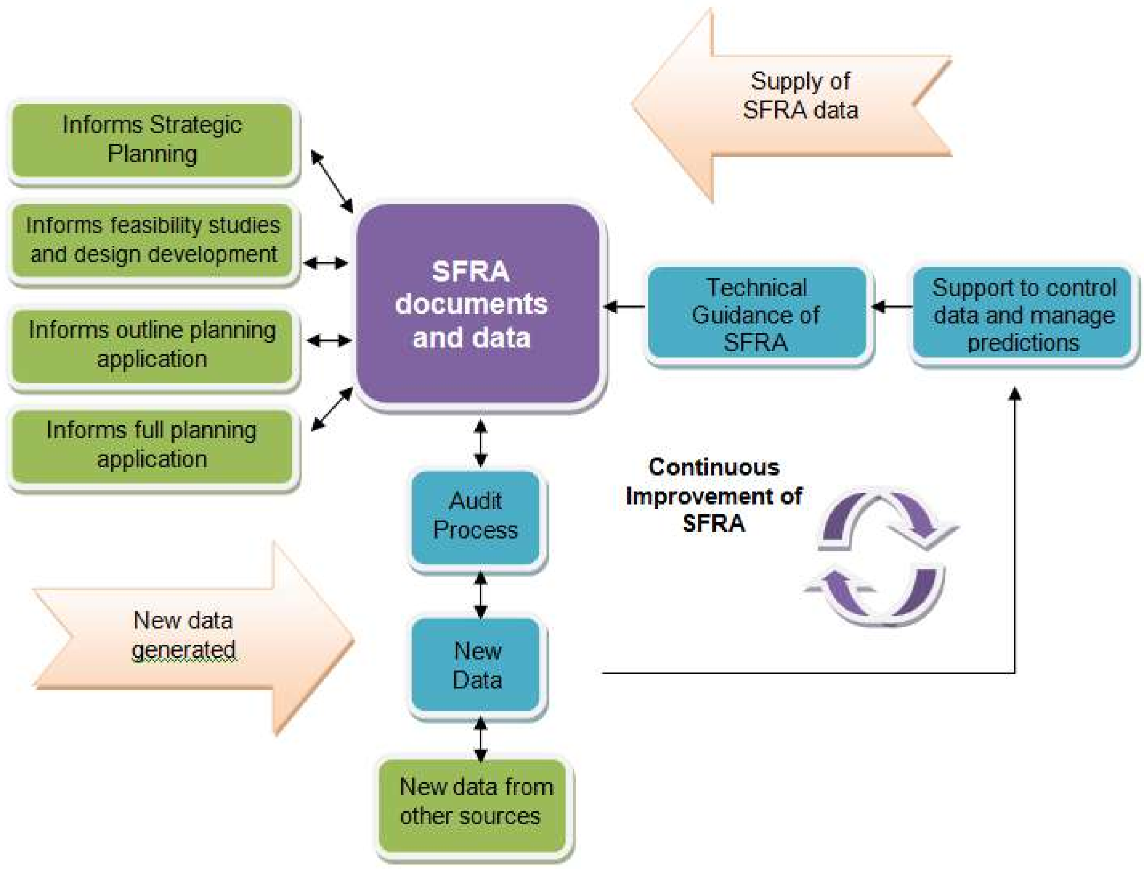

Figure 9-1: SFRA Data management System

9.6 Monitoring the SFRA

It is in the interest of Waverley Borough Council that the SFRA remains current and up-to-date. **To help facilitate this, it would be useful for the Council to liaise regularly with Thames region and Arun and Western Streams divisions of the Environment Agency to discuss the need for an update and if necessary organise an annual meeting to review the SFRA. Prior to this, it is recommended that the following maintenance checks be undertaken:**

- **Review the datasets used in the SFRA to ensure they are up to date.**
- **Consider whether a formal review of the SFRA is necessary.**

Whilst all datasets should be checked for updates and key organisations contacted, Table 9-1 contains a list of datasets that are likely to be updated regularly.

Table 9-1: Datasets that are suggested are updated regularly

Dataset	Owner	Comment
Flood Maps for Planning	Environment Agency	Updated quarterly
Catchment Flood Management Plans	Environment Agency	Updated every five years
National Flood and Coastal Defence Database (NFCDD)	Environment Agency	Ongoing updates
Historic flood incidents	Environment Agency, Water companies, Fire Brigade, Highways Dept WBC, Surrey County Council	Unknown

9.7 Incorporating new datasets

The following tasks should be undertaken when including new datasets in the WBC SFRA:

- **Identify new dataset.**
- **Save new dataset/information.**
- **Record new information in a log so that next update can review this information.**

9.8 Updating SFRA reports and figures

Volume 2 provides a record of all of the technical analyses used to develop the Waverley SFRA. In recognition that the SFRA will be updated in the future, the report has been structured in chapters according to the sources of flooding investigated. By structuring the report in this way, it is possible to undertake further analyses on a particular source of flooding and only have to supersede the relevant chapter, whilst keeping the remaining chapters unaffected.

In keeping with this principle, the following tasks should be undertaken when updating SFRA reports and figures:

- **Undertake further analysis as required after SFRA review**
- **Document all new technical analysis by rewriting and replacing relevant Volume 2 chapter/s.**
- **Amend and replace relevant SFRA Maps in Volume 3.**
- **Review and if required, amend Chapter 1 of Volume 1.**
- **Reissue to departments within Waverley Borough Council and other stakeholders.**

9.9 When should the SFRA be updated?

Volume 2 provides a record of all of the technical analyses used to develop the Waverley Borough SFRA. In recognition that the SFRA will be updated in the future, the report has been structured in chapters according to the sources of flooding investigated. By structuring the report in this way, it is possible to undertake further analyses on a particular source of flooding and only have to supersede the relevant chapter, whilst keeping the remaining chapters unaffected.

In keeping with this principle, the following tasks should be undertaken when updating SFRA reports and figures:

- Undertake further analyses as required after SFRA review
- Document all new technical analyses by rewriting and replacing relevant Volume 2 chapter/s.
- Amend and replace relevant SFRA Maps in Volume 3.
- Review and if required, amend Chapter 1 of Volume 1.
- Reissue to departments within Waverley Borough Council and other stakeholders.

10 Recommendations

Evidence collected through this Level 1 SFRA shows that Waverley is susceptible to flooding from a variety of flood sources, including:

- Fluvial;
- Surface Water;
- Drainage/Sewers;
- Groundwater.

Environmental responses to climate change are expected to exacerbate flooding from all sources unless management practices are changed and/or mitigation measures are implemented.

10.1 The Next Stage

10.1.1 Strategic Planning Policy

Using the information presented in this Level 1 SFRA, WBC should apply the Sequential Test to their strategic land allocations and future windfall sites, seeking to guide development to areas of lowest flood risk.

Where there are insufficient sites in areas of low flood risk to accommodate all of the required growth, consideration can be given to development in flood zones, but WBC should give consideration to the vulnerability of developments, seeking to match development vulnerability to acceptable levels of flood risk.

In addition WBC should give consideration to the policy recommendations, outlined below, in the preparation of its Local Plan.

10.2 Policy Recommendations

The objectives of this SFRA are set out in Chapter 1, and outlined in Table 10-1.

Table 10-2 highlights the key policy recommendations needed in order to meet these objectives. National and local planning policies have been reviewed along with the objectives and aspirations identified by the Environment Agency have been considered when making the policy recommendations.

Table 10-1 – SFRA objectives

Objective	
1	Identify the extent of all Flood Zones
2	Identify areas at risk of flooding from all flood sources present in the study area, providing WBC with the tools required to apply the Sequential Test
3	Provide evidence-based report which inform WBC's Local Plan and other Development Plan Documents about managing potential flood risk which are also suitable to inform the Sustainability Appraisal of related documents
4	Advise WBC on suitable policies to address flood risk management in a consistent manner across its administrative area
5	Advise WBC on the requirements of site specific flood risk assessments based on local conditions and policy recommendations
6	Advise WBC on the principles, objectives and applicability of Sustainable Drainage Systems (SuDS) throughout the study area
7	Present information to inform WBC of the flood considerations necessary in developing and progressing flood emergency planning.

Table 10-2: SFRA Flood Risk Policy Recommendations

	Policy Recommendation	More Information
1	Emergency Planning • Updated EA flood warning codes and alert information should be included in future updates of SFRA and in the development of the Waverley Borough Council Emergency Plan and Multi Agency Flood Plan • Consideration should be given by the council to the identification of alternative routes for emergency vehicles if the A3 and A31 are closed due to flooding. • Composition of evacuation plans should consider local knowledge and mobility of occupants • Evacuation plans for new developments should seek advice from emergency services to plan safe access and egress routes • The Multi Agency Flood Plan should be updated to include new developments and redevelopments.	Volume 1, Chapter 6 and 10
2	Flood Incident Information • Periodic review of the SFRA should be undertaken to incorporate any future flood incidents from all sources and updated flood risk information. • Information on all sources of flooding should continue to be collected, and reviewed. More resources should be invested in recording the source, location and date of flood incidents	Volume 1, Chapter 9

3	Defences • The most current NFCDD / AIMS extract should be used in future updates of the SFRA document • The condition of the defence information and standard of protection should be considered in assessing actual risk	Volume 2, Chapter 3
4	Flood Risk from Rivers • Updates to the Environment Agency Flood Maps for planning should be included in SFRA updates • Updates to existing or new detailed hydraulic model results should be incorporated into future SFRA updates. • Development proposals located in Flood Zone 2 and 3 should be subject to the Sequential Test and the Exception Test as required. Where the Exception Test is required, WBC will be required to undertake a Level 2 assessment. • All areas within Flood Zone 3 should be considered Flood Zone 3b (Functional Floodplain) unless or until an appropriate FRA shows, to the satisfaction of the Environment Agency, that it can be considered as falling within Flood Zone 3a (High Probability) • Consideration should be given both to areas indicated as at potential risk of flooding, and to the rural upper catchments, as any significant development in these areas could increase runoff entering the river network and therefore increase fluvial flood risk in Waverley and beyond.	Volume 2, Chapter 4
5	Catchment wide management • The policies of the CFMPs should be considered in planning policies to achieve continuity for both WBC and the wider area. • It is recommended that WBC liaise with adjacent LPAs regarding development policies in their administrative areas, to ensure consistency and 'joined up thinking' in relation to flood risk management.	Volume 2, Chapter 4

6	Flood Risk from Surface Water • Long term operation and maintenance of SuDS are a key requirement in managing surface water flood risk. WBC should adopt policies that reflect the changes in SuDS policies. • New development proposals should consult the Environment Agency and Thames Water for localised surface water flood risk information. Land use planning recommendations for managing SW • In areas of the catchment where the geology is less permeable, attenuation SuDS may be more suitable than infiltration SuDS. • Policies should be developed to ensure appropriate surface water management and mitigation in the low lying developed areas of Cranleigh, Bramley, Farnham, Weybourne, Upper Hale, Badshot Lea, Chiddingfold, Haslemere, Shottermill, Godalming and Milford.	Volume 1, Chapter 3 Volume 2, Chapter 5
7	Flood risk from Sewers • All new developments, and where possible existing networks, are advised to separate foul and surface water drainage to reduce the chance that flooding from drains is contaminated. • Individual proposed developments are required to carry out a more detailed sewer flooding assessment.	Volume 2, Chapter 6
8	Land use planning recommendations for managing SW • A more detailed assessment of groundwater flooding is required for individual proposed developments. • It is important to consider the risk of groundwater flooding when allocating development sites, and also when applying the sequential test to windfall sites. •	Volume 2, Chapter 7
9	Artificial Sources • Communication with WBC, the Wey and Arun Canal Trust and the Environment Agency should be undertaken in relation to future planning applications within close proximity of the canal to help identify any information to inform a FRA.	Volume 2, Chapter 8

10.2.1 Requirement for a Level 2 SFRA

In some cases application of the Exception Test may be required. Should this be the case a Level 2 SFRA will be required to improve the quantity/quality of data available in the areas requiring the Exception Test such that decisions regarding the safety and impact of the proposed developments can be made robustly.

Such situations will include any development allocations in areas of Flood Zone 3 and some locations in Flood Zone 2 where the development vulnerability dictates.

10.2.2 Development Control

WBC Development Control Officers should familiarise themselves with the SFRA and ensure that site specific Flood Risk Assessments are provided where necessary and prepared against the recommendations of Table 6.1.

10.2.3 Emergency Planning

WBC should use the findings of this Level 1 SFRA to refine and inform emergency plans developed for the area. This should include liaison with local emergency services to share and discuss the available data and its implications for emergency planning. Using information presented within this SFRA, the new Waverley emergency plans can be integrated with the planning system for those developments that cannot be located in lower risk flood zones.

10.2.4 River Wey River Bank Strategy

WBC should advise riparian owners and future property developers on their obligations for the maintenance of riparian areas including maintaining and where necessary improving the standard of defence offered by flood defence structures along the River Wey through Waverley.

Such a strategy should give strong consideration to the policy recommendations made in Section 10.2 and be developed through consultation with the Environment Agency.

11 References

- National Planning Policy Framework. Department for Communities and Local Government (March 2012)
- Planning Practice Guidance: Flood Risk and Coastal Change. Department for Communities and Local Government (March 2014)
- Thames Catchment Flood Management Plan: Summary Report. Consultation Environment Agency, Bristol (December 2009)
- Arun and Western Streams Catchment Flood Management Plan: Summary Report. Environment Agency, West Sussex (December 2009)
- Surrey County Council Preliminary Flood Risk Assessment (June 2011)
- Winter Readiness 2014-15 report. Waverley Resilience Group (November 2014)
- Waverley Multi Agency Flood Plan. Waverley Borough Council (November 2014)
- Lower Wey Remodelling Flood Study Modelling Report. Mott MacDonald (December 2009)
- River Blackwater Flood Study Final Flood Mapping report. Peter Brett Associates (August 2007)
- River Wey Flood Mapping Study. Atkins (February, 2006)
- Living with Environmental Change. study led by NERC (2013)
- Designing for Exceedance in Urban Drainage – good practice (C635). CIRIA (May 2006)
- Planning for SuDS – making it happen (C687). CIRIA (December 2010)
- The SUDS Manual (C697D). CIRIA (March 2007)
- Site Handbook for the Construction of SuDS (C698D). CIRIA (February 2007)
- Guidance on the Permeable Surfacing of Front Gardens. Department for Communities and Local Government (May 2009)
- Promoting Sustainable Drainage Systems: Design Guidance for Islington. Robert Bray Associates Ltd, Islington Borough (March 2012)
- Sustainable Drainage Systems (SuDS) – an introduction. Environment Agency (May 2003)
- Floods Review. Sir Michael Pitt (2008) (http://www.cabinetoffice.gov.uk/thepittreview.aspx)
- Living on the Edge. Environment Agency (2014)
- Flood Risk Standing Advice (March 2014) for local Planning Authorities (https://www.gov.uk/flood-risk-standing-advice-frsa-for-local-planning-authorities)

12 Glossary and Notation

Term	Definition
Alluvium	Sediments deposited by fluvial processes / flowing water
Annual Exceedance Probability (AEP)	The probability of an event occurring within any one given year.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Breach	An opening – For example in the sea defences
Brownfield	Previously developed land, usually of industrial land use within inner city areas.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert/culverted	A channel or pipe that carries water below the level of the ground.
Drift Geology	Sediments deposited by the action of ice and glacial processes
EA Flood Zone 1	Low probability of flooding
EA Flood Zone 2	Medium probability of flooding. Probability of fluvial flooding is 0.1 – 1%. Probability of tidal flooding is 0.1 – 0.5 %
EA Flood Zone 3a	High probability of flooding. Probability of fluvial flooding is 1% (1 in 100 years) or greater. Probability of tidal flooding is 0.5%(1 in 200 years)
EA Flood Zone 3b	Functional floodplain
Estuary	A tidal basin , where a river meets the sea, characterised by wide inlets
Exception Test	The exception test should be applied following the application of the Sequential Test. Conditions need to be met before the exception test can be applied.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood Resilience	Resistance strategies aimed at flood protection
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption)
Flood Risk Assessment	Considerations of the flood risks inherent in a project, leading to the development actions to control, mitigate or accept them.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Flood Zone	The extent of how far flood waters are expected to reach.
Fluvial	Relating to the actions, processes and behaviour of a water course (river or stream)
Fluvial flooding	Flooding by a river or a watercourse.
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.
Freeboard	Height of the flood defence crest level (or building level) above designed

	water level.
GIS	Geographic Information System – A mapping system that uses computers to store, manipulate, analyse and display data
Greenfield	Previously undeveloped land.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Highly Vulnerable Developments	Developments that are at highest risk of flooding.
Hydraulic Modelling	A computerised model of a watercourse and floodplain to simulate water flows in rivers too estimate water levels and flood extents.
Hydrodynamic Modelling	The behaviour of water in terms of its velocity, depth and hazard that it presents. Infiltration The penetration of water through the grounds surface.
Infrastructure	Physical structures that form the foundation for development.
LiDAR	Light Detection And Ranging – uses airborne scanning laser to map the terrain of the land.
Local Plan	Waverley's statutory development plan, comprising Part 1 (Strategic Policies and Sites) and Part 2 (Development Management and Site Allocations).
Local Planning Authority	The local authority or council empowered by law to exercise statutory planning functions for its administrative area.
Main River	Watercourse defined on a 'Main River Map' designated by DEFRA. The environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Overtopping	Water carried over the top of a defence structure due to the wave height exceeding the crest height of the defence.
Reach/ Upper reach	A river or stream segment of specific length. The upper reach refers to the upstream section of a river.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Riparian Owner	Owners of land adjoining, above, or with a watercourse running through it. Riparian owners have rights and responsibilities associated with river management.
Risk	The probability or likelihood of an event occurring.
River Catchment	The areas drained by a river
SAR	Synthetic Aperture Radar - a high resolution ground mapping technique, which uses reflected radar pulses.
Sequential Test	Aims to steer development to areas of lowest flood risk.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Solid Geology	Solid rock that underlies loose material and superficial deposits on the earth's surface
Source Protection Zone	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Standard of Protection	The flood event return period above which significant damage and possible failure of the flood defences could occur.

Storm surge	A high rise in sea level due to the winds of the storm and low atmospheric pressure.
Sustainability	To preserve /maintain a state or process for future generations.
Sustainable drainage system	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs
Tidal	Relating to the actions or processes caused by tides.
Topographic survey	A survey of ground levels.
Tributary	A body of water, flowing into a larger body of water, such as a smaller stream joining a larger stream.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

Appendix A - Data Document Register

Data	Description	Date Provided	Owner / Author
Upper Wey Modelling Study	Study undertaken by Atkins for the Environment Agency in 2006. Model outlines for the 20%, 5%, 1% and 1%+CC AEP events.	February 2015	Environment Agency
Lower Wey Modelling Study	Study undertaken by Mott Macdonald for the Environment Agency in 2009. Model outlines for the 20%, 5%, 2%, 1% 1%+CC and 0.1% AEP events.	February 2015	Environment Agency
River Blackwater Flood Risk Mapping Study	Study undertaken by JBA for the Environment Agency. Model outlines for the 20%, 1% and 1%+CC AEP events.	February 2015	Environment Agency
Waverley Infrastructure Resilience Group – Winter Readiness 2014-2015	Multi Agency response report to capture lessons learned from winter 2013-2014 weather events.	January 2015	Environment Agency
Historic Flood Data	GIS outlines showing recorded outlines and updated Historic Flood Map.	January 2015	Environment Agency
Flood Risk and Flood Alert Areas	GIS outlines showing the EA flood alert and flood warning areas covering WBC	December 2014	Environment Agency
Statutory Main Rivers	Watercourses layer – line data only at 1:10000 scale	January 2015	Environment Agency
Detailed River Network	Watercourses layer – line data only at 1:10000 scale	January 2015	Environment Agency
Risk of Flooding from Reservoirs Information	GIS layer showing the areas susceptible to flooding from Reservoirs	February 2015	Environment Agency
Flood Map	Flood Zone 2, Flood Zone 3, Defences, Areas Benefitting From Defences.	January 2015	Environment Agency
Updated Flood Map for Surface Water	Second generation flood map for surface water generated from a digital terrain model.	January 2015	Environment Agency
Historic Flood Incident Database	List of identified wetpots within WBC (for public use)	February 2015	Surrey County Council
Historical Flood Records	Wetspot database identifying areas reported to flood along roads within the Borough.	January 2015	Surrey County Council
Multi Agency Flood Plan (draft)	Report outlining areas susceptible to flooding and how responses should be	January 2015	Waverley Borough Council

	managed.		
Thames Catchment Flood Management Plan	Composed by the Environment Agency in December 2009, outlines flood risk management across the West Thames catchment	January 2015	Environment Agency
Wey and Arun Streams Catchment Flood Management Plan	Composed by the Environment Agency in December 2009, outlines flood risk management across the Wey and Arun catchments	January 2015	Environment Agency
Preliminary Flood Risk Assessment	Composed by Surrey County Council, June 2011	January 2015	Downloaded from Internet
Sewer Flooding Information	DG5 extract for Waverley Borough council	January 2015	Thames Water
Information on the Wey and Arun Canal	Correspondence on Historic Flood incidents	February 2015	Wey and Arun Canal Trust
Mapping	The 2009 OS Mapping (50k and 250k) was re-used under a new licence (2014) from the Ordnance Survey.	December 2014	Waverley Borough Council
Flood Risk from Groundwater Information	GIS layer showing areas susceptible to groundwater flooding	January 2015	British Geological Society
Detailed SuDS suitability Map	GIS layer containing detailed information surrounding ground suitability for sustainable drainage systems.	January 2015	British Geological Society
Reports of historic flood incidents	Email correspondence for the Waverley Parish Councils detailing reported flood incidents	January 2015	Busbridge, Chiddingfold, elstead, Ewhurst and Ellens Green, Hambledon. Witley

Appendix B - Additional Guidance on applying the Sequential Test

12.1 Additional Guidance

The sequence of steps presented below in tandem with Figure 4.1 is designed to provide WBC and developers with additional guidance on how to apply the Sequential Test strategically. The steps are designed to ensure land allocations are allocated in line with the principles of the Sequential Test or, failing this, that the requirement for application of the Exception Test is clearly identified.

1. The strategic developments (i.e. housing, hospitals, industrial etc) that need to be accommodated in the WBC administrative area within the lifetime of its Local Plan should be assigned a vulnerability classification in accordance with Table 2 "Flood Risk Vulnerability Classification" in NPPG;
2. The Flood Zone classification of all development sites identified by WBC should consider the effects of climate change on flood zone definition for the design life of any development that the site may be suitable for, i.e: 60- year design life for non residential development. Planners should use their experience within their locality to assess how long they anticipate the development being present for. Developers would be expected to justify why they have adopted a given lifetime for the development when preparing a site specific flood risk assessment. Residential development should be considered for a minimum of 100 year design life unless there is specific justification for considering a shorter period.
3. In the first instance the 'highly vulnerable' developments the LPA is required to accommodate should be located in those sites it has identified as being within Flood Zone 1. If the 'highly vulnerable developments' cannot be located in Flood Zone 1, because the identified sites are unsuitable or there are insufficient sites in Flood Zone 1 then sites in Flood Zone 2 can be considered. If sites in Flood Zones 1 and 2 are inadequate, then to accommodate the development the LPA may have to identify additional sites in Flood Zones 1 or 2 or seek opportunities to locate the development outside their administrative area.
4. Once all 'highly vulnerable' developments have been allocated to a development site, the LPA can consider those development types defined as 'more vulnerable'. In the first instance 'more vulnerable' development should be located in any unallocated sites in Flood Zone 1. Where these sites are unsuitable or there are insufficient sites, sites in Flood Zone 2 can be considered. If there are insufficient sites in Flood Zone 1 or 2 to accommodate the 'more vulnerable' development types, sites in Flood Zone 3a can be considered. However, any 'more vulnerable' developments in Flood Zone 3a will require application of the Exception Test (described in Section 0).
5. Once all 'more vulnerable' developments have been allocated to a development site, the LPA can consider those development types defined as 'less vulnerable'. In the first instance 'less vulnerable' development should be located in any remaining unallocated sites in Flood Zone 1, 2 or 3a (in that order). Less vulnerable development types are not appropriate in Flood Zone 3b – Functional Floodplain.
6. 'Essential infrastructure' developments should also be preferentially located in the lowest flood risk zone, however this type of development can be located in Flood Zones 3a and 3b, where necessary, through application of the Exception Test.
7. Finally, it is recommended that water compatible development is allocated last. Water compatible developments typically have the least flood risk constraints and therefore it is considered appropriate to consider them last when allocating development sites.

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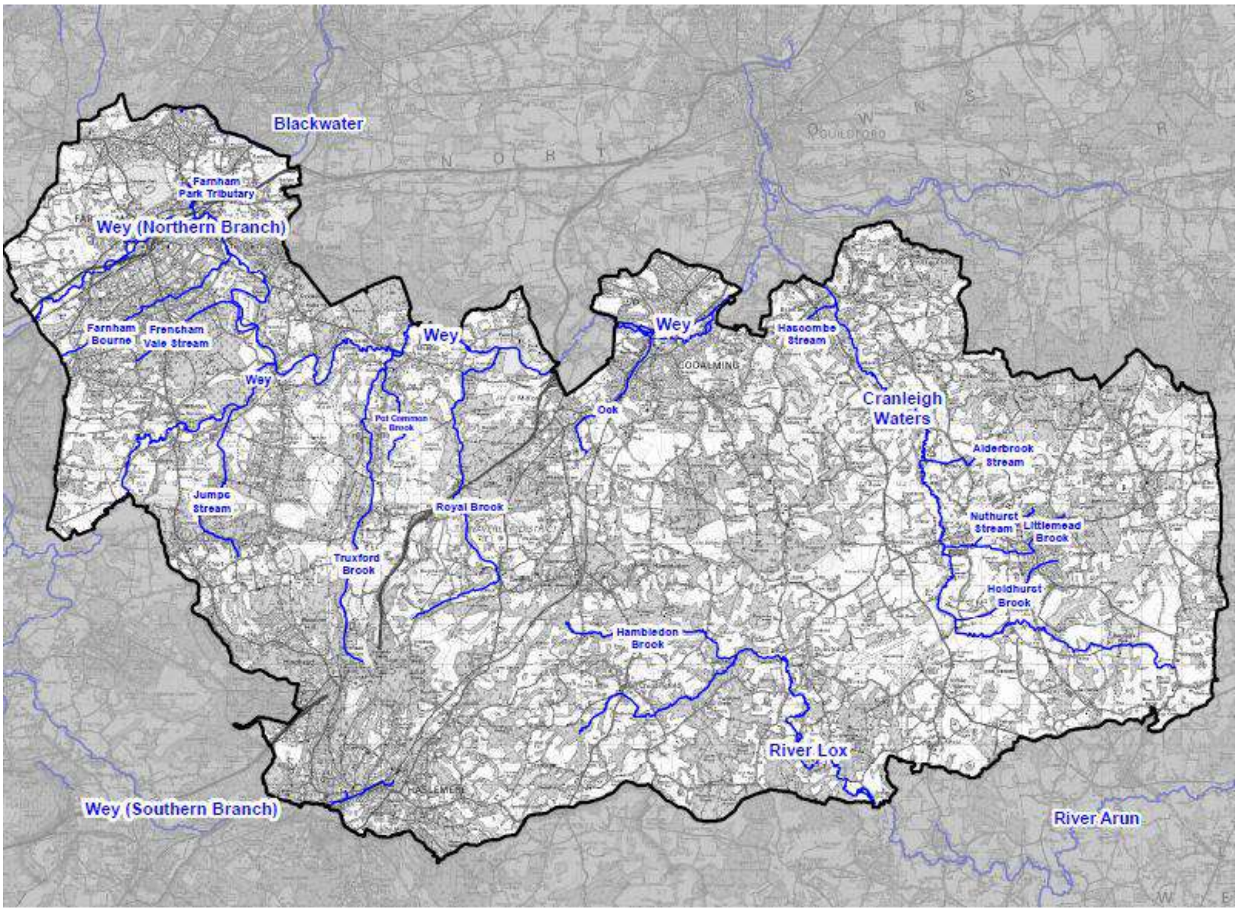
Waverley BOROUGH COUNCIL

Waverley Borough Council Strategic Flood Risk Assessment Final Draft Volume 2 Technical Report

July 2015



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Quality Management

Job No	CS078301		
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1	March 2015	Draft for Submission to WBC and EA	CJ / HT	KF	MA
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whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report at their own risk.

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Executive Summary

Introduction

This report is an update of the Strategic Flood Risk Assessment (SFRA) for Waverley Borough Council (WBC). The existing SFRA was produced in 2010, in line with the now superseded Planning Policy Statement 25 (PPS25). The updated report has been prepared in accordance with current best practice, the updated National Planning Policy Framework (NPPF) and its accompanying Flood Risk and Coastal Change Planning Practice Guidance (PPG). A number of new datasets, made available since the 2010 report (including Waverley Borough Council's 'flooding hotspots' map after the winter 2013/14 floods) have been considered or used to update this SFRA. Based on the assessment of present and future flood risk in the Borough from all sources, the updated SFRA will assess the impact that development will have on flood risk. The SFRA enables WBC to select and develop sustainable site allocations away from vulnerable flood risk areas.
The new SFRA will also form a key evidence document to support the vision and approach the Borough's new Local Plan. This document has been created in response to the changes in guidance within the National Planning Policy Framework (NPPF) and its Planning Practice Guidance (PPG), which states that a sequential risk based approach should be applied to decision making at all levels of the planning process.

Structure of the SFRA

Volume 1	Volume 2	Volume 3	
Decision Support Document	**Technical Summary**	**Map Series**	
How to interpret the SFRA results and inform planning decisions	Provides the data and strategy to assess flood risk within Waverley	Provides a full suite of maps to support SFRA decisions	
Introduction	Introduction	Figure 1	Study Area
Flooding in Waverley	Catchment Summary	Figure 2	Flood Warning, Flood Alert and Flood Defences
Policy Context	Asset and Structure Data	Figure 3A	Historic Flooding from Rivers
The Sequential Test	Flooding from Rivers	Figure 3B	Historic Flooding from Surface Water
The Exception Test	Flooding from surface water	Figure 4	EA Flood Maps
Using the SFRA in development control	Flooding from Sewers	Figure 5	Hydraulic Model Outlines
Drainage of Development Sites	Flooding From Groundwater	Figure 6	Climate Change
Future Flood Risk Management Practices	Flooding From Artificial Sources	Figure 7	SFRA Flood Zones
SFRA Maintenance and Management	Uncertainties in Flood Risk Assessment	Figure 8A	Flood Risk for Surface Water (extent)
Recommendations	Summary	Figure 8B	Flood Risk for Surface Water (hazard)
References		Figure 9	SuDS Suitability
Glossary		Figure 10	Flood Risk from Sewers
		Figure 11	Susceptibility to Groundwater Flooding
Appendix A – Data Register		Figure 12	Flood Risk from Artificial Sources

Summary of Flood Risk in Waverley

Type of Flood Risk	Discussion of key areas at risk	Further Information in this SFRA
From rivers	Within Waverley, much of the floodplain is rural and remains undeveloped. Within Farnham, Godalming, Tilford, Milford and Cranleigh, there is development that extends to the maximum outlines of areas identified as high risk. It is important that development remains out of the high risk functional floodplain. Developed areas that have been identified as high risk from previously reported flood incidents and the SFRA Flood Zones are: • Milford: Station Lane, Jubilee fields, Lower Millhouse Lane. • Witley: Oxted Green, Haslemere road, Gasden Lane, New Road, Middlemarch; • Farnham: Light industrial areas between the A325 and A31; • Bramley: Station Road; • Cranleigh: B2130 at Rye Farm, Cranleigh CofE Primary and Glebelands Schools, Rowland Road, Summerlands and The Riding; • Millbridge: A287 at Millbridge Court.	Volume 1 – Chapter 2 Volume 2 – Chapter 4 Volume 3 – Figures 3A, 4, 5, 6 and 7.
From surface water	There are very few areas at medium to high risk of surface water flooding (depth and velocity) within the Waverley Borough Council area. The areas that are identified are mostly located along the natural watercourses, but in certain places, road junctions and development is expected to exacerbate surface water flood risk. These locations include: • Areas adjacent to the railway line at Godalming station; • The junction between A3100 and Bridge street; and • The A287 at Millbridge Court.	Volume 1 – Chapter 9 Volume 2 – Chapter 5 Volume 3 – Figures 3B and 8
From sewers	The urban areas of Godalming, Farnham and Cranleigh are at an increased risk of sewer flooding, due to the increased density or the sewer network and proportion of culverted channels and combined sewer drainage systems. This aligns with historic data that shows properties within GU7, GU9 and GU6 reporting the most incidents of internal and external sewer flooding. Smaller settlements may be at a medium risk of sewer flooding, depending largely on the maintenance of the drains and influence of surface water runoff. The more rural areas across the Borough are at low risk of sewer flooding.	Volume 2 – Chapter 6 Volume 3 - Figure 10
From groundwater	In the south east of the Borough, there is a very low risk of groundwater flooding due to the underlying relatively impermeable clays and mudstones. Along the north western boundary, groundwater flood risk is also likely to be very low. In the predominantly rural areas to the west of Haslemere and to the north of Hambledon and Wormley, there is a low risk of flooding away from the river valleys, where underlying geology is mostly Lower Greensand Formations. Along the river channels, fluvial deposits and high water tables mean that the areas in the north of Godalming, Elstead and through Farnham town centre, there is likely to be a high risk of groundwater flooding, as indicated by	Volume 2 – Chapter Volume 3 - Figure 11

	the BGS groundwater susceptibility datasets. Large areas of impermeable surfaces in urban areas may affect the occurrence of groundwater flooding.	
From artificial sources	The Environment Agency Reservoir Inundation Maps show the following areas at risk of reservoir flooding • Jumps stream and Wey South Branch at Millbridge,downstream of the Frensham Great and Little Ponds • River Wey at Elstead, downstream of the Frensham Little Pond • River Wey in northern Godalming, downstream of the Enton upper Lake • River Ock at Mousehil, downstream of Johnson's Lake • Length of the Cranleigh Waters downstream of Vachery Pond Although the extents of areas at risk are large, most of the areas are at low risk Due to predominantly rural land and a low probability of occurrence.	Volume 2 – Chapter 8 Volume 3 – Figure 12

Objectives of the SFRA

The main objectives of the Waverley SFRA are to:

- Provide an evidence base for the application of the risk based Sequential Test to support planning decisions, in line with NPPF;
- Be strategic by covering a wide spatial area and looking at flood risk today and in the future;
- Support sustainability appraisals of the local plan under development;
- Identify what further investigations may be required in flood risk assessments for specific development proposals.

This SFRA is a live document that is intended to be updated as new information and guidance become available. The outcomes and conclusions of the SFRA may not be valid in the event of future changes to the data or the baseline flooding situation. Decisions also require the inclusive assessment of wider planning issues and the user should be aware that changes to decision making principles affecting other planning issues can potentially affect the outcome of the risk based Sequential Test. It is the responsibility of the user to ensure they are using the best available information.

1. Introduction

The Waverley SFRA provides a broad scale assessment of flood risk. This document is the Volume 2: Technical Report of the SFRA, and should be read in conjunction with Volume 1: Decision Support Document, which provides information on how to interpret the SFRA to inform land use planning, flood warning and emergency planning and development control.

This document outlines and describes the strategy adopted to assess strategic flood risk issues within Waverley Borough Council. The principal requirement for adopting a strategic approach to the assessment and consideration of flood risk is in accordance with advice given in National Planning Policy Framework (NPPF) 2012 and Planning Practice Guidance: Flood Risk and Coastal Change, 2014 (PPG).

This document does not replace, and should be read in conjunction with, national and regional policy including NPPF and relevant regional policy. The SFRA does not replace the responsibility at a broader level to consider wider catchment flood risk management approaches and solutions, nor does it remove the requirement for appropriately focused local/site FRA's.

The assessment evaluates risk as the product of the probability and the consequence of a particular event. Probability is defined as the frequency and magnitude of floods that are generated by fluvial flows and intense rainfall activity. The consequence is defined as the impact of floodwater on receptors (people, property, land, etc). This approach is sympathetic to the concept of source, pathway and receptor now adopted for flood risk management.

The study uses the best available information to assess flood risk. This includes the most up to date Flood Zones from the Environment Agency), and other information, including the Surrey County Council Preliminary Flood Risk Assessment (PFRA), the River Thames and Arun & Western Streams Catchment Flood Management Plan (CFMPs) (2010), and the recently released Updated Flood Map for Surface Water (December 2013). The assessment also includes updated modelling along the River Wey and River Blackwater through the Study Area. This will enable a broad assessment of the Flood Risk for the existing conditions within the study area.

This volume is a full technical report documenting the assumptions, processes and assessment undertaken in the development of the SFRA. It is intended to serve as a transparent record of the decisions and methodology that led to the outcomes of the SFRA.

2. Catchment Summary

2.1 The Catchment

The Waverley SFRA study area covers 344km^2 and incorporates the catchments of four main watercourses: the River Wey, Cranleigh Waters (a tributary of the Wey), the River Lox (a tributary to the upper River Arun), and to a minor extent the River Blackwater at the northern study area boundary. Volume 3, Figure 1 provides an overview of the main rivers and catchment areas.

As well as the main watercourses there are a number of smaller tributaries including the Holdhurst Brook, Littlemead Brook, Nuthurst Stream, Hascombe Stream, Alderbrook Stream, Royal Brook, Truxford Brook, Farnham Bourne and Frensham Vale Stream all within the Wey catchment; and the Hambledon Brook within the Arun catchment. The Wey and Arun Canal, managed by the Wey and Arun Canal Trust, passes through the study area, and was originally built to link the River Wey and the River Arun. It has fallen into disrepair and certain stretches are rarely in water, although there is active restoration to reduce this. The canal has the potential to interact with local watercourses and may influence surface water runoff patterns within the study area.

2.1.1 Wey Catchment

The total River Wey catchment area is 900 km^2, to its confluence with the River Thames outside of the borough catchment, and is predominantly rural in nature. The total length of the main river is 92km. The River Wey is navigable from Godalming downstream to the River Thames and includes a number of navigation channels separate from the main river, with water levels regulated by structures such as locks and weirs. At points where the River Wey and its tributaries pass through urban areas, such as Guildford, Godalming, Farnham and Weybridge, the channel is engineered and canalised to varying degrees. The River Wey and a number of its tributaries contain mill structures, side channels, and divisions within the study area. Flood risk management measures within the catchment are confined to localised flood bunds and bank protection, and there are no formal flood defences within the study area. Schemes to improve channel capacity have been implemented in Farnham.

There are three main tributaries in the upper Wey catchment that are included in the study area: the Northern and Southern branches of the River Wey, and Cranleigh Waters. The source of the Northern Branch lies outside the study area in the vicinity of Alton and the source of the Southern Branch of the Wey is in the vicinity of Haslemere. These two watercourses combine between Farnham and Goldalming (at Tilford) within the Waverley Borough Council area, from which point the watercourse is known as the River Wey. The source of Cranleigh Waters lies just north of Ewhurst. Several minor tributaries enter the River Wey within the northern region of the study area, these includes Truxford Brook and Royal Brook in the vicinity of Elstead and Ock at Goldalming.

The **Wey Northern Branch** flows in a predominantly north easterly direction, entering the study area to the west of Farnham. From here it skirts Farnham to the north before turning in a southerly direction, passing beneath the railway line, to flow towards Tilford. The Wey Northern Branch source is at an altitude of approximately 150m AOD and at the confluence with the Wey South Branch, at Tilford, is approximately 50m AOD. The Wey Northern Branch is approximately 30km long.

The **Wey Southern Branch** flows initially along the study area boundary in a predominantly north westerly direction towards Bordon. The river turns at Bordon to flow in a north easterly direction, re-entering the study area to the south of Farnham. From here it skirts Farnham to the south east before joining with the Wey Northern Branch at Tilford. The Wey Southern Branch source is at an altitude of approximately 185m AOD and at the confluence with the Wey Northern Branch, at Tilford, is approximately 50m AOD. The Wey Southern Branch is also approximately 30km long.

From the confluence of the Northern and Southern Branches, the River Wey flows in a predominantly easterly direction, passing to the north of Elstead and Milford. Further to the east, the River Wey flows through the centre of Godalming, beyond which it exits the study area and turns to the north prior to the confluence with the Cranleigh Waters. The River Wey continues to flow north through Guildford, outfalling into the River Thames at Weybridge. The River Wey, from the Northern and Southern Branch confluence, begins at an altitude of approximately 50m AOD and at the confluence with the River Thames, at Weybridge, is approximately 30m AOD. The River Wey over this reach is approximately 45km long.

From Ewhurst the Cranleigh Waters watercourse flows to the south of Cranleigh before turning to flow in a predominantly north westerly direction towards Bramley and Wonersh. The Cranleigh Waters tributary outfalls into the River Wey beyond Bramley, outside of the study area. The Cranleigh Waters source is at an altitude of approximately 150m AOD and at the confluence with the River Wey, at Broadford, is approximately 30m AOD. Cranleigh Waters is approximately 24km long.

2.1.2 Arun Catchment

The River Lox, within the south of the study area resides in the upper River Arun catchment and rises to the east of Haslemere in the study area and flows in a predominantly north east direction to pass to the south of both Chiddingfold and Dunsfold. The Hambledon Brook, draining the area between Hambledon and Chiddingfold, flows into the River Lox downstream of Chiddingfold before reaching Dunsfold. At Dunsfold the River Lox turns to a south easterly direction towards Loxwood, leaving the study area to the north west of Loxwood. The River Lox outfalls into the River Arun to the south east of Loxwood and North West of Billingshurst, at Drungewick. The altitude at the source of the watercourse is at approximately 120m AOD and at the confluence with the River Arun is approximately 15m AOD. The River Lox is approximately 28km long.

2.1.3 Blackwater Catchment

The River Blackwater rises to the north of Farnham and west of Aldershot, along the northern boundary of the Borough. The watercourse flows to the north of the study boundary to the east of Badshot Lea where it turns north to flow away from the study area towards Farnborough and Frimley. Although the River Blackwater channel is not within the study area, a small extent of its catchment is within the study area. The direction of flow alters at Frimley to the north west prior to outfalling into the River Loddon. The Blackwater begins at a height of approximately 110m AOD and at the confluence with the River Loddon, north of Swallowfield, is approximately 50m AOD. The River Blackwater is approximately 35km long.

2.2 Topography

The topography of a catchment has a significant impact on the mechanisms and processes of flooding. The shape of the land adjacent to rivers will influence fluvial flood extents. For example, in the steeper upper catchment areas the flood extent is likely to be more confined to narrower valleys, where as further downstream, the land is flatter and therefore the extent of flooding is likely to be greater. Topography also influences the speed and quantity of runoff of rainfall, and steep topography particularly in impermeable areas can rapidly transport water to lower lying areas causing surface water flooding or contributing to river flooding. The topography varies moderately within the SFRA study area. Ground levels range from approximately 40 to 250m AOD. The areas at higher elevation (greater than 150m AOD) include the settlements of Haslemere and Hindhead to the south west of the study area, Hale to the north west of the A31, parts of Farnham and the area of Busbridge. Areas of notable low elevation (less than 60m AOD) are associated with the watercourse corridors and include the settlements of Cranleigh, Dunsfold, Bramley, Wonersh, Shamley Green and Farncombe.

Steeper gradients tend to occur around the area of Hindhead, Haslemere, Hascombe, to the south east of Godalming and parts of Farnham. Notably shallow gradients are within the areas of Godalming, Bramley, Cranleigh, Wonersh and Dunsfold due to their location within the valley bottom of the nearby watercourse. Flood risk due to ponding of surface water is more likely in flat, shallow gradient areas than in areas with steeper land gradients. It is therefore likely that Godalming, Bramley, Cranleigh, Wonersh and Dunsfold are at greater risk of surface water flooding compared to areas of steeper gradients. It should be noted that localised hollows within otherwise steep areas could also be subject to surface water flooding.

2.3 Regional Geology

The geology of the catchment area is characterised by two main rock types. The north and north-east region consists of the Lower Greensand formation, whereas in the south and southwest, the Wealden Clay Formation dominates. The Lower Greensand formation comprises mostly of sandstone layers, although around Farnham, in the northwest of the study area several subgroups comprising of mudstones, limestones and a chalk band overlie the Lower Greensand sandstones. The geological boundaries between these units are further defined by the Farnham Bourne and Frensham Vale Stream tributaries. Permeable layers, like the chalk band, allow water to flow through them easier, resulting in both lower surface runoffs as water is absorbed and increased groundwater flood risk from up flow. Alternatively, more impermeable layers are expected to have a lower groundwater flood risk and higher surface water runoff.

Superficial geology (drift deposits) in the study area are predominantly fluvial, Alluvium and River Terrace Deposits, although Head deposits resulting from slope failure also occur. These deposits generally occur adjacent to watercourses, particularly along Cranleigh Waters and Wey. However, there is also a minor area of gravels (consisting of sands and gravels) to the far north west of the study area.

2.4 Main Urban Areas

The WBC area is mostly rural but contains a number of established settlements, incorporating a total of 21 town and parish councils. The largest settlements within the study area are Farnham, located to the northwest, Haslemere, located to the southwest, Godalming, located to the north, and Cranleigh, located to the east of the study area. Development pressure within the study area has increased in recent years due its proximity to Guildford and the commutable distance to London.

Farnham, Godalming and Cranleigh are close to the River Wey (including Cranleigh Waters), while Haslemere is located at the headwaters of the River Wey, on the watershed with the River Arun catchment. In these areas the river channels have been changed historically with the floodplain being constrained by development including the railway lines and major roads. Within the rural areas there has been little, if any, diversion of the watercourses from their natural courses.

Urban areas are potentially susceptible to surface water flooding due to the extent of impermeable area leading to greater and more rapid run-off than within rural areas or failure of the surface water drainage system. Surface water flooding has been recorded within Busbridge, Haslemere, Thursley, Farnham, Witley, Ewhurst and Godalming.

2.5 Infrastructure

In the study area, the main transport infrastructure links are the A3 and A31 trunk roads and the London to Portsmouth (via Guildford) and Farnham to London (via Aldershot) railway lines. The London to Portsmouth railway line has five stations within the study area, at Haslemere, Milford, Witley, Godlaming and Farncombe. These transport links cross main rivers in several places within the upper and middle reaches of the Wey and minor watercourses of the upper reaches of the Arun. The bridges, tunnels, embankments, and culverts associated with these transport links may have a significant effect on flooding processes, through their interaction with the watercourses and their influence on floodplain flows.

Other major roads in the area include the A281 Guildford to Horsham, the A283 from Milford to Chiddingfold, the A286 from Milford to Haslemere, the A287 from Farnham to Haslemere and the A3100 from Guildford to Godalming. The A281, A287 and A3100 potentially have a significant effect on the River Wey and Cranleigh Waters floodplain between Farnham, Godalming, Bramley and Cranleigh and are considered to be at potential risk of flooding from these watercourses. There are a number of critical infrastructure sites (hospitals, schools, fire stations, police stations and sewage treatment works), indicated as being at risk of fluvial flooding within Waverley.

3. Asset and Structure Data

3.1 Introduction

Flood defences help reduce the occurrence, and therefore consequences of, flooding. Some structures provide flood defence benefits, however they are also built to manage low flows or are part of the infrastructure network. These assets can be owned, operated and maintained by the Environment Agency, Local Authorities, private business and/or local residents. In addition to defences, infrastructure such as major roads and railway lines can influence river flows. Although these features are not considered flood defences they influence river flows and floodplain extents.

3.2 Flood Defences

According to the flood defence dataset provided by the Environment Agency, within their flood map for planning dataset, the only formal recorded defence present in the study area is along the Wey northern branch channel at Farnham. This defence is a two-stage channel that was constructed in 1975. There are also two weirs, built as part of the River Wey Improvement Scheme (Catteshall and Unstead Weir) which are classified as flood defence assets. There are several other local defences within Farnham that are associated with the Farnham Flood Alleviation Scheme (FAS) (described in section 3.4). Following the winter floods of 2013/14, more work has been completed within the borough to develop and maintain flood defences. Further discussion on these schemes is in included section 3.4.

During the production of this SFRA, defence information recorded in the Asset Information Management System (AIMS) was not supplied. Although the current EA flood map records only one formal defence at Farnham, according to information gathered in the 2010 SFRA completed by Capita there were multiple localised flood defences and measures identified by the National Flood and Coastal Defence Database (NFCDD). These include earth embankments, sections of brick and concrete wall and bank protection, through the use of bagwork and concrete bank retention. Additionally, four main flood relief / alleviation channels that exist along the Farnham Park tributary at Shepherd and Flock Roundabout, and two-stage flood relief channels exist at Long Bridge Road and at Borelli Park along the River Wey North Branch.

3.3 Structures over and along Watercourses

There are a number of existing structures over watercourses including vehicular bridges, pedestrian bridges, pipe bridges, and railways. The River Wey is crossed numerous times by road bridges, with major dual carriageway road crossings including the A3 at Godalming, and the A31 at Farnham. It is similarly crossed by railways at Godalming, Farnham and West of Haslemere. Within the study area, the other main tributaries of Cranleigh Waters and the River Lox are not crossed by any A roads, although are crossed by more minor roads. All hydraulically significant structures have been considered in the detailed models described further in section 4.5.3.

3.4 Flood Alleviation Schemes

In Waverley, several local flood alleviation schemes (FASs) have been established and incorporate engineering flood defences and strategies to reduce risk, and include:

- Farnham FAS – engineered and altered channel sections, and bank protection, that act to redirect out of bank flows into the River Wey channel upstream of Farnham;

- Kiln Lane FAS
- Godalming Centre FAS - approximately 200m of flood relief channel with channel maintenance and bank protection associated with the River Wey.

There is also an Environment Agency led flood alleviation schemes within Waverley, at Bishop's Meadow Farnham, which involves floodplain restoration and environmental enhancements.

Assessments are being conducted into the viability of a FAS at Haslemere and further flood defence schemes in Godalming that would involve raised defences. Funding is currently being discussed for the latter.

The EA is currently progressing The Wey Flood Alleviation Scheme (Wey FAS) which includes identifying a viable scheme for various locations along the Wey, one of which is in Godalming which would protect over 73 properties. A preferred option has been selected at a n outline level; a feasibility study will be completed and the impact of this must be considered when assessing future flood risk.

3.5 Maintenance

The responsibility of maintaining watercourses and flood defences is split between the Environment Agency, the local operating authority (Waverley Borough Council) and private landowners. These roles and responsibilities are set out in Volume 1, Section 3.1. Recent maintenance schemes by each of these stakeholders is described further in section 3.6. No database regarding ongoing maintenance procedures was provided during the preparation of this SFRA, it is recommended that the borough develops such a database as it can highlight problem areas and potential for development.

The Environment Agency has **permissive powers** to maintain and improve watercourses designated as 'Main River' and associated structures for the efficient passage of river flow and the management of water levels. The Agency also has a general supervisory duty for all flood risk management activities.

As operating authorities, Councils have the regulatory and supervisory role for flood defences on all ordinary watercourses which are not within the area of an internal drainage board (IDB). Culverts under roads are generally the responsibility of the relevant Highways Authority (Surrey County Council).

Riparian owners have responsibilities to maintain any watercourse that passes through their land ownership. This includes all streams, ditches and river channels and any structures on them that fall within riparian ownership. Riparian owners are not always aware of their responsibilities in relation to watercourses, and this can lead to poor maintenance along minor watercourses in particular.

3.6 Waverley Infrastructure Resilience Group

Following significant flooding during the winter of 2013/14, which affected much of the UK, WBC have developed the Winter Readiness 2014-15 report[1] that reviews the various methods and inputs of stakeholders in improving the resilience of infrastructure in Waverley. These include significant maintenance, reconstructions and measures to reduce flood risk across the Borough:

[1] Winter Readiness 2014-15 report. Waverley Infrastructure Resilience Group, November 2014

Environment Agency led flood risk management measures

- River Wey Channel Capacity Restoration project – work has been completed in Godalming, Elstead and Unstead to remove accumulated sand and blockages within the River Wey and Hell Ditch, that occurred during the winter floods.
- Godalming Flood Alleviation Scheme – investigation of flood risk reduction schemes, favouring raised defences and researching funding options (November 2014).
- River Wey weirs operation review – acting to improve on the compliance of weir operators with the procedures in the River Wey weirs operating agreement, and ensuring 24/7 communication during flood events.
- Flood Warning improvements – this includes the installation of a radar gauge at Westbrook Mill and river gauge at Catteshall Road Bridge, and lowering flood thresholds for Godalming, Tilford, Elstead and Eashing, after a review of the winter 2013 flood warnings.
- Haslemere (Lion Lane) Flood Alleviation Study. Following an initial study, Atkins consultants are developing a Project Appraisal Report (PAR) to model the potential benefits of the scheme.

Waverley Borough Council-led flood risk management measures

- Ditch Clearance – assigned budget of £81,000 to clear ditches within the following localities: Gaston gate, Rushett Common, Corner Cottage (Guildford Road), Alford Road (Alford), Guildford Road (Cranleigh). Work has been completed at various levels.
- Local improvement schemes – at Lammas Land flood meadows, ditches connectivity to culverts have been restored; Elmbridge Road, desilting and dredging the Cranleigh Waters channel; Clappers meadows in Alford, consulting in regards to pump station failure; Webb Road in Witley and North Avenue/Brooklands Road in Farnham, where a screen wall has been erected for the regular collection of calculated debris.
- Culverted land drainage assets – commissioned condition survey of culverted land drainage assets where all works should be completed by June 2015.

Surrey County Council-led flood risk management measures

- Ditch Clearance along Gasden Lane, Witley – work underway involving National Trust and residents. Additionally, a new culvert has been installed under Haslemere Road (A286).
- Flood Defence Grant in Aid (FDGiA) applications – pipeline bids submitted (April 2014) for Waverley, Middle Bourne, Cranleigh and Weybourne. Current research to identify potential for Haslemere FAS and funding by FDGiA.

3.7 Multi Agency Flood Plan

The Waverley Multi Agency Flood Plan (MAFP), completed November 2011, identifies the active flood related plans, the types of flooding risk and the locations at risk from flooding within Waverley. In identifying vulnerable areas it intends to prioritise operational response in the case of flooding, and improve emergency planning prior and action following. The report identifies eight main areas at risk from flooding based on the Environment Agency Flood Warning Areas, with support from Surrey Police flood reports. The MAFP is currently being updated, following the winter 2013/2014 floods. This work is taking place alongside a wider review by the Surrey Local Resilience Forum and is expected to be available by 2016.

4. Flooding from Rivers

The assessment of fluvial sources of flooding in Waverley concentrates on the two principle watercourses, the River Wey and the River Arun and their tributaries. More recently, flooding was experienced from these rivers in December 2013-January 2014. The results of detailed hydraulic modelling on the Lower Wey, completed in 2009, the Upper Wey, completed in 2006 and the River Blackwater, completed in 2007 have been used to assess fluvial flood risk within Waverley. This chapter will assess and discuss the risk of river (fluvial) flooding within the borough from these watercourses, through reference to historical fluvial flooding records, Environment Agency Flood Maps and detailed hydraulic modelling studies. This section provides a background to fluvial flooding and risk, and how risk is presented.

4.1 Causes and Classifications

Flooding from rivers occurs when water levels rise higher than bank levels, causing floodwater to spill across adjacent land (floodplain). The main reasons for water levels rising in rivers are:

- intense or prolonged rainfall causing runoff rates and flow to increase in rivers, exceeding the capacity of the channel. This can be exacerbated by wet antecedent (the preceding time period) conditions and where there are significant contributions of groundwater;
- constrictions in the river channel causing flood water to backup;
- snowmelt;
- blockage of structures or the river channel causing flood water to backup.

The consequences of river flooding depend on how hazardous the flood waters are and what the receptor of flooding is. The hazard of river flood water is related to the depth and velocity, which depends on:

- the magnitude of flood flows;
- size, shape and slope of the river channel;
- width and roughness of the floodplain; and
- types of structures that cross the channel.

Flood hazard can vary greatly throughout catchments and even across floodplain areas. The hazard posed by floodwater is proportional to the depth of exposure, the velocity of flow and the speed of onset of flooding. Hazardous river flows can pose a significant risk to unprotected people, property and infrastructure. Whilst low hazard flows are less of a risk to life (shallow, tranquil water), they can disrupt communities, require significant post-flood clean-up and can cause costly and possibly structural damage to property.

4.2 Probability of flooding

The probability of fluvial (river) flooding uses the Annual Exceedance Probability (AEP). This is sometimes known as the ‘annual probability’ of flooding. A flood event described as a 1% AEP has a 1% (or 1 in 100) chance of occurring in any given year. This could alternatively be described as a 100 year return period flood event, that is, it is an event that is likely to occur, on average, once every 100 years.

The initial assessment of risk from fluvial sources is based on the Environment Agency dataset referred to as the EA Flood Maps for Planning, which contains flood extents for catchments greater than $3km^2$ for several different probability events. These are defined in four Flood Zones defined in the Planning Practice Guidance: Flood Risk and Coastal Change document, and summarised in Table 4-1.

Table 4-1 - Definition of Flood Zones (Table 1, PPG2)

Flood Zone	Definition
Zone 1 - Low probability	Land having a less than 0.1% annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3
Zone 2 - Medium Probability	Land having between a 1% and 0.1% annual probability of river flooding; or Land having between a 2% and 0.1% annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a - High Probability	Land having a 1% or greater annual probability of river flooding; or Land having a 2% or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b - The Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Where available, the assessment of flood risk also utilises flood extents determined by detailed hydraulic models. These have been provided by the EA in the flood event probabilities that are listed in Table 4-2.

Table 4-2 – Fluvial flood event probabilities provided in detailed Hydraulic Models

Annual Exceedance Probability (AEP) of flood event	Return Period of flood event	Studies for which flood extents provided
0.1 % AEP	1 in 1000 years	• Lower Wey
1%+CC AEP	1 in 100 years plus Climate Change	• Lower Wey • River Blackwater • Upper Wey
1% AEP	1 in 100 years	• Lower Wey • River Blackwater • Upper Wey
5% AEP	1 in 20 years	• Lower Wey • River Blackwater • Upper Wey

4.3 Functional Floodplain

The Functional Floodplain comprises land where water has to flow or be stored in times of flood. In line with the NPPF, all new development should be kept outside of the Functional Floodplain, with the exception of certain 'water compatible' land uses (e.g. recreational and conservation uses), as well as essential transport/utilities infrastructure that have no viable alternative location. The Exception Test must be passed for essential infrastructure developments to take place in this zone.

[2] Planning Practice Guidance, Flood Risk and Coastal Change, March 2014

Within Waverley, Flood Zone 3b will be defined using the 5% AEP model outline from the available hydraulic model outlines from the models provided and outlined in Table 4-2. Where detailed modelling and the 5% AEP outlines are unavailable, Flood Zone 3 from the Environment Agency Flood Maps for Planning should be used to define the Functional Floodplain.

Table 4-3 – Model results and outlines used to define SFRA Flood Zones

SFRA Flood Zone	Outlines used for definition
SFRA Flood Zone 3b	Modelled 5% AEP event; if unavailable - EA Flood Zone 3
SFRA Flood Zone 3a	Modelled 1% AEP event minus the modelled 1 in 20 year event
SFRA Flood Zone 3	Modelled 1% AEP event plus Climate Change event; if unavailable - EA Flood Zone 3
SFRA Flood Zone 2	Modelled 0.1% AEP event; if unavailable - EA Flood Zone 2

4.4 Climate Change

There is increasing concern about the impacts of climate change on the global environment. The nature of climate change at a regional level will vary. In the UK projections indicate more frequent, short duration, high intensity rainfall and more frequent periods of long duration rainfall of the type responsible for the summer 2000 and winter 2013/14 floods. These changes are likely to result in the more frequent occurrence of all types of flooding, including fluvial, surface water, sewer and groundwater flooding. All are relevant to the Waverley SFRA study area.

The potential impacts of climate change are an important aspect of uncertainty relevant to flood risk estimation. NPPF and PPG suggests that the impacts of climate change can be managed by either monitoring change in risk and adapting in the future as the need arises (Managed Adaptive Approach) or acting now to manage the eventuality (Precautionary Approach).

NPPF requires that climate change is considered as part of the spatial planning process, and as such is considered as part of this SFRA. Where detailed modelling is available, the 1% AEP plus climate change outline has been mapped to show increased flood risk from climate change. These results have been acquired by adding 20% of the flow to the 1% AEP event. These are shown in Volume 3, Figure 6.

4.5 Fluvial Flood Risk Datasets

Information on fluvial flooding in the study area was collected from Waverley Borough Council, Surrey County Council and the Environment Agency in the form of flood incident databases and flood outlines, as detailed in Volume 1, Appendix A. The Environment Agency also provided GIS layers showing Flood Zones 2 and 3, as well as detailed hydraulic model outlines. Information has been collated by source and flood type and is analysed in the following section.

4.5.1 Historical Fluvial Flood Events

Historical fluvial flooding records are represented in Volume 3, Figure 3A. This map displays the EA dataset, 'Recorded Flood Outlines' which provides a comprehensive record of historical fluvial flood extents, determined from discussions, surveys and aerial photography. This is limited to the quality of data, and does not represent all past flooding. The dataset was most recently updated in August 2013, and will not include flood extents that occurred during the winter of 2013/14. Waverley Borough Council has since produced a Christmas flooding 'hotspots' map after the 2013/14 floods to illustrate the areas of inundation during this event.

Surrey County Council maintains a wetspot database that identifies flooding incidents along roads which was supplied during SFRA production. Most sources of flooding are typically surface water in the example of road flooding, although a few incidences indicate fluvial sources and have been identified (Volume 3, Figure 3A). Historical incident data was further requested from Parish Councils and the limited information supplied has also been included in Volume 3, Figure 3A where the fluvial source is easily determined.

It is worth noting that flooding records vary significantly in quality, with discontinuity in provided details that should include location, event, dates, impact and source. As Waverley is predominantly rural there is an apparent bias in what is reported, depending on its interference with public infrastructure, given the tendency for individual landowners not to report events to the WBC.

4.5.2 Environment Agency Flood Risk Maps

The Environment Agency Flood Risk Maps for Planning for Waverley are shown in Volume 3, Figure 4, and are available online on the Environment Agency website. The zones are primarily based on the results of their national generalised broad scale modelling (JFLOW). In some locations they are also based on historic information and more detailed hydraulic modelling. The detailed hydraulic modelling will supersede JFLOW results where they are available. The Environment Agency periodically updates the Flood Zones with acquisition of new information and more detailed modelling. The latest version was received by WBC in December 2014 and is used in the SFRA to determine areas at risk of flooding where more detailed assessments were not available. Flood Zones are the starting reference point of the Sequential Test (discussed in greater detail in Volume 1, Section 2.6) and refer to the probability of river and sea flooding only, ignoring the presence of existing defences.

4.5.3 Detailed Hydraulic Modelling Flood Risk Maps

There are several detailed hydraulic modelling studies completed on watercourses in the study area, the Lower Wey, the Upper Wey and the Blackwater. The fluvial flood extents from each are shown in Volume 3, Figure 5, as supplied by the EA. These studies were all commissioned by the EA, and vary in their outputs and structure.

Lower Wey (2009) - The Environment Agency completed a study on the Lower Wey and its major tributaries in 2009. This included a hydrological model developed for input into a hydraulic model, with hydrograph inputs derived using the ReFH rainfall runoff model and design flows derived using FEH estimates. The resulting hydraulic model was run for 20% to 0.1% AEP events, and calibrated using five key historic flood events. Seven 1D hydraulic models were developed using the ISIS software package, of which three sub-models are included in this SFRA study area. A further five 1D-2D models were developed using ISIS and TUFLOW in conjunction, for main urban areas in the Lower Wey catchment that include Godalming and those adjacent to Cranleigh Waters, within this SFRA study area. Flood risk maps were produced for the 5%, 1% and 0.1% AEP flood events, with and without the influence of flood defences and including the PPG climate change scenario. Flood extents, represented in Volume 3, Figure 5, were provided for 5% and 1% and 1% +CC AEP flood events, as undefended scenarios, and 1% and 0.1% AEP flood events, defended. The undefended climate change scenario is discussed further in section 4.6.4, and represented in Volume 3, Figure 6.

River Blackwater (2007) – This Environment Agency study produced flood maps for the Blackwater catchment between Aldershot and the confluence with the River Loddon. The study involved the development of a hydraulic model of the River Blackwater and produced 20%, 5%, 1% and 1% plus climate change flooding extents for undefended and defended. Although the only structures considered are significantly downstream of where the Blackwater enters the study area. The EA used the 1% AEP flood extents to update the Flood Zone 3 of their dataset Flood Maps for Planning in 2008. Flood extents represented in Volume 3, Figure 5, were provided for 5% and 1% flood events, as defended scenarios, and cover only a minor extent of the study area at Weybourne and Badshot Lea.

The defended climate change scenario is discussed further in Section 4.6.4, and represented in Volume 3, Figure 6.

Upper Wey (2006) – Atkins completed a Flood Mapping Study on the Upper Wey from Alton and Haslemere to Tilford. A set of linked hydrological and hydrodynamic models was constructed which was capable of predicting inundation of the catchment floodplain under extreme fluvial flood conditions. The hydrodynamic models were constructed using ISIS; a 1D modelling method was preferred based on better representation of the floodplain. The hydrological inflows were derived using FEH. The flood extent outlines for the 5% and 1% and 1% +CC AEP defended flood event scenarios were provided, and are shown in Volume 3, Figure 5.

4.6 Fluvial Flooding

4.6.1 Historical Fluvial Flood Events

The EA Recorded Outlines dataset, shown in Volume 3, Figure 3A, shows the following flood events, with the majority described as having the common cause of channel capacity becoming exceeded in the absence of raised flood defences:

- March 1947
- Summer 1960
- September 1968
- November 1974
- December 1979 (Isolated to just Chiddingfold)
- January 1981
- February 1990
- Autumn 2000
- Winter 2003

This event list does not include significant flood incidents that have been reported in discussions with SCC, WBC, the Parish Councils and the Wey and Arun Canal Trust, including events that occurred in December 1999, July 2007, Winter 2008/09 (in Bramley from Cranleigh Waters), and more recently the region-wide flooding of Winter 2013/14. These flood events are summarised in Table 4-4.

Volume 3, Figure 3A shows that Cranleigh Waters, River Wey, and the north and south branches of the River Wey all experienced significant fluvial flooding in 1968. This reflects an atypical weather pattern that caused flooding across much of south eastern England, and no fluvial flooding event has affected as great an area since. It is likely that this event reflects a 1 in 100 year annual probability flood event.

Several areas have been identified in the SCC as having experienced flooding from fluvial sources, and are shown in Volume 3 Figure 3B. These include roads in Milford, vulnerable to the Ock tributary, and road junctions in Elstead, as supported by Parish Council reports. The Ock was identified as having overtopped twice in the past 20 years. Other recognised flood areas include Bramley High Street. Several wetspots within the SCC database that are documented as fluvial flooding do not occur near significant watercourses and are likely miscategorised.

Historic flooding records, although sometimes limited in accuracy, do provide a good indication as to whether an area historically suffers from frequent flooding. Historic records are useful to verify river flooding models and to identify areas where further investigations may be required before proceeding with land allocations or development proposals. However, the implementation of flood defences and alleviation schemes will have a significant effect on the future recorded flood extents. Therefore, this dataset may be used to review ‘problem areas’ and should be used to help inform rather than identify flood risk.

It would be useful for Waverley Borough Council develops a more established method for recording flood incidents, particularly with the use of GIS to identify key areas susceptible to flooding. This will also help inform flood risk policy within the local plan, and help ensure the SFRA is kept live (refer to Volume 1, Chapter 9 for further recommendations).

Table 4-4 - Information from historic flooding records (limited information available)

Year of Event	River	Location	Comment on flooding
1947	Wey	Godalming, Elstead and Milford	Property and roads flooded
1960	Wey (North Branch)	Farnham	Property and roads flooded
	River Lox	Chiddingfold	Road junction flooded
1968	WBC wide		Several hundred properties flooded across the area
	Wey (North Branch)	Farnham	Roads flooded
	River Lox	Chiddingfold	Property and roads flooded
		Tilford	Roads flooded
		Elstead	Roads flooded
		Dunsfold	Property and roads flooded, bridge destroyed
1981	Wey	Godalming	Roads flooded
1990	WBC wide		Property and roads flooded
1999	Wey	Tilford	Localised flooding
		Elstead	Localised flooding
2000	WBC wide		Property and roads flooded
	Wey (North Branch)	Farnham	Extensive catchment wide flooding
	Wey	Tilford	Roads flooded
	Cranleigh Waters	Cranleigh	Flooding from Littlemead Brook
		Bramley	Flooding of property and roads
2003	Wey	Godalming	Roads flooded
2007	No spatial / temporal data reported.		
2009	No spatial / temporal data reported.		
2013/14		WBC wide	Property and roads flooded

4.6.2 Environment Agency Flood Maps for Planning

Volume 3, Figure 4 shows the Environment Agency Flood Map for Planning across Waverley. Throughout the study area, the areas at high and medium risk, Flood Zone 3 and Flood Zone 2 respectively, for the most part have the same area as each other and generally include small rural undeveloped areas along the watercourse floodplains. There are a few exceptions to this; the areas at flood risk include wider bands of land along meandering stretches of the watercourse, and in the built-up areas of central Godalming, northern Farnham and Bramley.

Within Farnham, several developed areas are identified as potentially at high risk of flooding from the northern Wey branch. These areas include the Guildford Road light industrial area adjacent to the Farnham Bypass, and a number of properties located along Waverley Road. At Tilford, the Flood Zones include undeveloped areas although appear to potentially influence minor roads including Tilford Road and Whitmead Lane.

The Flood Zones indicate fluvial risk for several settlements in Elstead and Milford. In the more urban area of Godalming, there is a 400m wide area at risk of flooding from the River Wey. This includes Bridge Road, Borough Road and Catershall Road, which intersect the river at this point, and properties located along them.

The level of fluvial flood risk deviates more within the south eastern region of the study area, such as the span along and adjacent to the B2128 Elmbridge Road, west of Cranleigh town centre. Within Cranleigh there is more significant and dispersed flooding around the High Street.

In the south-west of the study area, the Flood Zones extend minimally from the watercourses, with low fluvial risk posed to the urban centres of Haslemere and Chiddingfold. The mapped Flood Zone 2, areas at moderate risk, includes sections the A283 Petworth Road, and poses limited risk to the Chiddingfold village and surrounding areas associated with the River Lox and its tributary Hambledon Brook.

4.6.3 Detailed Hydraulic Modelling

The flood outlines from the detailed hydraulic models (Volume 3, Figure 5) show a smaller area at risk of flooding than indicated by the Environment Agency Flood Zones, with reduced extents along Cranleigh Waters, the Wey northern branch and the River Blackwater, where modelling accounts for flood defences. However, there is no significant difference between the two and the detailed modelling outlines are limited to the main rivers and do not include the tributaries. The results from hydraulic modelling have been summarised in Table 4-5.

Table 4-5 – Summary of available hydraulic model results

Flood Event	Lower Wey	Upper Wey	River Blackwater
5% AEP (1 in 20 year outlines)	Along Cranleigh Waters, there are small areas where the watercourse extends past its undeveloped floodplain and influences some properties in West Cranleigh (between the Nuthurst Stream and Littlemead Brook). The area is predominantly rural and shows minimal human influence from the 5% AEP event. Where the Wey passes through Godalming, flooding is more extensive, spanning the area of low topography near Godalming town centre, and influencing the A3100 (note the railway through this area has raised embankments and appears to be unaffected by the 5% AEP event) and some properties. The Wey floodplain extends from Elstead to Tilford affecting several properties in both village centres as well as the critical infrastructure between them intersected by the watercourse.	Flooding extensive in the Wey northern branch, along the stretch through Farnham, although predominantly confined to the floodplain. Shown to affect the A31, towards the west and some properties north of the Farnham Bypass. Limited flooding shown to occur around Millbridge and Wrecclesham affecting a limited number of properties including a hotel.	Within Badshot Lea flooding is shown to extend from the River Blackwater where it pools at the Badshot Lea Big Pond, affecting a few properties adjacent, although is confined mostly to the pond. Additional flooding occurs towards the A31, Guildford Road, but does not reach it, as a region of mixed vegetation likely forms an informal defence.
1% AEP (1 in 100 year outlines)	There is slight deviation from the 5% AEP event flood extents, notably at upstream Cranleigh Waters (which is predominantly rural and undeveloped) and within Godalming, where the flood risk posed to the railway is shown to increase.	There are limited deviations from the 5% AEP event that occur in Farnham, although these do affect a higher number of properties than the other events, north of the Farnham Bypass, and within the low-lying Coxbridge Business Park.	There is no noticeable deviation from the 5% AEP event.
0.1% AEP (1 in 1000 year outlines)	Slightly more extensive flooding, particularly west of Elstead, does not appear to affect any additional property than the other probability events.	This extent was not provided during the production of this SFRA.	This extent was not provided during production of this SFRA.

4.6.4 Climate Change Considerations

The Planning Practice Guidance for Flood Risk and Coastal Change states that, '*A Strategic Flood Risk Assessment is a study carried out by one or more local planning authorities to assess the risk to an area from flooding from all sources, now and in the future, taking account of the impacts of climate change, and to assess the impact that changes or development in the area will have on flood risk'.*

The latest guidance recommends a 20% increase in peak river flows is used to assess the impacts of climate change on rivers for time horizons between 2025 and 2115 (PPG, 2014). Climate change has been investigated within this SFRA to provide more detailed information upon which to make land use planning decisions. It will be up to the decision-maker to select the most appropriate time horizon for the specific land use they are investigating.

The 1% AEP plus climate change flood event has been produced for all three detailed hydraulic modelling studies that cover the watercourses in the Borough, and are mapped in Volume 3, Figure 6. The results are summarised in Table 4-6.

Table 4-6 – Summary of available hydraulic modelling results for climate change scenario

Lower Wey	Upper Wey	River Blackwater
Upstream, Cranleigh Waters is predominantly rural with only minor roads affected by climate change flooding. The flooding extends along the Littlemead Brook and Nuthurst Stream tributaries, although due to the sparse extent pattern it is unlikely that the flooding is of significant depth. Within Godalming few properties appear affected, although the roads which cross the low-lying floodplain near the centre are all influenced. Furthermore some properties in western Elstead and roads are affected by this flood event. Most of the railways adjacent to the watercourses are embanked at intersections and therefore unaffected, except for the branch that is running through Godalming.	Flooding throughout Farnham is shown as extending to a significant number of properties and infrastructure north of the Farnham Bypass, including the Coxhill business park, museums and parts of the A31.	Within Badshot Lea, flooding in confined predominantly to the Badshot Lea Big Pond and affects limited property and extends towards the Badshot Lea village hall.

4.7 Management of Fluvial Flooding

There are two Catchment Flood Management Plans (CFMPs) which encompass the SFRA study area, the Thames CFMP that oversees the River Wey catchment, and the Arun and Western CFMP, overseeing the River Arun catchment. The River Lox in the south of the study area is a major tributary to the River Arun and therefore is encompassed by this catchment and the CFMP.

4.7.1 Messages from the Thames Catchment Flood Management Plan (December 2009)

The Environment Agency has prepared a Catchment Flood Management Plan (CFMP) for the River Thames catchment within which the River Wey is specifically considered. The Thames CFMP considers on a broad scale how flood risk can be expected to change on a 50 – 100 year timescale taking into account climate and land use change and will be used to target investment in flood risk management. According to the Thames CFMP, Waverley has 1000 to 2000 properties which are at risk during a 1% annual probability river flood as it lies within the overarching Thames Catchment Area. It is important that the policies WBC develops as a result of the SFRA are consistent with the policy framework outlined in the Thames CFMP. Waverley covers two sub-areas included in the plan:

the Rural Wey and the Upper and Middle Blackwater. Waverley Borough does not overlap significantly with the Blackwater sub-area, which is located towards the northwest of the study area, although its policy is included below for reference.

<u>The Rural Wey sub-area</u>

Policy Option 2:
Areas of low to moderate flood risk where it is generally possible to reduce existing flood risk management actions.

Vision and preferred policy:

- Maintain, and where possible maximise, the flow of water in the rivers through the towns.
- In the undeveloped areas, maintenance will be reduced to allow the flood plain to flood more frequently, allowing efforts to be focused where it is most beneficial.
- To ensure that high risk areas can prepare and respond accordingly, work will be complimented with increased flood warning and awareness measures.
- New habitat generation will aid increased biodiversity in the sub area.
- Where possible, opportunities for recreation and navigation will be improved also, through the relationship between the EA and the National Trust.

The proposed actions to implement the preferred policy:

- Maintenance of the capacity of watercourses in towns and villages through ongoing annual EA maintenance programme. Levels of maintenance elsewhere will be reduced.
- Safeguarding of the natural floodplain from inappropriate development by working with Local Authority partners. This will provide local social and economic benefits (by reducing flood risk) and environmental benefits (by allowing flooding).
- Working with Local Authority partners to ensure that plans are prepared to respond to flooding. This will help communities to work with local organisations and produce community flood plans.

<u>The Upper and Middle Blackwater sub-area</u>

Policy Option 4:
Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but here we may need to take further actions to keep pace with climate change.

Vision and preferred policy:

- Reducing the consequences of flooding will be the main feature of future flood risk management in these places.
- The proposed expansion of these places will need flood risk to be considered and inform the location, layout and design of new development.
- Local Authority Strategic Flood Risk Assessments (SFRAs) should ensure development is located and designed to mitigate flood risk, preventing the need for costly flood defences and management in the future. The EA will continue to influence and inform these decisions at the regional, county and local scales.
- In the long-term the urban environment should be adapted to make it more resilient to flooding. It is hoped that rivers will become part of the urban landscape instead of being hidden away in culverts and revert to more natural conditions where possible.
- Options to reduce the probability of flooding in some areas can be considered, although as there are many sources of flooding, it may not be possible to do this everywhere. Some interventions will rely on local opportunities to increase the flow of the watercourses by modifying or removing obstructions, or to store water.
- Awareness and response to rapid flooding from heavy rainfall should be improved. Urban expansion in these areas should not lead to an increase in flood risk.
- Partnership working should bring about gradual improvements in modified watercourses and put in place policies that bring about long-term adaptation of the urban environment.

The proposed actions to implement the preferred policy:

- Development should be located in areas of lowest flood risk and incorporate a layout and design that is resilient to flooding. Strong recommendations in SFRAs and policies in Local Plans will help to ensure this.
- Partners will identify opportunities to reduce flood risk by recreating river corridors in urban areas.
- New and re-development should allow space for water, wildlife and recreation in their site layout and design.
- The EA will support partnerships to identify those areas that are most vulnerable to other types of flooding, for example through Surface Water Management Plans (SWMPs) and encourage initiatives to manage these risks.
- Promotion of greater awareness of flood risk amongst organisations and communities will focus actions to reduce the impact of flooding.

4.7.2 Messages from the Arun and Western Streams Catchment Flood Management Plan (December 2009)

The Arun and Western Streams CFMP considers inland flooding that may occur from sources including rivers, in order to identify flood risk management policies. According to the CFMP, properties and infrastructure in Waverley, that are part of this catchment, are exposed to minimal risk. The policy option addresses this low risk and proposes using land in the upper catchment sub-area, which includes Waverley, to reduce flood risk in other sub-areas.

<u>The Rother Valley/Middle Arun/the Weald sub-area</u>
Policy Option 6:
Areas of low to moderate flood risk where action will be taken to store water or manage run-off that can provide overall reduction in flood risk or environmental benefits.

Key Messages:

- Flooding has had a positive influence in many areas on the environment, such that the policy supports flooding or retaining water on the land.
- Large areas of existing wet woodlands would benefit from increased flooding.

Proposed actions to implement the preferred approach:

- Develop a System Asset Management Plan (SAMP) that is capable of reviewing maintenance regimes,
- Determine potential opportunities to work with landowners to create wetland habitat.
- Explore the potential for land use and land management practice changes, through contact with the National Farmers Union and Natural England. The intention being to reduce run-off from the surrounding countryside, reduce soil erosion and local flood risk.

4.7.3 Planning Policy specific to Waverley

The information within the SFRA will be used by WBC to develop specific planning policy and guidance for Waverley that takes full account of flood risk now and in the future. These policies will be reported within future updates of the SFRA and will take account of the EAs approach to flood risk management in the Wey catchment as described in the relevant sections of the Thames CFMP.

Table 4-4 - Summary of CFMP Policies for Waverley

CFMP	Policy Unit	WBC Area	Policy	Policy Summary
Thames	Rural Wey	Significant area including Cranleigh, Farnham, Godalming and most of Haslemere	2	Reduce existing flood risk management actions (accepting that flood risk will increase over time).

Thames	Upper and Middle Blackwater	Far north-west area	4	Take further action to sustain the current level of flood risk in to the future (responding to the potential increase in risk from urban development, land use change and climate change).
Arun and Western Streams	Weald	South-central area including Chiddingfold, Dunsfold, Hambledon and part of Haslemere	6	Take action to increase the frequency of flooding to deliver benefits locally or elsewhere, which may constitute an overall flood risk reduction (for example for habitat inundation). This is to be applied as a strategic policy and flooding will only be increased in suitable locations, where a benefit elsewhere can be achieved.

5. Flooding From Surface Water

5.1 Overview

The built-up areas of the largest settlements (Farnham, Cranleigh, Godalming and Haslemere) have large areas of impermeable surfaces such as roads, pavements and driveways. This leads to faster and higher volumes of surface water runoff and subsequently presents a higher risk of surface water flooding. This chapter will provide a brief background to the definition and causes of surface water flooding (section 5) and assess the flood risk in the study area using historic records and the Environment Agency Updated Flood Map for Surface Water.

5.1.1 Causes and Classifications

Surface Water is classified several ways, as:

- Rainfall that infiltrates into the soil but resurfaces further down the hill;
- The water in lakes, marshes and reservoirs; and
- Water flowing over the ground surface that has not entered a natural channel or artificial drainage system is classified as surface water runoff or overland flow.

Surface water runoff/overland flow occurs when intense, often short duration rainfall is unable to soak into the ground or enter drainage systems. Poorly-drained material that is saturated contributes to a a higher runoff potential and is more likely to cause flooding. The excess water then ponds in low points, overflows or concentrates in minor drainage lines that are usually dry.

This type of surface water flooding is usually short-lived and associated with heavy rain. Often there is limited warning before this type of localised flooding occurs. Surface water runoff can cause localised flooding in natural valleys and in natural low spots where water may collect.

Drainage basins or catchments vary in size and shape, which has a direct effect on the amount of surface runoff. The amount of runoff is also a function of geology, slope, climate, rainfall, saturation, soil type and vegetation. Geological considerations include rock and soil types and characteristics, as well as degree of weathering. Porous material (sand, gravel, and soluble rock) absorbs water more readily than fine-grained, dense clay or unfractured rock and has a lower runoff potential. Poorly drained material has a higher runoff potential and is more likely to cause flooding. Urban settlements often have large areas of impermeable surfaces, such as roads, pavements and driveways, which behave similarly to poorly drained materials.

Surface water flooding can occur in rural and urban areas, but usually causes more damage in the latter. Flood pathways include the land and water features over which floodwater flows, as well as drainage channels, rail and road cuttings. Flood management infrastructure can also serve as a flood pathway. Developments that include significant impermeable surfaces, such as roads and car parks may increase the occurrence of surface water runoff. Urban areas have extensive drainage and sewer systems, but blockages or constraints can exacerbate surface water flooding. Developments which are close to artificial drainage systems, or located at the bottom of hill slopes, in valley bottoms and hollows, may be more prone to flooding. This may especially be the case in down slopes that have a high runoff potential including agricultural land, impermeable areas and compacted ground.

Flooding from land can also occur when structures used to manage flooding fail. For example, flooding would be worse if a culvert were to collapse or block. Note, these are culverts to manage surface water runoff, not urban drainage systems or rivers.

5.1.2 Impacts of Surface Water Flooding

Surface water flooding can affect all forms of the built environment, including:

- Residential, commercial and industrial properties;
- Infrastructure, such as roads and railways, telecommunication system and sewer systems;
- Agriculture;
- Amenity and recreation facilities.

Often surface water flooding can be short-lived, lasting only as long as the rainfall event. However flooding may persist in low-lying areas where ponding occurs. Flooding may occur as sheet flow or as rills and gullies causing increased erosion of agricultural land. This can result in 'muddy floods' where soil and other material are washed onto roads and properties, requiring extensive clean-up.

Both rural and urban land use changes are likely to alter the amount of surface water in the future. Future development is also likely to change the position and numbers of people and/or developments exposed to flooding.

5.2 Surface Water Flooding Datasets

Information on surface water flooding in the study area was collected from the stakeholders, as detailed in Volume 1, Appendix A. The Updated Flood Map for Surface Water was received from the Environment Agency. Surrey County Council has provided surface water flood records in the form of a wetspot database. Waverley Borough Council has provided information supplied by Parish Councils on roads typically affected by surface water flooding.

5.2.1 Historic Records

Historic records of surface water flooding include the Environment Agency Recorded Outlines dataset and the Surrey County Council Wetspot database. Within the EA dataset are several flood extents mostly attributed to fluvial sources. The only surface water related flood events within this dataset occurred during the New Year 2003 (where flood source was attributed to sewer or drainage causes).

The Surrey County Council wetspot database records reported flooding incidents along roads that can almost entirely be attributed to surface water causes, as road flooding typically results from drainage problems. The database has many attributes, including the state of the wetspot (current, reduced, pending review and dormant) and what is being done to address the issue. This information has been summarised to represent the number of surface water flooding events on a given road, presented in Volume 3, Figure 3B.

5.2.1.1 Parish Council Reports

Several Parish Councils provided useful information regarding areas which have experienced flooding or ongoing flooding problems. These included the Witley, Busbridge, Elstead, Ewhurst and Ellens Green, and Hambledon Parish Councils, and do not cover the entire borough. Depending on the description provided, the majority of these incidents were determined as having a surface water source of flooding, and a total of 23 individual affected areas were identified. These incidences are summarised in

Table 5-1 and shown spatially in Volume 3, Figure 3B.

Table 5-1 – Identified areas by Parish Councils that are susceptible/have experienced surface water flooding

Parish	Location	Causes	Identified Issues
Chiddingfold	Prestwick Lane	High run off, private flood measures and traffic damaging ditches	Blocked grills and drains, and broken under-road culverts
Hambledon	Hambledon Road	Ditches and drains not coping	
Ewhurst	Plough Lane, Horsham Lane and The Glebe residential area	None provided	Culverts not withstanding flow
Elstead	Farnham Road, Somerset Bridge, Springfield Way and Orchard Close	None provided - occurred during Winter 2013/14	
Witley	Station Lane, Jubilee Fields, Lower Mousehill Lane, Milford Heath Road, Oxted Green, Cramhurst Lane, Fasden Lane, A283, Combe Lane, Brook, Haslemere Road, Petworth Road, new Road, Gasden Copse, Middlemarch and Lakes Lane.	Many of the causes for these have been described as having been improved by drain maintenance and alerting the SCC/WBC. Many of these events are described as occurring following heavy rain.	Private owners filling in ditches, failure to maintain ditches, blockages occurring

5.2.2 Updated Flood Map for Surface Water (2014)

The Updated Flood Map for Surface Water (uFMfSW) GIS data has been provided by the Environment Agency and is presented in Volume 3, Figures 8A and 8B, showing flood extent and flood hazard respectively. These maps are more detailed than the second generation flood map for surface water (known as the Flood Map for Surface Water: FMfSW), and have been generated based on a JFLOW model using a 5m grid size and detailed hydrology. The updated flood map model includes representation of buildings, structures and road networks.

The map in Volume 3, Figure 8A displays surface water flooding extent resulting from 1 in 30 (~3% AEP), 1 in 100 (1% AEP) and 1 in 1000 (0.1%AEP) year probability rainfall events. These categories have been used to broadly assess which areas are at higher risk of surface water flooding. Areas within the borough where there are concentrated areas of predicted surface water flooding have been described as 'most susceptible'. Quantifying risk depends on many other factors, including antecedent conditions and drainage maintenance conditions. Historic records of surface water flooding may indicate an increased risk; however, attention to the problems in these areas may change the associated risk through time.

The map in Volume 3, Figure 8B displays the flood hazard ratings, as calculated by the Environment Agency, for the 1 in 30 (~3% AEP), 1 in 100 (1% AEP) and 1 in 1000 (0.1% AEP) year probability rainfall events. This rating is based on the equation from Defra research and development on risks to people[3]:

[3] http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=12016

Hazard rating = depth x (velocity + 0.5) + debris factor

Debris factors are further defined in the Defra Research and Development on risks to people. For each rainfall probability event, areas which are modelled as having a hazard category of moderate or greater (hazard rating >0.75) have been displayed. Moderate hazard is defined in Defra R&D on risks to people as "Dangerous for some (i.e. children) "Danger: Flood zone with deep or fast flowing water"". This indicates that the flood extent does not directly correspond to hazard and therefore risk.

5.3 Surface Water Flood Risk

The following discussion summaries the risk from surface water flooding in the study area. It utilises the outputs from the uFMfSW and SCC Wetspot database. There have been no Surface Water Management Plans carried out within the borough, and thus further information has been drawn from the LFRMS, PFRA and CFMPs.

The majority of the north west of the borough is shown to be at low or very low risk of surface water flooding by the uFMfSW. Flood risk from surface water is higher in the south east of the district, as shown in Volume 3, Figure 8A. Areas at increased risk of surface water flooding are predominantly within the fluvial floodplains and more densely built up urban areas, including Farnham Town Centre. The areas that are mapped as at high risk of surface water flooding (1 in 30 year flood) are mostly adjacent to the fluvial river channels in rural and undeveloped areas. Farnham is the main area of settlement where residential and business properties are shown at flood risk, adjacent to the Farnham Bourne through the town centre, along the ordinary watercourse and tributary drainage networks and along roads. Across the rest of the Borough, high risk areas are isolated to agricultural fields.

The areas at risk of moderate or greater hazard for three probability flood events are presented in Volume 3, Figure 8B. These are dispersed across the borough, mostly confined to areas adjacent to major and minor tributaries. Areas at moderate or greater hazard for the 3% AEP (1 in 30 year) flood event are mainly in the south and east of the borough, particularly along upstream Cranleigh Waters and its' tributaries and the River Lox and associated tributaries. There are no urban centres or significant degree of properties shown at risk except for a western part of Farnham. The 1% AEP event shows a similar pattern to that presented by the 3% AEP event, with more noticeable hazard extents south of the Vachery Pond, south of Cranleigh, and at the Badshot Lea Big pond. The 0.1% AEP event is extensive, showing isolated pockets at increased risk of moderate surface water flooding hazard. Review of this probability event shows that the south east and north west of the borough is at risk relative to the centre and north.

Flooding associated with the highway network is the most common form of localised flooding and occurs during or immediately after heavy storms. The Surrey County Council Wetspot database shows that, across the Waverley, 147 incidents relating to the public sewer, highway systems or runoff have been recorded since 2006. Relatively major A roads, which have experienced several surface water flooding events include Horsham Road (Bramley), Petworth Road (Haslemere), Tilford Road (Rushmoor) and Guildford Road (Cranleigh). Smaller roads which have experienced multiple flooding events include Blackheath Lane, Hambledon Road and The Street.

The majority of information received indicated repeated surface water flood incidents in the Witley Parish area. They appear to occur predominantly at road junctions and in developed areas such as Witley, Milford and Elstead. Many of the roads identified are those that have been reported in the Surrey County Council Wetspot database including Petworth Road, Station Lane, Hambledon Road and Farnham Road.

The central, elevated regions of the borough have very low risk of surface water related flooding, due to the steep topography and more permeable sandstone and siltstone bedrock. The Thames CFMP and Arun and Western Streams CFMPs highlight that the majority of the study area is at low risk of flooding from all sources including surface water run-off, and as a result, these large expanses of open and undeveloped floodplains will be used to store water and manage runoff downstream.

5.2.3 Climate Change

Future climate change projections indicate that more frequent short- duration, high intensity rainfall and more frequent periods of long duration rainfall are to be expected. Studies into the impact of climate change on surface water are ongoing. Research from the Living with Environmental Change study led by NERC (2013) may feed into UK Flood Risk and Coastal Erosion Risk Management Strategy. Indirect impacts of climate change on land use and land management may also change future flood risk.

In the absence of certainty, the NPPF advocates a precautionary approach. Sensitivity ranges are suggested for peak rainfall intensities over various time horizons. As our understanding of the impacts of climate change improves, these guidelines are likely to be revised. It is imperative that the SFRA is reviewed appropriately.

5.4 Management of Surface Water Flooding

5.4.1 What is the Sustainable Urban Drainage Systems (SuDS) Approach?

The SuDS approach is centred on mimicking natural drainage. SuDS encourages the management of water as close to its source as possible, using features that collect, filter, store and/or infiltrate water using mechanisms similar to that found in nature. SuDS practices should be designed taking the following criteria into consideration:

- water quantity;
- water quality; and
- Amenity/biodiversity.

Water Quantity

SuDS practices can play a key role in managing surface water through two mechanisms: runoff rate and storage volumes. As SuDS features often utilise pervious surfaces, they reduce runoff rates from the site compared to conventional development comprised primarily of impervious surfaces. SuDS can also help supplement the volume of water that must be stored on-site (attenuation volume) to achieve the desired runoff rate from the site. SuDS practices can store and/or infiltrate surface water into the surrounding soil, providing the necessary for attenuation storage for frequent rainfall events.

Water Quality

SuDS techniques help to improve surface water quality through the use of a ‘Management Train,’ which recommends incorporating a chain of techniques throughout a development, (as outlined in CIRIA C697 (Woods Ballard *et al*, 2007), where each component adds to the performance of the whole system. The Management Train approach consists of four stages:

- **Prevention** good site design and upkeep to prevent runoff and pollution (e.g. limited paved areas, regular pavement sweeping)
- **Source control** runoff control at/near to source (e.g. rainwater harvesting, green roofs, pervious pavements)

- **Site control** water management from a multitude of catchments (e.g. route water from roofs, impermeable paved areas to one infiltration/holding site)
- **Regional control** integrate runoff management from a number of sites (e.g. into a wetland).

It is important that the management train is implemented correctly, such that there is no derogation in groundwater quality.

Amenity/Biodiversity

As SuDS techniques can be integrated within the fabric of a site they provide opportunities to create amenity areas and improve the site's biodiversity. Many SuDS techniques are landscaped with grasses and/or plantings that help to create green streets, neighbourhoods and commercial/industrial properties. SuDS can also be implemented as part of multi-functional places, enabling both the management of surface water and other uses like recreation within the same space.

5.5 SuDS Techniques

There are a wide range of SuDS techniques available for use throughout the four stages of the Management Train. Techniques available to manage the quantity of surface water typically operate in combination or solely on the basis of the following two main principles:

- Infiltration
- Attenuation

The effectiveness of techniques in achieving the goals of attenuating discharges, reducing pollution and providing amenity benefit will depend on a number of other factors such as filtration, settlement and oxidation.

The SuDS Manual (C697)[4] provides a summary of SuDS techniques and their suitability to meet the three goals of sustainable drainage systems (water quantity, water quality and amenity biodiversity) and their suitability within the stages of the Management Train. Table 5-2 presents a summary of a variety of SuDS techniques along with their suitability in achieving the goals of sustainability and their place within the Management Train.

[4] CIRIA, The SUDS Manual (C697), March 2007

Table 5-2 – Summary of SuDS Techniques and their suitability to meet the three goals of sustainable drainage systems

Management Train	SuDS Technique	Description	SuDS Principle	Water Quantity	Water Quality	Amenity Biodiversity
Source, Prevention	Green roofs	Layer of vegetation or gravel on roof areas providing absorption and storage.	Attenuation	●	●	●
Source, Prevention	Rainwater harvesting	Capturing and reusing rainwater for domestic or irrigation uses.	Attenuation	●	○	○
Source, Prevention	Permeable pavements	Infiltration through the surface into underlying layer.	Infiltration	●	●	○
Source	Filter drains	Drain filled with permeable material with a perforated pipe along the base.	Infiltration	●	●	X
Source	Infiltration trenches	Similar to filter drains but allows infiltration through sides and base.	Infiltration	●	●	X
Source	Soakaway	Underground structure used for store and infiltration.	Attenuation	●	●	X
Source	Bio-retention areas	Vegetated areas used for treating runoff prior to discharge into receiving water or infiltration	Attenuation	●	●	●
Site, Source	Swales	Grassed depressions, provides temporary storage, conveyance, treatment and possibly infiltration.	Attenuation	●	●	○
Site	Sand filters	Provides treatment by filtering runoff through a filter media consisting of sand.	Infiltration	●	●	X
Regional, Site	Basins	Dry depressions outside of storm periods, provides temporary attenuation, treatment and possibly infiltration.	Attenuation	●	●	○
Regional, Site	Ponds	Designed to accommodate water at all times, provides attenuation, treatment and enhances site amenity value.	Attenuation	●	●	●
Regional, Site	Wetlands	Similar to ponds, but are designed to provide continuous flow through vegetation.	Attenuation	●	●	●

Key: ● – highly suitable, ○ - suitable depending on design, X – unsuitable

5.6 Design of SuDS techniques

Detailed guidance for the design of SuDS, including specific guidance for individual techniques, is available in the CIRIA SuDS Manual C697, and the associated document 'Site Handbook for the Construction of SuDS', C698 (Woods Ballard *et al*, 2007a). These publications provide best practice guidance on the planning, design, construction, operation and maintenance of SuDS to ensure effective implementation within developments.

The design of SuDS measures must be undertaken as part of a drainage strategy and design for a development site. A ground investigation should form part of the SuDS assessment to determine ground conditions and the most appropriate technique(s). Hydrological analysis should be undertaken using industry approved procedures to ensure an appropriate design is developed. This should account for the effects of climate change over the lifetime of the proposed system/development and based on an agreed permitted rate of discharge from the site.

During the design process, liaison should take place with the authority responsible for the receiving water body and any organisations involved in the long term maintenance of the system. This may include liaison with WBC, the Environment Agency and Thames Water, and which should focus on establishing a suitable design methodology, any restrictions and provision for the long-term maintenance of the SuDS system.

5.7 Incorporating SuDS into a site plan

The flexibility of SuDS to be placed throughout a site, to meet a variety of criteria and be integrated within the urban fabric, means that it is suitable for a wide range of land use types, site topographies and geology. Often a successful SuDS solution will utilise a number of techniques in combination, providing flood risk, pollution and landscape/wildlife benefits to the site and surrounding area. This section provides some guidance on how to incorporate SuDS techniques as part of the master planning and outline planning stages. It has been adapted from C687 'Planning for SuDS'.

5.7.1 Examine site topography and geology

During this stage, the existing site topography should be characterised to determine natural flow paths. Bedrock and superficial geology can be used as an initial tool to determine locations where SuDS techniques should be located to maximize their infiltration potential. More in-depth analysis of soil conditions, including borehole testing and soakage testing are required to confirm the suitability of SuDS techniques and their ideal placement upon the site.

5.7.2 Create a spatial framework for SuDS

The next step in the planning process is to develop an estimate of impermeable (paved roads, paths and buildings) and permeable surface across the site. This information is used to assess pre- and post-development runoff rates and volume, from which attenuation storage/infiltration targets can be set. The number, type(s) and size of SuDS practices can then be determined as part of the surface water management scheme at the site.

5.7.3 Look for multi-functional spaces

Areas of the site where SuDS practices could be integrated within the urban fabric should be sought, for instance locating SuDS in planned green space, within a play area.

5.7.4 Integrate the street network with SuDS

The street network is one of the most important areas to incorporate SuDS. Swales can be located along the road network to accept street runoff, tree planters can be configured to accept runoff from roads and car parks and the use of rain gardens and bio-retention techniques can be used to create 'green streets' that improve the amenity of a property. Large below-ground storage/infiltration practices can also be located beneath the street network or car parks. Pervious pavement materials are ideal for car parks and parking lay-bys.

A common concern with incorporating SuDS in developments is the belief that all SuDS are 'land hungry' and significantly impact on the developable area of sites. By applying the principles discussed above, SuDS can be integrated within the site using as little land as possible, whilst creating multi-functional spaces that improve the amenity value, and hence enhance the property value. In addition, SuDS can be employed on a strategic scale, for example with a number of sites contributing to large scale jointly funded and managed SuDS, however, each development site must offset its own increase in runoff; attenuation cannot be "traded" between developments.

5.8 SuDS Constraints

The underlying ground conditions of a development site will influence the type(s) of SuDS technique suitable at an individual site. While this will need to be determined through ground investigations carried out on-site, an initial assessment of the site's suitability to the use of SuDS can be obtained from a review of the available soils/geological survey of the area.

A band within the northwest of the borough is located on impermeable clay which is an unsuitable geology for the use of infiltration based SuDS. In areas like these, sustainable drainage can be achieved by the use of ponds, swales, wetlands and other such methods which do not rely on infiltration into the ground. The northern part of the borough, around the Wey catchment is located on sandstones of the Lower Greensand group, which is mostly indicated as being areas where infiltration based methods may be appropriate. However, areas around Tilford, Churt and Wrecclesham lie within a Source Protection Zone which may limit the use of infiltration based SuDS. It is recommended that for all sites where infiltration drainage is proposed on site test are carried out to determine specific infiltration rates.

It is recommended that developers should consult WBC, the Environment Agency, and relevant service authorities and Utility Companies at the earliest stage of the development process to establish the best solution for a particular site.

During the design process, in addition to considering the properties of the underlying soils and strata it is necessary to also consider the sensitivity of the receiving water body and any previous uses of the site.

The use of SuDS can be limited based on a number of constraints, which include:

- Groundwater vulnerability and potential contamination of an aquifer;
- Current or target water quality of a receiving watercourse;
- The presence of groundwater Source Protection Zones and potential contamination of a potable water source;
- Restrictions on infiltration on contaminated land to prevent the spread of contamination; and,
- Restricted area on development sites where housing densities are high.

5.8.1 Groundwater Vulnerability

Groundwater resources can be vulnerable to contamination from both direct sources (e.g. into groundwater) or indirect sources (e.g. infiltration of discharges onto land). Groundwater vulnerability within the study area has been determined by the Environment Agency based on a review of aquifer characteristics, local geology and the leachability of overlying soils.

The vulnerability of the groundwater is important when advising on the suitability of SuDS. The Environment Agency is the responsible drainage authority for any discharges to groundwater and should be consulted on proposals to discharge to ground. Groundwater vulnerability for the study area can be assessed by reviewing the most up-to-date maps on the Environment Agency's website.

5.8.2 Groundwater Source Protection Zones

In addition to groundwater vulnerability, the Environment Agency also defines groundwater Source Protection Zones (SPZs) around groundwater abstraction points. Source Protection Zones are defined to protect areas of groundwater that are used for potable supply, including public/private potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks.

SPZs are based on the time it takes for pollutants to reach an abstraction point. Depending on the nature of the proposed development, and the location of the development site with regards to the SPZs, restrictions may be placed on the types of SuDS appropriate to certain areas.

Any restrictions imposed on the discharge of site generated runoff by the Environment Agency will be determined on a site by site basis using a risk based approach. SPZ for the study area can be assessed by reviewing the most up-to-date maps on the Environment Agency's website.

5.8.3 Water Quality

Under the Water Framework Directive all member states are required to take steps to achieve good ecological status of water bodies by 2015. To achieve this, discharges to watercourses draining development areas will require pre-treatment to remove oils and contaminants. Appropriately designed SuDS can assist developments improve water quality discharges through passive treatment, whilst additionally providing ecological benefit to a development or local area.

5.8.4 Contaminated Land

Previous site uses can leave a legacy of contamination that if inappropriately managed can cause damage to local water bodies. During the design of SuDS it is essential to have regard to the nature of potential ground contamination.

Particular restrictions may be placed on infiltration based SuDS, forcing consideration of attenuation based systems. Early discussion with the authority responsible for the receiving water body should be undertaken to establish the requirements of SuDS on contaminated sites.

5.8.5 High Development Densities

Where developments are required to achieve higher densities, it is essential that the requirement for SuDS and their constraints are identified early in the masterplanning process. High development densities can restrict the land area available for SuDS, which, if mandatory, can affect the ability of a site to gain planning permission.

Early consideration of SuDS enables the drainage requirements to be integrated with the design, limiting the impact they have on developable area and development densities.

5.9 Application of Sustainable Drainage Systems

5.9.1 Available Datasets

The British Geological Society (BGS) has produced a range of datasets which provide information surrounding the suitability of the ground for infiltration SuDs, The selection and design of an appropriate system depends on the properties of the ground and in particular the following four factors:

- the presence of severe constraints that must be considered prior to planning infiltration
- the drainage potential of the ground
- the potential for ground instability when water is infiltrated
- the protection of groundwater quality

The Infiltration SuDS Map is based on 15 nationally-derived subsurface property datasets, some of which are a result of direct observations, whilst others rely on modelled data.

The dataset is structured using the above four factors, and allows consideration of the subsurface permeability, the depth to groundwater, the presence of geological floodplain deposits, the presence of artificial ground, ground stability (soluble rocks, collapsible ground, compressible ground, running sand, shallow mining, landslide and shrink swell clays), potential for pollutant attenuation and the Environment Agency's Source Protection Zones.

The maps show data at 1:50,000 scale. The following datasets were purchased for use in this SFRA.

5.9.2 Infiltration SuDS Map: Summary Layer

The summary map comprises four summary layers, providing an indication of the suitability of the ground for infiltration SuDS. The layers summarise: the presence of severe constraints; the drainage potential of the ground; the potential for ground instability as a result of infiltration and the susceptibility of the groundwater to contamination. The layer is derived from the following datasets:

- Infiltration constraints summary
- Superficial deposit permeability
- Superficial deposit thickness
- Bedrock permeability
- Depth to water level
- Geological indicators of flooding

This map is anticipated to be of use in strategic planning and not for local assessment. It does not provide specific subsurface data or state the limitations of the subsurface with respect to infiltration.

These dataset have been used to assign areas with the classifications assigned in Table 5-3.

Table 5-3 – Drainage Summary Map classifications

Score	Description	Typical Storage Capacity
1	Highly compatible for infiltration SuDS	The subsurface is likely to be suitable for free-draining infiltration SuDS
2	Probably compatible for infiltration SuDS	The subsurface is probably suitable for infiltration SuDS although the design may be influenced by the ground conditions
3	Opportunities for bespoke infiltration SuDS	The subsurface is potentially suitable for infiltration SuDS although the design will be influenced by the ground conditions
4	Very significant constraints are indicated	There is a very significant potential for one or more geohazards associated with infiltration

5.9.3 SuDS Suitability Assessment

For this high level SFRA, the infiltration constraints layer within the drainage summary map, shown in Volume 3, Figure 9, has been analysed to provide a summary of the locations suitable for infiltration SuDS techniques across Waverley.

The infiltration constraints layer, which provides an indication of the extent to which the ground will be suitable for infiltration SuDS with respect to drainage, based on the geology and hydrogeology of the subsurface should be used to advise the methods and location of SuDS. Volume 3, Figure 8 shows the BGS Drainage Summary dataset across Waverley.

Within the borough, the region that is highly compatible for infiltration SuDS includes broadly the north and west, encompassing the urban centres of Godalming, Farnham and Haslemere. This is likely the result of underlying permeable bedrock, sandstones, and soils. It may also be the result of a deep water table. There is some variation in this trend, including a couple of bands in and north of Farnham and along the Wey watercourse at Elstead and Godalming, where is it indicated that very significant constraints exist to prevent SuDS implementation. These areas are likely to have a shallow water table, and limited permeability.

The south and the eastern part of the study area, forming a buffer zone around the River Lox and the Cranleigh Waters tributary, have opportunities for infiltration SuDS. Along the Cranleigh Waters tributary, it is indicated that there are very significant constraints on infiltration SuDS being implemented. This could be a factor of the superficial geological deposits or a shallow water table.

5.10 Adoption and Maintenance of SuDS

As of 6th April 2015, SuDS are a material planning consideration for development of ten dwellings or more, and equivalent non-residential schemes, unless developers can demonstrate that SuDS would not be appropriate.

The changes within NPPF, require the inclusion of SuDS designs with all Major Developments planning applications. Full planning application are required to be accompanied by a detailed SuDS drainage design including simulation modelling of the proposed system, the SuDS pro-forma must be completed and signed by a competent drainage engineer and submitted as part of the planning application. The proposed drainage system shall be designed in accordance with the Non-Statutory Technical Standards for Sustainable Drainage Systems and the Woking Borough Sustainable Drainage Systems Design and Adoption Guide.

In accordance with PPG paragraph 80, all planning applications must follow the hierarchy for discharge destinations. Where it is not possible to achieve the first hierarchy, discharge through the ground, applicants must demonstrate in sequence why the subsequent discharge destinations were selected.

Where the intention is to dispose to soakaway, these should be shown to work through an appropriate assessment carried out under Building Research Establishment (BRE) Digest 365. All designs shall be based on actual infiltration figures obtained through percolation tests, carried out in accordance to BRE Digest 365.

In accordance with CIRIA Report 156, Infiltration Drainage and SuDS Manual (C697 or latest amended version C753), an adequate factor of safety must be applied to the observed infiltration value. The minimum factor of safety acceptable is 2 and that must be increased to reflect the consequences of failure of the system, the topography of the site and the likelihood of flooding.

Infiltration units must stand the test of half-emptying the provided storage within 24hrs for up to the 1 in 10 year annual probability storm (for al rainfall durations). The proposed infiltration devices shall not intercept the water table and shall have at least 1m of unsaturated ground between the base of the infiltration device and the water table. There should be no infiltration of water into contaminated land.

If infiltration is not viable, subject to evidence being provided to support the choice of discharge destination, proposals to dispose of surface water in to a watercourse, surface water sewer, highway drain or another drainage system, should be accompanied by evidence of the system having spare capacity downstream.

5.11 Further Guidance on SuDS

The following publications provide more information on SuDS.

- CIRIA C635 Designing for Exceedance in Urban Drainage – Good Practice (2006)
- CIRIA C687 Planning for SuDS – Making it Happen (2010)
- CIRIA C697 The SUDS Manual (2007)
- CIRIA C698 Site Handbook for the Construction of SuDS (2007)
- Communities and Local Government – Guidance on the Permeable Surfacing of Front Gardens (2008)
- London Borough of Islington - Promoting Sustainable Drainage Systems (2013)
- CIRIA C609 Sustainable Drainage Systems – Hydraulic

6. Flooding from Sewers

Flooding from sewers occurs when rainfall exceeds the capacity of networks or when there is an infrastructure failure. Flooding from foul and combined sewers occurs when rainfall exceeds the capacity of networks or when there is an infrastructure failure.

5.9.4 Causes and Classifications

The main causes of sewer flooding are:

- Lack of capacity in sewer drainage networks due to original under-design.
- Lack of capacity in sewer drainage networks due to an increase in demand (resulting from climate change and/or new developments).
- Lack of capacity in sewer drainage networks due to events larger than the system designed event.
- Lack of capacity in sewer drainage networks when a watercourse is fully culverted, thus removing floodplain capacity.
- Lack of maintenance of sewer networks which leads to a reduction in capacity and can sometime lead to total sewer blockage.
- Water mains bursting/leaking due to lack of maintenance or as a result of damage.
- Groundwater infiltration into poorly maintained or damaged pipe networks.
- Restricted outflow from the sewer systems due to high water levels in receiving watercourses.

The impact of sewer flooding is usually confined to relatively small localised areas. When flooding is associated with blockage or failure of the sewer network, flooding can be rapid and unpredictable. Flood waters from this source are also often contaminated with raw sewage and pose a health risk. The spreading of illness and disease can be a concern to the local population if this form of flooding occurs on a regular basis.

Drainage systems often rely on gravity assisted dendritic systems, which convey water in trunk sewers located at the lower end of the catchment. Failure of these trunk sewers can have serious consequences, which are often exacerbated by topography, as water from surcharged manholes will flow into low-lying land which may already be suffering from other types of flooding.

The modification of watercourses into culverted or piped structures can result in a reduced capacity. Excess water may be sent along unexpected routes as its original channel is no longer present and the new system cannot absorb it.

Whilst an area affected by sewer flooding is often localised, the quality of water can be poor. Flooding of combined sewers can lead to contaminated water entering properties nearby watercourses.

Sewer flooding is likely to have a high concentration of solid, soluble and insoluble contaminants. This can lead to a reduction in the environmental quality of receiving watercourses. Flooding of contaminated land (such as landfills, motorways, and petrol station forecourts) will transport contaminants such as organics and metals to vulnerable receptors if the respective drainage systems are not designed to treat the water.

6.1 Sewer Source Flooding Datasets

All Water Companies have a statutory obligation to maintain a register of properties/areas which have reported records of flooding from the public sewerage system, and this is shown on the DG5 Flood

Register. This includes records of flooding from foul sewers, combined sewers and surface water sewers which are deemed to be public and therefore maintained by the Water Company. Although the study area is covered by Southern Water, South East Water and Thames Water, Thames Water are responsible for the waste water removal and therefore provided extracts of the DG5 register for the study area.

The aim of the DG5 levels of service indicators is to measure the frequency of actual flooding of properties and external areas from the public sewerage system by foul water, surface water or combined sewage. It should be noted that flooding from land drainage, highway drainage, rivers/watercourses and private sewers is not recorded within the register. In addition, the records do not account for the effect of any capital works designed to alleviate flooding.

6.2.1 Historical Sewer Flooding

The data provided by Thames Water shows postcodes where properties are known to have experienced sewer flooding prior to January 2014. The DG5 register records 52 flood incidents resulting in internal property flooding, and 82 external flooding incidents, as shown in Figure 6-1 and Figure 6-2. The records indicate that internal property flooding occurs predominantly for the larger scale (but less frequent) flooding events (5% AEP events), whilst more external flooding has been reported during smaller scale (but more frequent) events (10% AEP and 20% AEP events). Volume 3, Figure 10 provides a broad overview map of flood incidents in the borough as it is not property specific, instead providing information in postcode sectors (up to a four digit postcode), which may further extend from the borough study area. The majority of recorded incidents are in densely populated postcode areas, such as GU7, GU9 and GU8, which encompass Godalming, Farnham and Cranleigh town centres respectively. These postcodes fall within the Wey catchment, encompassing the Northern Wey branch, River Wey and Cranleigh Waters tributaries. Relative to the large span of postcode areas GU8 and GU10, the total recorded flooded incidents is relatively low.

Figure 6-1 – Total Internal property flooding from Sewers within Waverley

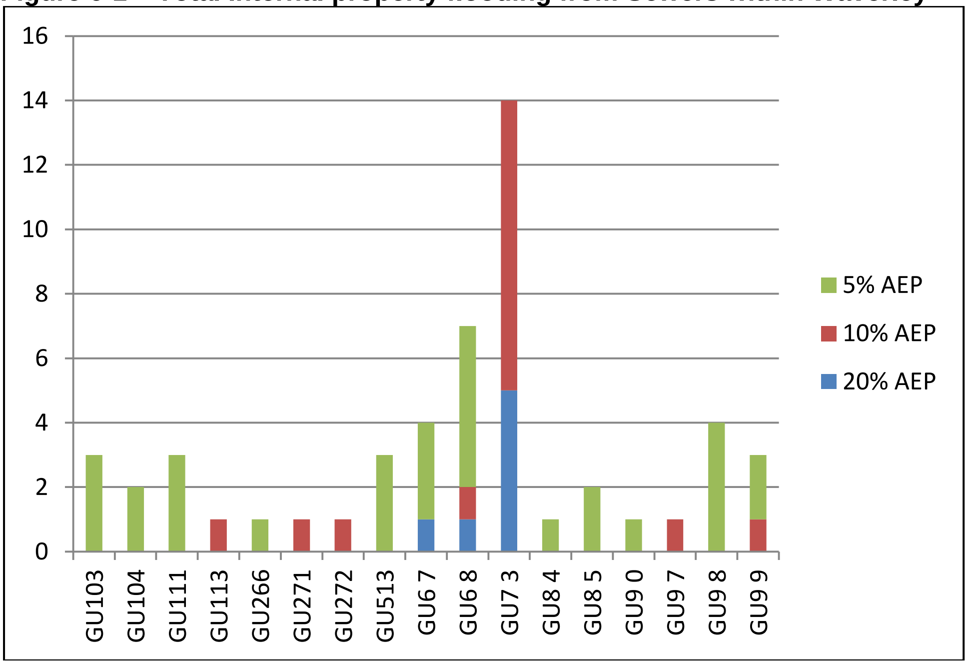
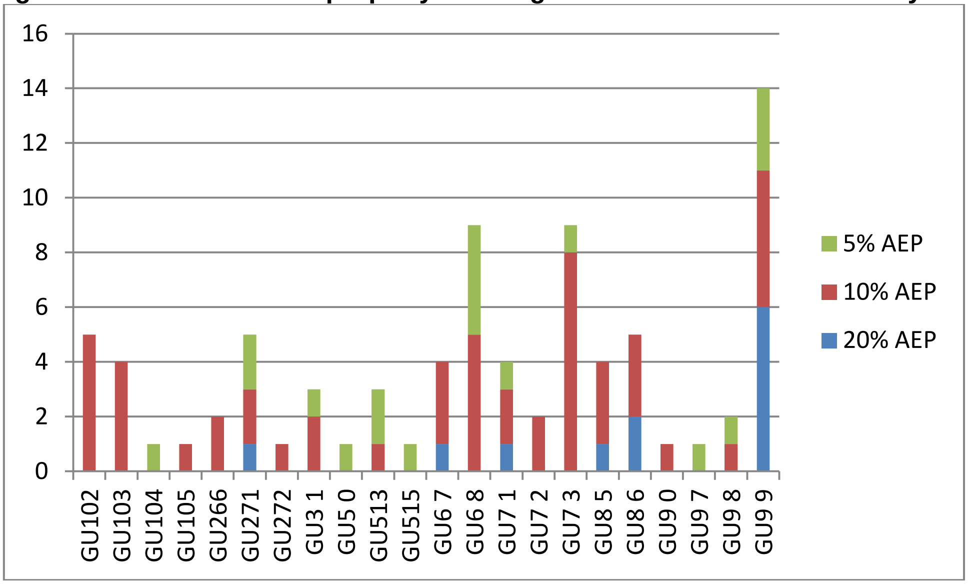


Figure 6-2 - Total External property flooding from Sewers within Waverley



Historic Incidents of sewer flooding may indicate areas at higher risk than others, however the urban drainage system is maintained and where improvements have been completed the risk may be significantly lowered making the historic occurrence of flooding an inadequate indicator of future problems.

6.2 Assessing Flooding From Sewers

The three most appropriate methods for assessing the risk of flooding from sewers within the SFRA were:

- Review of historical data - qualitative review of areas at risk and/or GIS analysis to create a buffer zone around locations of known risk. ***This method was used during the SFRA.***
- Reference to existing studies carried out by water companies, the Environment Agency and private developers. *No studies of this kind were provided during the SFRA.*
- Urban drainage modelling - model the urban drainage network and determine locations likely to flood. Historically urban drainage models have been unable to provide a representation of the integrated impact of different flood mechanisms (i.e. river flooding with sewer flooding), however software packages such as TUFLOW are now able to jointly model these sources. *This is too detailed for the SFRA.*

6.3 Sewer Flood Risk

Sewer flooding is a particularly damaging source of flooding because of the after affects associated with this type of flooding. Sewer flooding is often combined with surface water flooding when combined sewerage and drainage systems surcharge. In the study area this type of flooding is more likely to occur in urban areas, such as Godalming and Farnham. This is supported by the higher recorded number of flooding incidents in these postcodes.

The use of historic data to estimate the probability of sewer flooding is the most practical approach, however does not take account of possible future changes due to climate or future development. Historic results should also be viewed with caution as the sewer network is constantly being maintained, upgraded and improved. Thus flooding issues may be relatively short lived (<10 years). If identified by the Environment Agency or the water company as a major risk, sewer flooding will need to be assessed in greater detail in individual flood risk assessments.

6.3.1 Climate Change

Climate change is expected to impact sewer flooding by increases in rainfall intensity. This may require new infrastructure to be designed with greater capacities and existing infrastructure may require upgrading to maintain the same level of service. The relevant climate change predictions contained with NPPF are reproduced in Table 6-1.

Table 6-1 – Predicted increase in rainfall intensity with climate change

	1990 to 2025	2025 to 2055	2055 to 2085	2085 to 2115
Peak rainfall intensity	5%	10%	20%	30%

6.4 Management of Sewer Flooding in Waverley

Flooding from sewers or urban areas can theoretically be managed with engineering works for any size event. However, such works are not always economically or environmentally sustainable. Improvements to urban drainage can also lead to rapid rainfall runoff into rivers, increasing flood risk downstream and potentially transporting contaminants.

The National Planning Policy Framework recommends that Sustainable Urban Drainage Systems (SuDS) are used to decrease the probability of flooding by limiting the peak demand on urban drainage infrastructure. All new developments, and wherever possible existing networks, are also advised to separate out foul drainage from surface water drainage to ensure that any flooding that does occur is not contaminated.

7. Flooding from Groundwater

7.1 Description

Groundwater flooding is caused by the emergence of water originating from sub-surface permeable strata. A groundwater flood event results from a rise in groundwater level sufficient for the water table to intersect the ground surface and inundate low lying land. Groundwater floods may emerge from either point or diffuse locations. They tend to be long in duration developing over weeks or months and prevailing for days or weeks.

There are many mechanisms associated with groundwater flooding, which are linked to high groundwater levels, and can be broadly classified as:

- Direct contribution to channel flow.
- Springs emerging at the surface.
- Inundation of drainage infrastructure.
- Inundation of low-lying property (basements).

Groundwater levels rise and fall in response to rainfall patterns and distribution, with a time scale of months rather than days. The significance of this rise and fall for flooding, depends largely on the type of rock it occurs in, i.e. how permeable to water the rock is, and whether the water level comes close to or meets the ground surface.

Groundwater flood events have been recorded in various aquifer units (including Cretaceous Chalk, Limestones, river terrace gravels). Compared to other aquifer units, Chalk is more vulnerable to groundwater flooding because of its geological formation. It contains many pores and fissures which can result in rapid rises in groundwater levels, which take a long time to recede.

The primary controls on the distribution and timing of groundwater flooding include:

- Spatial and temporal distribution of rainfall.
- Spatial distribution of aquifer properties.
- Recharge mechanisms.
- Spatial distribution of geological structures (drift deposits, stratigraphy).
- Efficiency of the surface drainage network.

The likelihood of an area experiencing groundwater flooding can largely be determined on a broad scale through an analysis of the previous meteorological conditions and geological knowledge. This can be helped by the analysis of groundwater boreholes and historic information.

7.1.1 Causes of high groundwater levels

High groundwater levels can result from the combination of geological, hydrogeological, topographic and recharge phenomena and can mostly be associated with the seven mechanisms described in Table 7-1. Each has been described using the source-pathway-receptor model.

Table 7-1 – Causes of high groundwater levels

Flooding phenomenon	Sources	Pathways	Receptors	Hazard	Characteristics
Rising groundwater levels in response to prolonged extreme rainfall (often near/beyond the head of ephemeral streams)	Long duration rainfall	Permeable geology, mainly chalk	People, properties, environment	Basement flooding/rural ponding	Responsible for the large majority of groundwater flooding. May occur a few days after the rainfall or up to several weeks after. Usually lasts for a number of weeks. An increase in the baseflow of channels, which drain aquifers, is often associated with elevated groundwater levels and may lead to an exceedance of the carrying capacity of these channels. Floodwaters are most often clear and so this form of groundwater flooding may be referred to as 'clear water flooding'. High groundwater levels may also inundate sewer and storm water drainage networks, exceed capacity and lead to flooding in locations, which would otherwise be unaffected. This flooding can be associated with pollution.
Rising groundwater levels due to leaking sewers, drains and water supply mains	Water in water mains, drainage and sewerage networks	Cracks in pipes/permeable strata	People, properties, environment	Basement flooding/water quality issues	Leakage from sewer, storm water and water supply networks can lead to a highly localised elevation in groundwater levels, particularly where the leak is closely associated with chalk bedrock.
Groundwater rebound owing to rising water table and failed or ceased pumping	Groundwater	Permeable geology and artificial pathways e.g. adits	Property, commercial	Basement flooding / flooding of underground infrastructure	Where historic heavy abstraction of groundwater for industrial purposes has ceased, a return of groundwater levels to their natural state can lead to groundwater flooding. This process can potentially cover large areas or maybe associated
Upward leakage of groundwater driven by artesian head	Groundwater emerging from boreholes or through permeable geology	Artesian aquifer and connection to surface	Property	Basement flooding / flooding at surface	Mainly associated with short duration and localised events this process can lead to significant volumes of discharge. It can occur in locations where boreholes have been drilled through a confining layer of clay to reach the underlying aquifer.
Inundation of trenches intercepting high groundwater levels	Groundwater	Permeable geology	Property	Routing of floodwaters	The excavation and fill of engineering works with permeable material can create groundwater flow paths. High groundwater levels maybe intercepted, resulting in flooding of trenches and land to which they drain.
Other – alluvial aquifers, aquifer, sea level rise	Rivers, rainfall, sea	Floodplain gravels, permeable geology	Property, environment	Basement flooding / flooding at surface/saline intrusion.	Other mechanisms of groundwater flooding include leakage of fluvial flood waters through river gravels to surrounding floodplains e.g. behind flood defences; and a rise in groundwater levels as a result of adjacent sea level rise as a result of the discharge boundary rising.

7.1.2 Impacts of groundwater flooding

The main impacts of groundwater flooding are:

- Flooding of basements of buildings below ground level – in the mildest case this may involve seepage of small volumes through walls, temporary loss of services etc. In more extreme cases larger volumes may lead to the catastrophic loss of stored items and failure of structural integrity.
- Overflowing of sewers and drains – surcharging of drainage networks can lead to overland flows causing significant but localised damage to property. Sewer surcharging can lead to inundation of property by polluted water. Note: it is complex to separate this flooding from other sources, notably surface water or sewer flooding.
- Flooding of buried services or other assets below ground level – prolonged inundation of buried services can lead to interruption and disruption of supply.
- Inundation of farmland, roads, commercial, residential and amenity areas – inundation of grassed areas can be inconvenient; however the inundation of hard-standing areas can lead to structural damage and the disruption of commercial activity. Inundation of agricultural land for long durations can have financial consequences.
- Flooding of ground floors of buildings above ground level – can be disruptive, and may result in structural damage the long duration of flooding can outweigh the lead time which would otherwise reduce the overall level of damages.

Additionally groundwater flooding can cause a change in the structural properties of clay overlying chalk aquifers. This may cause costly damage to structures in the ground and the buildings that they support.

Groundwater flooding has always occurred. It generally occurs more slowly than river flooding and in specific locations. The rarity of groundwater flooding combined with the mobility of the population means that people often do not know there is a groundwater flood risk.

New developments are particularly at risk because little consideration is given to groundwater as a source of flooding in the planning process. The sparse frequency of groundwater flood events can contribute to poor decision-making. The economic and social costs of groundwater flooding are compounded by the relative long duration of events.

The nature and occurrence of groundwater flooding in England is highly variable. 1.7 million properties are vulnerable to groundwater flooding in England (Jacobs 2006). The occurrence of groundwater flooding is very local and often results from the interaction of very site specific factors, e.g. aquifer properties, topography, man-made structures etc.

In general terms groundwater flooding rarely poses a risk to life. However it can be associated with significant damage to property.

7.2 Groundwater Flood Risk Datasets

Information on historical groundwater flooding in the study area was collected from Waverley Borough Council, Surrey County Council and the Environment Agency in the form of flood incident databases, as detailed in Volume 1, Appendix A, although indicated limited events. Therefore, to determine flood risk the British Geological Society (BGS) dataset for Groundwater flooding susceptibility was referred to and is represented in Volume 3 Figure 11.

7.2.1 Historical Groundwater Flood Events

There are very few records of groundwater flooding across Waverley, and subsequently these have not been shown in a map within Volume 3. The Surrey County Council wetspot database does not attribute any of the incidents to groundwater. The Environment Agency flood incident database also does not identify groundwater as the source of any of the reported incidents, although the source of flooding within this database is not always verified. Based on previous records made available it appears groundwater flooding has historically occurred in Upper Hale, Godalming, Elstead, Churt, Shottermill, Wormley, Witley, south of Busbridge, and Cranleigh. Hambledon is noted as being within the South East England Regional Flood Risk Assessment as being at risk from groundwater flooding. In the examples of Upper Hale and Cranleigh, it is more likely that the recorded flooding problems were related to waterlogging and poor surface water drainage than groundwater flooding.

The lack of flood incident records may not be reflective of the occurrence of groundwater flooding, as groundwater flooding may occur following prolonged rainfall events simultaneously with other types of flooding. Furthermore, it is likely that fewer incidents are reported throughout the study area because of the high proportion of land which is rural in nature.

7.2.2 British Geological Society Susceptibility to Groundwater flooding dataset

Following the particularly wet winter of 2000/2001, the British Geological Survey produced a national dataset on the susceptibility of groundwater flooding. The dataset is based on geological and hydrogeological information and can be used to identify areas where geological conditions could enable groundwater flooding to occur and where groundwater may come close to the surface. It is important to note that it is a susceptibility set, and does not indicate hazard or risk.

The Environment Agency also produce an ‘Areas susceptible to groundwater flooding map’, which is based on some of the information from the BGS maps and information on superficial deposits. Again the dataset identifies susceptibility and not risk.

The British Geological Society’s Groundwater Susceptibility Maps are considered to be more detailed and accurate and have a finer resolution to the Environment Agency maps, and therefore identifying groundwater susceptibility in Waverley has been done based on this dataset. The dataset is classified into four subgroups, as shown in Table 7-2, and is presented for the study area in Volume 3, Figure 11.

Table 7-2 - BGS susceptibility to groundwater flooding classifications

Classification	Description
A	**Limited potential for groundwater flooding to occur:** based on rock type and estimated groundwater level during periods of extended intense rainfall.
B	**Potential for groundwater flooding of property situated below ground level:** based on rock type and estimated groundwater level during periods of extended intense rainfall. Where this may have an impact, you are advised to check that this has not been a problem in the past at this location and/or that measures are in place to sufficiently reduce the impact of the flooding.
C	**Potential for groundwater flooding to occur at surface:** based on rock type and estimated groundwater level during periods of extended intense rainfall. You are advised to check that this has not been a problem in the past at this location and/or that measures are in place to sufficiently reduce the impact of the flooding.
Elsewhere	Not considered to be prone to groundwater flooding: based on rock type.

7.5 Groundwater Flood Risk

Geology is an important influence on groundwater flooding. The underlying geology beneath Waverley borough can be divided into two predominant groups: the Lower Greensand, consisting of sandstone and some limestone interbeds, and the Wealden Group, consisting of mainly mudstones in this area. Towards the north western boundary of the borough, several beds of low permeability clay are adjacent to the highly permeable White Chalk Subgroup. The two key groups reflect opposing groundwater capacities, and this divide is clearly seen in the BGS susceptibility to groundwater flooding dataset mapped in Volume 3, Figure 11.

The dataset has been analysed to identify areas within the borough at risk from groundwater flooding. These results have been summarised below. The BGS dataset is a susceptibility dataset: it does not indicate hazard or risk and does not provide any information on the depth to which groundwater flooding occurs, or the likelihood of the occurrence of an event of a particular magnitude.

The south eastern area of the borough has low to no susceptibility to groundwater flooding according to the BGS dataset. This is likely due to the presence of the Weald Clay formation that consists of fine-grained mudstones of low permeability that do not store groundwater. Subsequently flooding events that occur here are more likely to be the result of waterlogging and poor surface water drainage. Exceptions occur adjacent to Cranleigh Waters and its' tributaries, which are Class C areas, with the potential for groundwater flooding. This area is marked by superficial fluvial deposits, which are typically poorly consolidated and capable of storing groundwater.

In contrast the north western band of the study area is broadly classed as having limited potential for ground water flooding (Class C). Within this region, there are several areas outlined as having higher potential for groundwater flooding (Class A), including the permeable chalk band north of Farnham, the region around Elstead and Hambledon, and Godalming. Review of the geology shows these areas are underlain by superficial deposits of head (unconsolidated deposits), formed by sub aerial slopes with high permeability.

7.6.1 Climate Change

There is currently no research specifically considering the impact of climate change on groundwater flooding. The mechanisms of flooding from aquifers are unlikely to be affected by climate change, however if winter rainfall becomes more frequent and heavier, groundwater levels may increase. Higher winter recharge may however be balanced by lower recharge during the predicted hotter and drier summers.

8. Flooding from Artificial Sources

8.1 Description

The NPPF describes non-natural or artificial sources of flooding such as reservoirs, canals and lakes where water is retained above natural ground level. It also includes operational and redundant industrial processes including mining, quarrying, and sand and gravel extraction as they may increase water depths and velocities in adjacent areas. In addition to this the impacts of flood management infrastructure and other structures need to be considered. Flooding may result from a facility being overwhelmed or from failure of a structure. Failure of structures can result in rapid, deep flowing water which poses a serious hazard, threatening life and potentially causing major property damage. Failure of pumps may also result in flooding.

For the purpose of the SFRA, flooding from artificial sources has been defined as that arising from failure of man-made infrastructure or human intervention that causes flooding. This includes failure of canals or reservoir embankments, as well as activities such as ground water pumping. To understand flooding from artificial sources the whole hydrological and drainage system must be considered, along with the potential for interaction with other sources of flooding.

The spatial and temporal extent of flooding from artificial sources is highly variable. For example the likelihood of a new reservoir failing is very low compared to that of a canal embankment that is more than one hundred years old. However the consequences of a reservoir failing is potentially catastrophic in comparison to a local canal embankment breaching.

Increased urbanisation, ageing infrastructure and the impacts of climate change all result in the requirement for consideration of flooding from artificial sources within the development process. There are multiple structures that present artificial flood risk in Waverley, including twelve artificial water bodies (reservoirs, lakes and ponds with raised embankments) mapped by the Environment Agency, the Wey and Arun Canal and a stretch of the Wey Navigation in the north of the study area.

Reservoirs are defined as artificial lakes, used to store water for various uses. They can be either modified natural structures or completely man-made. An 'attenuation' or 'impoundment' reservoir is used to prevent flooding to lower lying lands or regulate flows for abstraction and irrigation purposes. Control reservoirs collect water at times of excess (or unseasonably high rainfall), then release it slowly on demand or over the course of the following weeks or months.

Managed or un-managed reservoir release may increase floodwater depths and velocities in adjacent areas. Reservoir flooding may occur as a result of failure of a reservoir’s civil structure due to the system being overwhelmed; or malfunction of the water level control system.

10.1.1 Reservoirs Act

Reservoirs with an impounded volume in excess of 25,000 cubic metres (measured above natural ground level) are governed by the Reservoirs Act 1975 and the Flood and Water Management Act 2010. The Reservoir Act makes owners (undertakers) responsible for the safety of their reservoirs and they are obliged to ensure assessments are undertaken by appropriately qualified engineers on a routine basis.

The Environment Agency have the following key roles:

- Surveillance - maintaining a register of reservoirs for England and Wales.
- Enforcement - achieving compliance.

For reservoirs below the threshold of 25,000 cubic metres above ground volume, regulation is managed by the Health and Safety Executive and they carry out inspections in accordance with the Health and Safety at Work Act. The Environment Agency has a register of reservoirs and undertakers, as well as a set of risk maps for all reservoirs greater than 25,000 cubic meters. Within the study area Frensham great Pond and Broadwater Lake are registered as Reservoirs.

10.2 Artificial Source Flood Risk Datasets

Flood risk presented by Artificial Sources such as reservoirs and canals are presented in Volume 3 Figure 12, using information from the Environment Agency, and previous work completed by Capita to determine the flood risk from the Wey and Arun Canal.

10.2.1 Historical Flooding from Artificial Sources

No documented historic records of flooding from artificial water bodies have been identified during the production of the Waverley SFRA. However, it should be noted that flood events may have occurred in the past but were not recorded. These are therefore not represented in Volume 3.

10.2.2 Environment Agency Reservoir Flood Map

The Environment Agency provided the Reservoir Flood Map maximum Flood Outline which represents the maximum extent of flooding, should the unlikely event of a reservoir embankment breach occur. This flood map only considers embanked “large” reservoirs, and combines the flood extents from several potential breach locations.

10.2.3 Wey and Arun Canal

As part of this SFRA update, there was correspondence with the Wey and Arun Canal Trust, a voluntary organisation that seeks to restore the canal. Previous data from the 2010 SFRA completed by Capita has been used, and was procured through prior consultation with the trust. Further information regarding the canal has been inferred from available online sources. However, information regarding weir protocols, areas which have breached in the past, maintenance regimes, and embanked reaches (which therefore may pose a risk in the event of a breach) is not available.

10.3 Assessing Flooding from Artificial Sources

Reservoir mapping for the Environment Agency provided dataset commenced during the spring of 2009, and the locations of the artificial water bodies have been confirmed with OS mapping. Flood risk from the Wey and Arun Canal has been extracted from the 2010 SFRA and was determined from discussion with the Canal Trust and through analysis of topographic data, where higher risk of breach and flooding is the result of the water body being raised above natural ground levels.

The location of registered reservoirs and ponds and lakes noted as being a potential source of flooding in the study area are outlined in Table 8-1.

Table 8-1 - Location of artificial water bodies and reservoir sites in WBC SFRA area

Location	Ward	Owner
The Tarn	Elstead	The Trustees of Hampton Estate
Enton Upper Lake	Godalming	Kirk
Thursley lake	Witley	Witley Park Holdings Ltd
Enton Lower Lake	Witley	Kirk
Vachery Pond	Cranleigh	Cook
Broadwater Lake	Godalming	Waverley Borough Council
Upper Lake (Witley Park)	Witley	Witley Park Holdings Ltd
Rowe's Flashe Lake (Winkworth Arboretum)	Bramley	The National Trust
Lower Busbridge Lake	Busbridge	Godalming Angling Society
Frensham Little Pond	Frensham	The National Trust
Frensham Great Pond	Frensham	Waverley Borough Council
Johnson's Lake	Witley	Godalming Angling Society

10.4 Flooding from the Artificial Sources

10.4.1 Flood Risk from Reservoirs

Reservoir flooding is extremely unlikely to happen; there has been no loss of life in the UK from reservoir flooding since 1925. Although potentially large uncontrolled releases of water from the reservoirs could result in deep and fast moving floodwaters and place people's lives in danger, the probability of occurrence is very low, and therefore flood risk is considered as low. The extents of the breaches mapped in Volume 3 Figure 12, indicate the credible worst case scenario and are unlikely to occur at such a great extent.

Given this information the flood risk from artificial sources to property or infrastructure is very low, with the reservoir flooding predominantly following water courses and spilling across rural areas. Enton Upper Lake and Johnson's Lake, in the event of an embankment breach, could cause flooding in properties through Milford, Station Lane and the Milford station. Enton Upper Lake presents a flood risk that extends along the Ock tributary towards central Godalming. Vachery pond, presents a flood risk to the largest area, although does not present risk to a significant amount of properties. The flood map does indicate potential flooding along major infrastructure including the Cranleigh railway and the A281, Horsham Road. The extent of its flooding continues downstream, along the Cranleigh Waters tributary, out of the Borough northwards, although the flooding deviates minimally from the watercourse.

The Frensham Great Pond breach occurs on the western side of the water body, and flooding occurs northwards along the Wey Southern branch to its confluence Jumps Stream. It presents minor risk to property and roads in the villages of Dockenfield, Spreakley and Millbridge. In comparison the Frensham Little Pond barely exceeds its current location and extent.

The Broadwater Lake, due to its location in central Godalming, presents a more significant flood risk, based on the increased consequences to both property and infrastructure. As shown in Volume 3, Figure 12.

10.4.2 Flood Risk from the Wey and Arun Canal

The Wey and Arun Canal stretches 23 miles, striking south to north across the study area. It follows a 50m topographic contour, entering the borough south of Dunsfold, connecting to the

River Arun, and exiting north of Bramley, connecting to the River Wey. The canal is in disrepair and the only significant stretch that is “usually” in water runs parallel to the Dunsfold Aerodrome boundary. There have been recorded incidents of flooding due to overtopping from the canal on the Dunsfold Road, at Alford. These were as a result of the canal channelling surface water runoff.

Flood risk is posed by the Wey and Arun Canal where it is above surrounding ground levels, which, given a breach of the canal’s embankments could cause damage to property and infrastructure close to the canal below the 50m contour. Breach of embankment on a short length of canal will pose a lesser risk than that of a longer length due to the limited volume of water within the discreet canal section. Even so, where the canal is embanked there is the potential for a breach, producing a risk to nearby development.

There was no information provided by the Canal Trust during the production of this SFRA and therefore the following analysis has been summarised from the 2010 WBC SFRA. It is also assumed that no emergency procedures are in place, which may require local new developments to manage risk instead through design such as raised floor levels.

Breach of embankment

Seven sections of embanked canal within Waverley were identified using OS mapping. If these embankments were to breach there is potential for immediate flooding, but to varying extents, to land and property adjacent to the canal. The sections of embankment are located:

- At Birtley Book, south of Bramley;
- South of Fanesbridge Cottage, south of Bramley;
- North of Rushett Farm between Bramley and Rowly;
- From west of East Whipley Farm to south of Bridgeham Farm, north of Rowly;
- From north of Elmbridge Road, west of Cranleigh, to Alfold Road, south of Cranleigh;
- Within Sidney Wood, south east of Dunsfold; and
- At the WBC southern boundary where the recent Southwood lock has been reinstated.

As the water from any breach in the canal embankment is likely to follow land drainage routes to the nearby watercourses, flows in the River Lox and Cranleigh Waters would be increased, depending on where the breach occurred. Downstream areas, particularly the village of Bramley are potentially at risk, particularly if levels within the Cranleigh Waters are already high.

Culvert Failure

In restoring the canal, the Trust has built culverts to enable the canal to pass over minor watercourses, although the majority of these exist in the southern restored reaches of the canal which are external to the study area. These culverts are at risk of failure should a blockage or collapse occur (resulting in a blockage), which could result in flooding and also could surcharge the land drainage system.

It should be noted that the canal through Waverley can alleviate flooding by channelling water that has run off the land, particularly during intense summer storms where there is increased runoff from overland flow entering the system.

10.4.3 The Wey Navigation

The Wey Navigation is managed by the National Trust and extends into the study area, following the River Wey and ending in the Catteshall district of Godalming. It is a combination of engineered channels separate from the river, and sections of navigable river. The sections of navigable river will flood with the river naturally, and therefore the extent of flooding is indicated by the modelled fluvial flood extents. The engineered sections should not flood, and are controlled by various weirs and gates. However, some of the engineered sections are on perched embankments and, therefore, there is a small risk of breach or failure. Should there be a failure, the gates controlling water flow through the engineered section of the navigation could be operated to isolate the breached section. Although a specific breach analysis has not been done as part of this SFRA, it is anticipated that the flooding resulting from a breach would be within the extents of flooding indicated on the fluvial flood maps.

11. Uncertainties in Flood Risk Assessment

When assessing risk, the impact of uncertainties associated with the predictions of the hazard and the consequences should be recognised and appreciated so informed decisions can be made.

This SFRA update addresses the inherent uncertainties and where necessary seeks to institute measures for their reduction.

The strategy for risk management requires that all phases of the planning and implementation process are fully co-ordinated. The level of detail on flood risk assigned to particular proposals will be limited by the information available at the time of the submission of respective planning applications. It should be noted that the outputs of the SFRA are only as good as the data inputs.

This SFRA is owned by Waverley Borough Council and should be kept as a live document, reviewed and updated as necessary as the best available information is improved or the inherent uncertainties identified are reduced. Ownership of the SFRA document and maps will be established by the SFRA Steering Group (See Volume 1, Section 9.5). The implementation of measures or strategic options may change the Actual Risk, Residual Risk and Flood Hazard.

Other future uncertainties that will affect the estimate of flood risk in the Waverley SFRA study area include (but are not limited to):

- Updated hydrological and hydraulic modelling studies
- Changes to the upstream catchment and river channel
- Changes in land use within and upstream of the study area
- Revision of climate change predictions.

It is probable that specific development proposals will be a focus for the collection of better data in the future and the catalyst for commissioning studies that lead to a reduction in the uncertainty in the magnitude or frequency of influential parameters, i.e. the improvement of hydrometric data, or completion of new hydraulic models on previously unmodelled reaches. A prudent response is to use the best available data at each stage of the planning process and prepare proposals that are respectively precautionary in accordance with the advice in PPG and flexible with respect to uncertainty. The need to prepare standalone Flood Risk Assessments in support of planning applications will serve to highlight information that would be the trigger for a review of the SFRA.

The Waverley SFRA is based on information that will inevitably be amended by better data, changes in the baseline condition due to development and changing institutional and policy conditions. To be robust and able to withstand challenge in the planning process there is a need to ensure the SFRA reflects conditions at the time particular evaluations are made. Failure to maintain the SFRA may reduce the effectiveness of flood risk management measures; delay plan making and development processes; and potentially lead to the neglect of flood risk considerations and the failure to capture strategic responses and interventions.

The borough council will have the prime responsibility for managing and maintaining this SFRA. The SFRA will be reviewed annually as part of its Annual Monitoring Report.

11.1 Flood Risk from Rivers

The following section summarises the uncertainties and assumptions associated with the hydraulic modelling completed on the watercourses in the area:

- The flows predicted using the hydrological analyses for the River Wey rely on data from a system of gauges that are generally not accurate at high flow magnitudes;

- Topographic data that is used to determine flood extents in the modelling are of limited accuracy due to the techniques used for its production. This has a significant bearing on the uncertainty and accuracy of the flood mapping produced;
- Not all flood defences may have been considered/more may have been constructed following the modelling studies; and
- Not all watercourses in the study area have been specifically hydraulically modelled for this SFRA. Quantification of flood risk on these watercourses is subject to greater uncertainty.

It is also worth noting when considering flood risk that the historic record of flooding is not complete and could be supplemented in future updates of the SFRA. Furthermore when considering the climate change scenario, the additional 20% in magnitude peak flow added to the 1% AEP flood event is not definitive and peak flows could in actuality be more or less.

11.2 Flood Risk from Surface Water

The supporting guidance document to the uFMfSW highlights the limitations inherent to the dataset. The following uncertainties therefore apply to the flood risk from surface water:

Although the uFMfSW is a significant improvement on past nationally-produced surface water flood mapping, it is important not to lose sight of the limitations which remain. These include the following:

- The methodology assumed a single drainage rate for all urban areas within the nationally produced modelling unless LLFAs were able to provide better local data. Modelled flood extents are particularly sensitive to the way drainage is taken into account. Omitting large subsurface drainage elements such as flood relief culverts and flood storage can also significantly affect the modelled pattern of flooding.
- The nationally produced modelling assumes a free outfall and so does not take into account tide locking or high river levels which may prevent surface water from draining away freely.
- Limited recorded surface water flood data exists for LLFAs, so in many places LLFAs have not yet been able to validate the nationally produced modelling.
- As with many other flood models:
    - The input information, model performance and modelling that was used to create the nationally produced modelling varies for different areas. For example, in many areas, the ground level data is based on detailed LIDAR information, but where this is not available ground levels are much less accurate. Similarly, models of this type tend to perform better in steeper rural areas than in flat urban areas. These variations affect the reliability of the mapped flood extents and, in turn, the suitability for different applications.
    - UFMfSW does not take individual property threshold heights into account so the map shows areas that may potentially flood but cannot accurately predict the impacts on individual properties.
    - The flood extents show predicted patterns of flooding based on modelled rainfall. The patterns of flooding from two similar storm events can vary due to many local circumstances.

Consequently, these maps cannot definitively show that an area of land or property is, or is not, at risk of flooding, and the maps are not suitable for use at an individual property level.

11.3 Flood Risk from Sewers

Assessing the risk of sewer flooding over a wide area is limited by the lack of data and the quality of data that is available. Furthermore, flood events may be a combination of surface water, groundwater and sewer flooding.

An integrated modelling approach is required to assess and identify the potential for sewer flooding but these models are complex and require detailed information. Obtaining this information can be problematic as datasets held by stakeholders are often confidential, contain varying levels of detail and may not be complete. Sewer flood models require a greater number of parameters to be input and this increases the uncertainty of the model predictions.

Existing sewer models are generally not capable of predicting flood routing (flood pathways and receptors) in the above ground network of flow routes (for example, streams, dry valleys, and highways).

Use of historic data to estimate the probability of sewer flooding is the most practical approach; however it does not take account of possible future changes due to climate change or future development. Nor does it account for improvements to the network, including clearance of blockages, which may have occurred.

11.4 Flood Risk from Groundwater

The supporting document to the British Geological Society outlines the limitations of the dataset and highlights the importance of using the information in conjunction with other flood risk data. The following is taken from the supporting document.

The susceptibility data is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. It might also be used in conjunction with a large number of other factors, e.g. records of previous incidence of groundwater flooding, rainfall, property type, and land drainage information, to establish relative, but not absolute, risk of groundwater flooding at a resolution of greater than a few hundred metres. The susceptibility data should not be used on its own to make planning decisions at any scale, and, in particular, should not be used to inform planning decisions at the site scale. The susceptibility data cannot be used on its own to indicate risk of groundwater flooding.

11.5 Flood Risk from Artificial Sources

The reservoir flood map outline shows the largest area that might be flooded if the reservoir fails and releases all of the water it holds, which is extremely unlikely, and is a prediction of worst case scenario. Actual flood risk is considered to be much lower than these outlines show. The flood map does not include smaller reservoirs of reservoirs commissioned after spring 2009 (when mapping began).

Flood risk from the Wey and Arun Canal has been assessed based on areas susceptible to breach, failure and overtopping during the 2010 SFRA. Degradation as well as maintenance of embankments will affect the risk of failure, which has not been considered in the assessment.

12. Summary

Evidence collected through this Level 1 SFRA highlights the areas within Waverley that are susceptible to flooding from a variety of sources. Flood sources include:

- Fluvial
- Surface Water
- Groundwater
- Sewers
- Artificial Sources.

Fluvial flood risk is concentrated along the River Valleys of the Wey and its tributaries, and to a lesser extent the River Lox and River Blackwater. The areas at risk are constrained to well defined valley topography and there is little difference in flood extent between the 1% AEP and 0.1% AEP event outlines from the hydraulic models in the study area for the Upper and Lower Wey and the River Blackwater. A 20% increase in river flows as a result of predicted climate change also do no show a very significant increase in flood extent to the developed areas of the borough. The main areas impacted by fluvial flood risk are central Godalming, parts of Cranleigh and central Farnham. In other areas, the floodplains remain largely undeveloped and rural. The Functional Floodplain has been defined by the 5% AEP event where detailed modelling is available, and the developed areas along the banks of the River Wey through Farnham are at risk.

Surface water and sewer flooding have been considered using recorded incidents by the EA, SCC, WBC and the Parish Councils. Flood risk has been also evaluated using the uFMfSW dataset provided by the EA. Most of the surface water flood risk is concentrated in the developed areas of Godalming, Farnham and Cranleigh, and are mostly parallel with the natural drainage patterns of ordinary watercourses. Maintenance of small watercourses and structures has an important impact on local flooding mechanisms.

Groundwater flooding has been assessed using data from the British Geological society, and large areas in Farnham, Badshot Lea, Tilford, Godalming and Cranleigh have been identified as having potential for groundwater flooding to occur at the surface, based on underlying river terrace soils and Chalk and Greensand geology, combined with recorded depths to the water table. The north western part of the borough has limited potential for groundwater flooding, whereas the south eastern region of the borough is at very low risk of flooding from groundwater.

Areas that lie below the Wey and Arun Canal that are currently protected by embanked ground are at low risk of flooding from the canal due to breach of embankment or overtopping. These areas have been identified as at Mill Farm, west of Cranleigh, and patches within Bramley parish. Areas along the main river channels and adjacent to artificial bodies are at risk of flooding should embankments fail. These predominantly include Vachery Pond, Broadwater Lake, Frensham Great Pond and Enton Upper Lake reservoirs. Although the consequences of reservoir failure are high, the probability of occurrence is very low and therefore flood risk from reservoirs is considered low.

11. References

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- Floods Review. Sir Michael Pitt (2008) (http://www.cabinetoffice.gov.uk/thepittreview.aspx)

13. Glossary and Notation

Term	Definition
Alluvium	Sediments deposited by fluvial processes / flowing water
Annual Exceedance Probability (AEP)	The probability of an event occurring within any one given year.
Attenuation	In the context of this report - the storing of water to reduce peak discharge of water
Aquifer	A source of groundwater comprising water-bearing rock, sand or gravel capable of yielding significant quantities of water.
Breach	An opening – For example in the sea defences
Brownfield	Previously developed land, usually of industrial land use within inner city areas.
Catchment Flood Management Plan	A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
Culvert/culverted	A channel or pipe that carries water below the level of the ground.
Drift Geology	Sediments deposited by the action of ice and glacial processes
EA Flood Zone 1	Low probability of flooding
EA Flood Zone 2	Medium probability of flooding. Probability of fluvial flooding is 0.1 – 1%. Probability of tidal flooding is 0.1 – 0.5 %
EA Flood Zone 3a	High probability of flooding. Probability of fluvial flooding is 1% (1 in 100 years) or greater. Probability of tidal flooding is 0.5%(1 in 200 years)
EA Flood Zone 3b	Functional floodplain
Estuary	A tidal basin , where a river meets the sea, characterised by wide inlets
Exception Test	The exception test should be applied following the application of the Sequential Test. Conditions need to be met before the exception test can be applied.
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Floodplain	Area adjacent to river, coast or estuary that is naturally susceptible to flooding.
Flood Resilience	Resistance strategies aimed at flood protection
Flood Risk	The level of flood risk is the product of the frequency or likelihood of the flood events and their consequences (such as loss, damage, harm, distress and disruption)
Flood Risk Assessment	Considerations of the flood risks inherent in a project, leading to the development actions to control, mitigate or accept them.
Flood storage	A temporary area that stores excess runoff or river flow often ponds or reservoirs.
Flood Zone	The extent of how far flood waters are expected to reach.
Fluvial	Relating to the actions, processes and behaviour of a water course (river or stream)
Fluvial flooding	Flooding by a river or a watercourse.
Freeboard	Height of flood defence crest level (or building level) above designed water level
Functional Floodplain	Land where water has to flow or be stored in times of flood.

Freeboard	Height of the flood defence crest level (or building level) above designed water level.
GIS	Geographic Information System – A mapping system that uses computers to store, manipulate, analyse and display data
Greenfield	Previously undeveloped land.
Groundwater	Water that is in the ground, this is usually referring to water in the saturated zone below the water table.
Highly Vulnerable Developments	Developments that are at highest risk of flooding.
Hydraulic Modelling	A computerised model of a watercourse and floodplain to simulate water flows in rivers too estimate water levels and flood extents.
Hydrodynamic Modelling	The behaviour of water in terms of its velocity, depth and hazard that it presents. Infiltration The penetration of water through the grounds surface.
Infrastructure	Physical structures that form the foundation for development.
LiDAR	Light Detection And Ranging – uses airborne scanning laser to map the terrain of the land.
Local Plan	Waverley's statutory development plan, comprising Part 1 (Strategic Policies and Sites) and Part 2 (Development Management and Site Allocations).
Local Planning Authority	The local authority or council empowered by law to exercise statutory planning functions for its administrative area.
Main River	Watercourse defined on a 'Main River Map' designated by DEFRA. The environment Agency has permissive powers to carry out flood defence works, maintenance and operational activities for Main Rivers only
Mitigation measure	An element of development design which may be used to manage flood risk or avoid an increase in flood risk elsewhere.
Overland Flow	Flooding caused when intense rainfall exceeds the capacity of the drainage systems or when, during prolonged periods of wet weather, the soil is so saturated such that it cannot accept any more water.
Overtopping	Water carried over the top of a defence structure due to the wave height exceeding the crest height of the defence.
Reach/ Upper reach	A river or stream segment of specific length. The upper reach refers to the upstream section of a river.
Residual Flood Risk	The remaining flood risk after risk reduction measures have been taken into account.
Return Period	The average time period between rainfall or flood events with the same intensity and effect.
Riparian Owner	Owners of land adjoining, above, or with a watercourse running through it. Riparian owners have rights and responsibilities associated with river management.
Risk	The probability or likelihood of an event occurring.
River Catchment	The areas drained by a river
SAR	Synthetic Aperture Radar - a high resolution ground mapping technique, which uses reflected radar pulses.
Sequential Test	Aims to steer development to areas of lowest flood risk.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
Solid Geology	Solid rock that underlies loose material and superficial deposits on the earth's surface
Source Protection Zone	Defined areas in which certain types of development are restricted to ensure that groundwater sources remain free from contaminants.
Standard of Protection	The flood event return period above which significant damage and possible failure of the flood defences could occur.
Storm surge	A high rise in sea level due to the winds of the storm and low atmospheric

	pressure.
Sustainability	To preserve /maintain a state or process for future generations.
Sustainable drainage system	Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques.
Sustainable development	Development that meets the needs of the present without compromising the ability of future generations meeting their own needs
Tidal	Relating to the actions or processes caused by tides.
Topographic survey	A survey of ground levels.
Tributary	A body of water, flowing into a larger body of water, such as a smaller stream joining a larger stream.
1 in 100 year event	Event that on average will occur once every 100 years. Also expressed as an event, which has a 1% probability of occurring in any one year.
1 in 100 year design standard	Flood defence that is designed for an event, which has an annual probability of 1%. In events more severe than this the defence would be expected to fail or to allow flooding.

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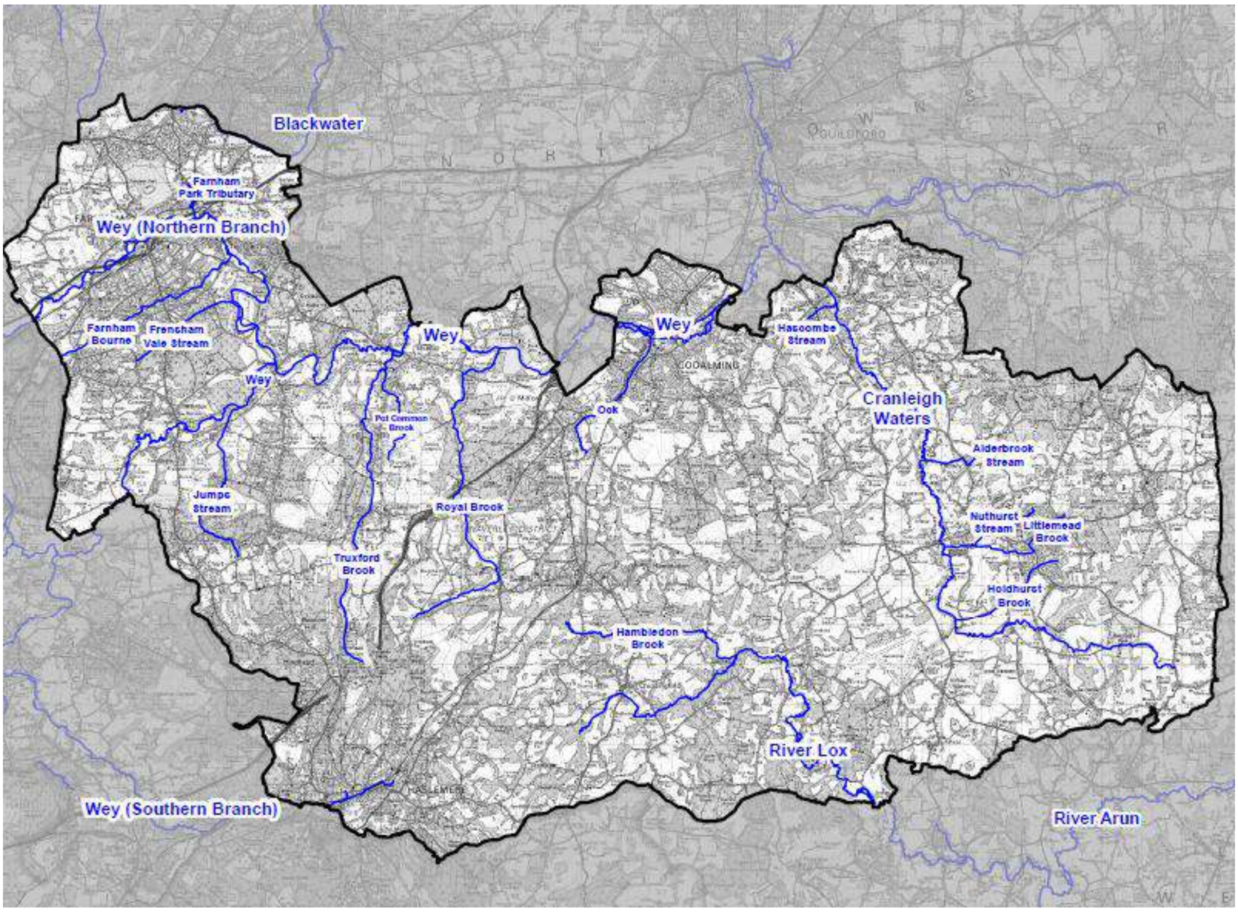
Waverley Borough Council Strategic Flood Risk Assessment Draft Volume 3 – SFRA Maps

July 2015



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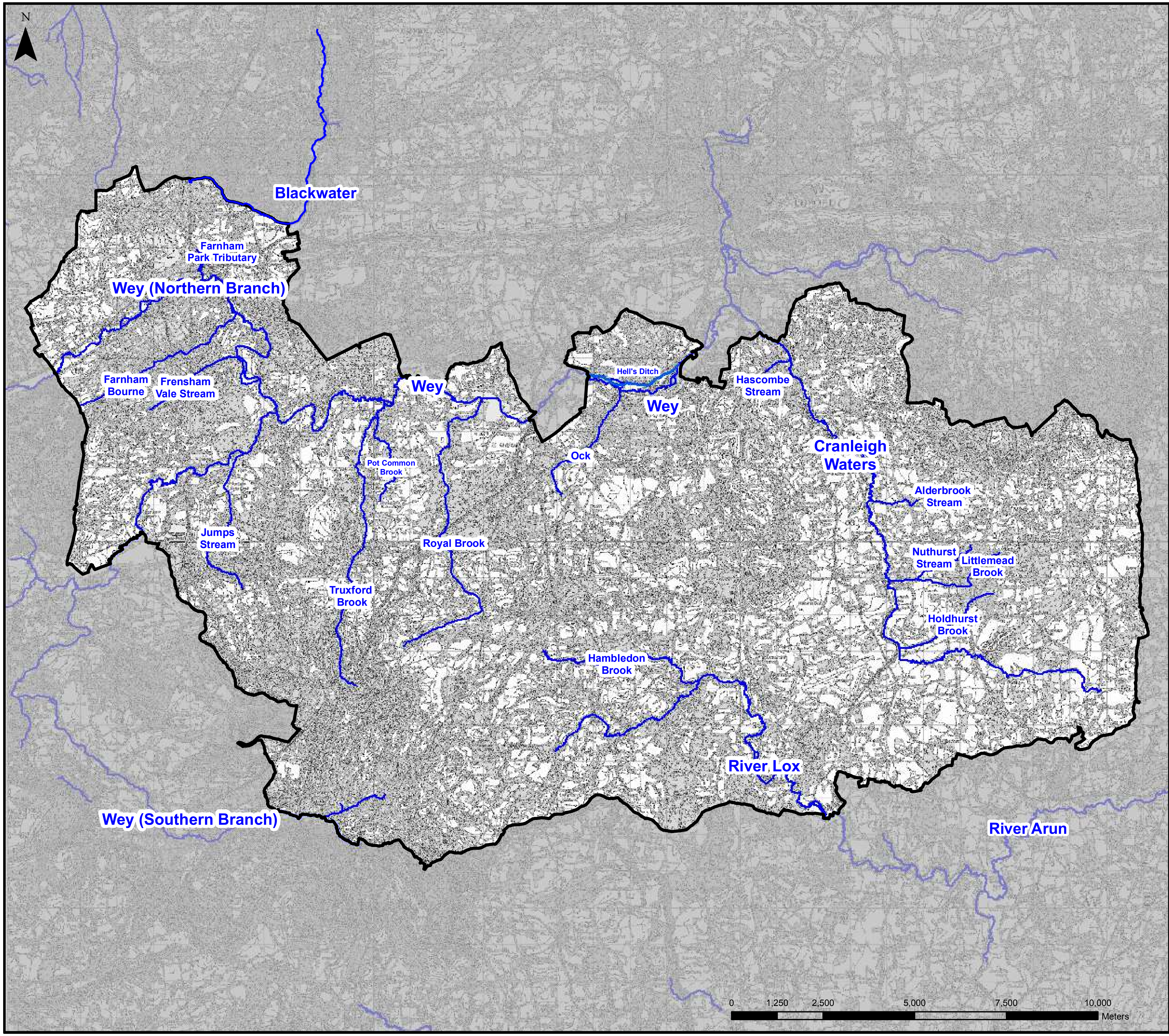
Quality Management

Job No	CS078301		
Project	Waverley Borough Council SFRA Update		
Location	F:\Environment\ZWET\CS078301_Waverley_SFRA_update\GIS\PDF		
Title	Volume 3 – SFRA Maps		
Document Ref	Waverley Borough Council SFRA Report Volume 3 SFRA Maps	**Issue / Revision**	Draft
Date	July 2015		
Prepared by 1	Hayley Todd	Signature (for file)	
Checked by	Nicole Shamier	Signature (for file)	
Authorised by	Nicole Shamier	Signature (for file)	

Revision Status / History

Rev	Date	Issue / Purpose/ Comment	Prepared	Checked	Authorised
1	March 2015	Draft for Submission to WBC and the EA	CJ / HT	KF	MA
2	July 2015	Final Draft Submission to WBc and the EA	HT	NS	NS

Mapping Contents



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Legend

- Main River
- Borough Administrative Boundary

Notes

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Figure 1
Study Area

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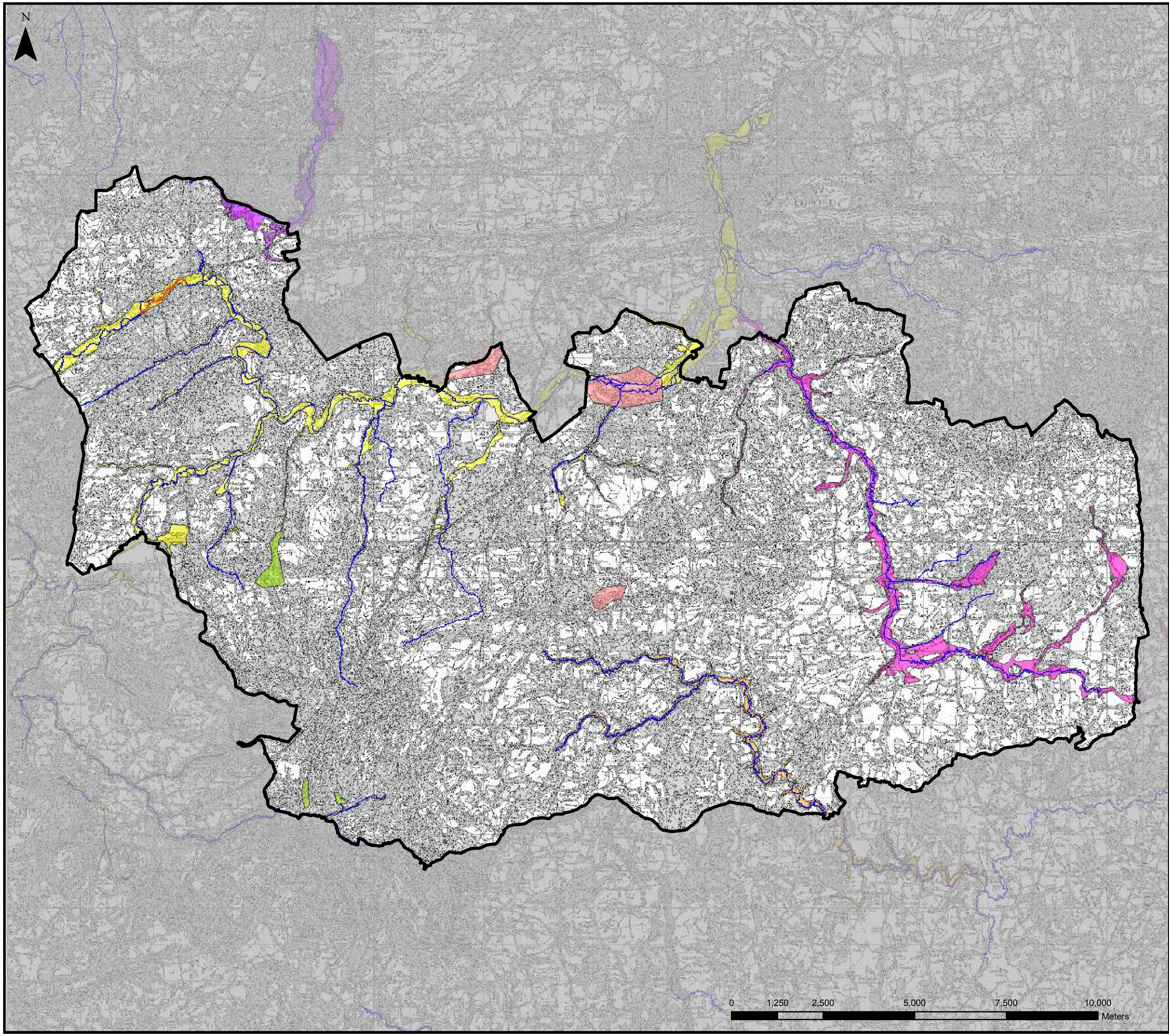

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Legend

Main River
Borough Administrative Boundary
Flood Defences

Flood Alert Areas

Cranleigh Waters
Groundwater flooding in Godalming, Shackleford and Hambledon areas
Groundwater flooding in the Haslemere and Churt areas
Loxwood Stream/River Lox
River Blackwater and The Cove Brook
Upper River Wey

Note, these maps are available on the Environment Agency Website; http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=fwa&layerGroups=default&lang=_e&ep=map&scale=5&x=531500&y=181500#x=531500&y=181500&lg=1,2,&scale=5

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Flood Alert Areas and Defences

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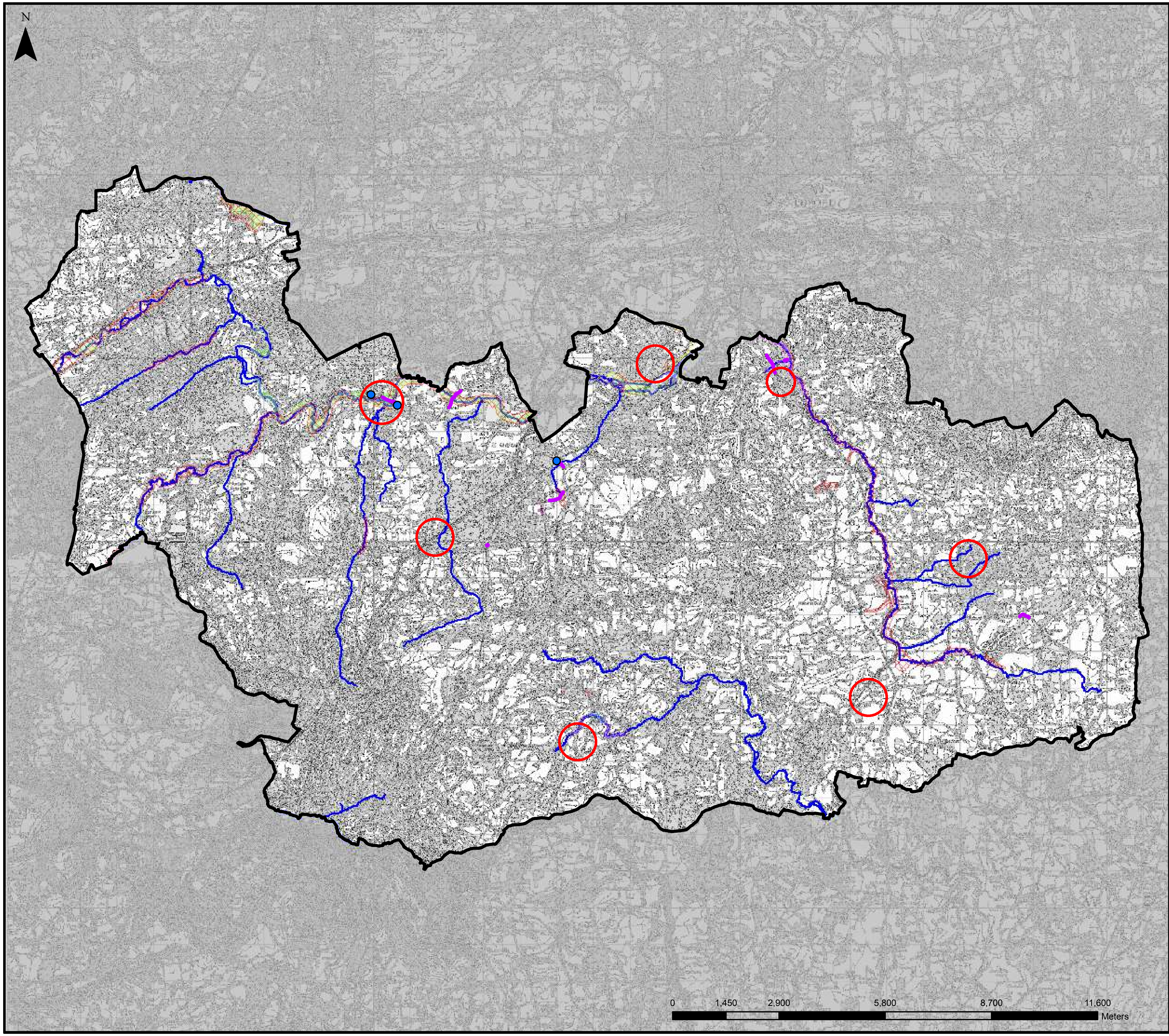

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Legend

- Main River
- Borough Administrative Boundary
- Historical Fluvial Flood events*
- Flood incidents on Roads**

Recorded Flood Outlines***

- 1947
- 1960
- 1968
- 1974
- 1979
- 1981
- 1990
- 2000
- 2003

*Data based on reports and correspondence with Parish Councils
**Data acquired from Surrey County Council Wetspots data
*** Environment Agency data grouped by year of flooding event

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Figure 3A
Historic Flooding - Fluvial

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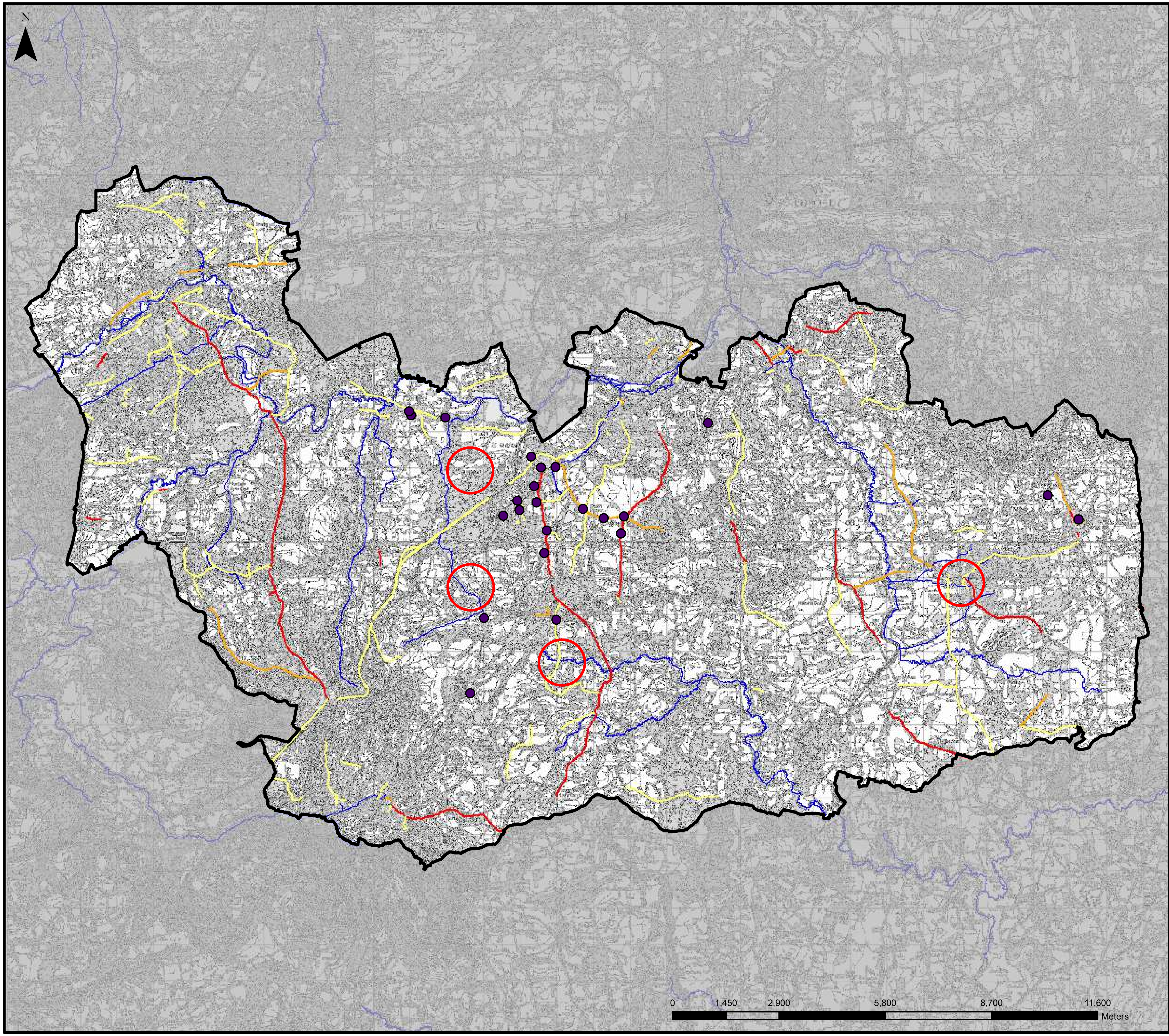

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Legend

- Main River
- Borough Administrative Boundary
- Historical Surface Water flood events*

No. of flood incidents on road**

- 1
- 2
- 3

* Data extracted from discussion with Parish Councils
** Data summarised from Surrey County Council Wetspot database

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Figure 3B
Historic Flooding - Surface Water

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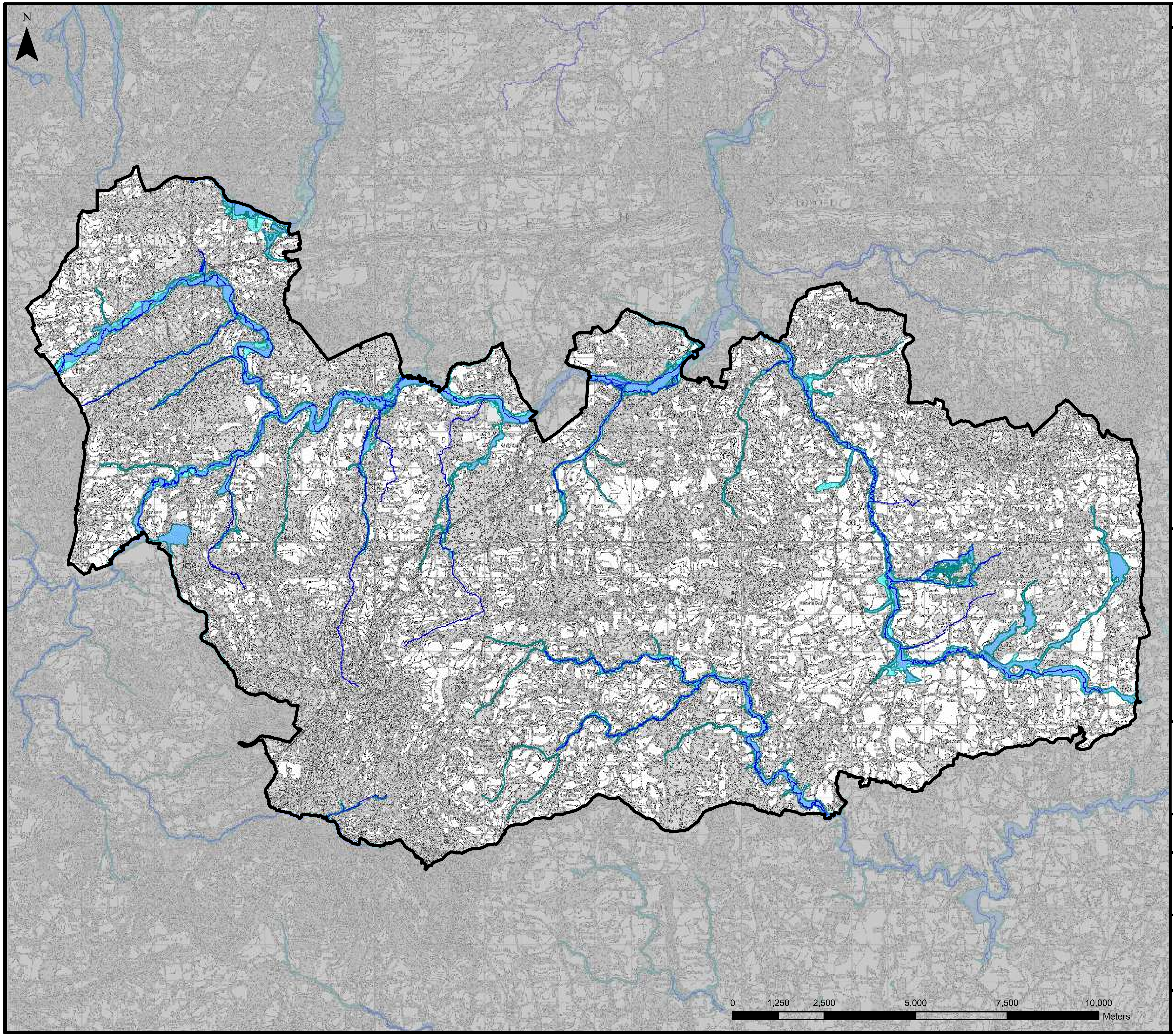

Legend

- Main River
- Borough Administrative Boundary
- Environment Agency Flood Zone 2
- Environment Agency Flood Zone 3

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Figure 3
Environment Agency
Flood Maps for Planning

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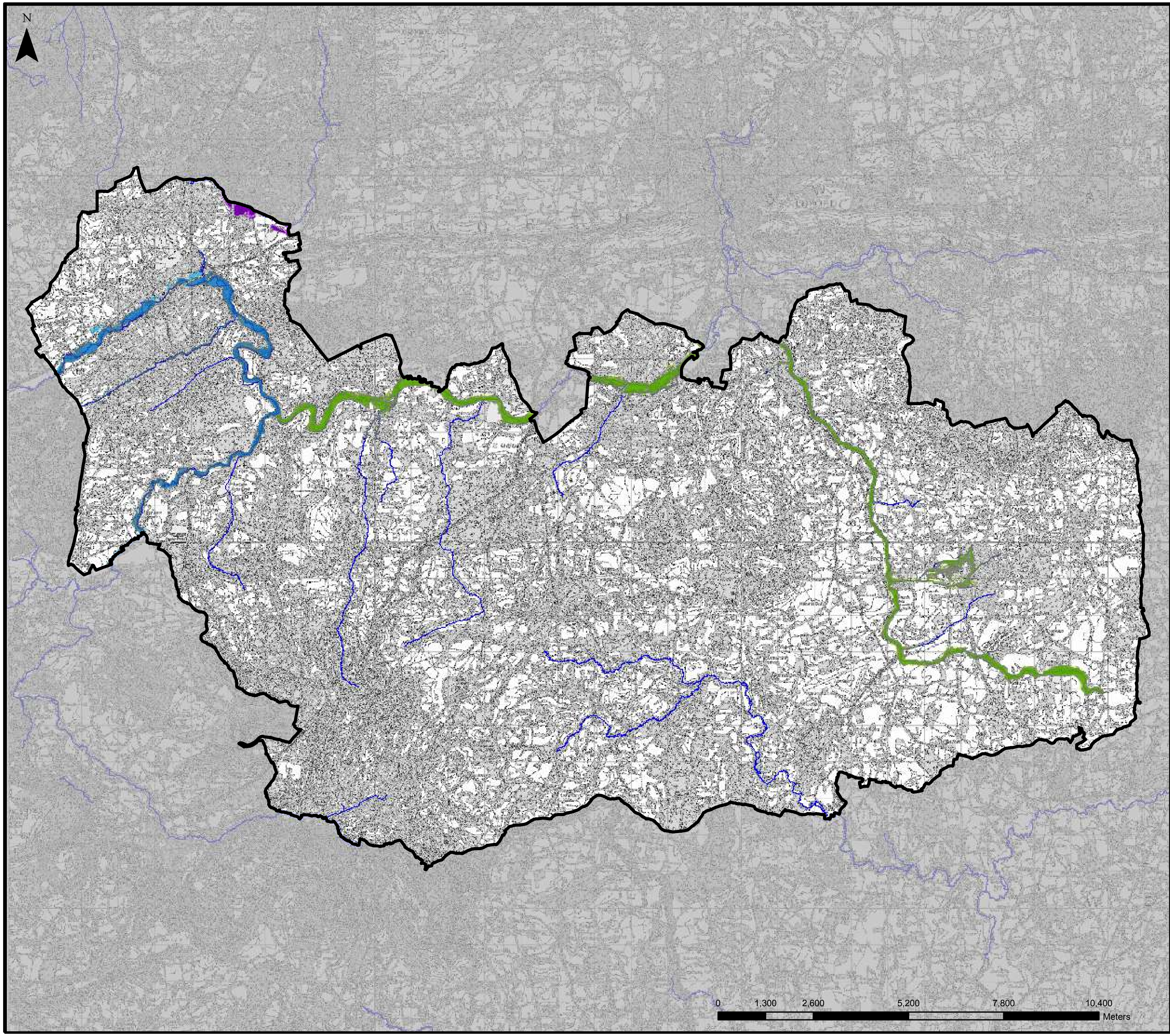

Legend

Main River

Borough Administrative Boundary

Detailed Model Flood Extents

River Blackwater (2007)

1 in 20yr - defended

1 in 100yr - defended

Lower Wey (2009)

1 in 20yr

1 in 100yr - defended

1 in 1000yr - defended

Upper Wey (2006)

1 in 20yr

1 in 100yr

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Figure 5
Detailed Hydraulic Model
Fluvial Flood Outlines

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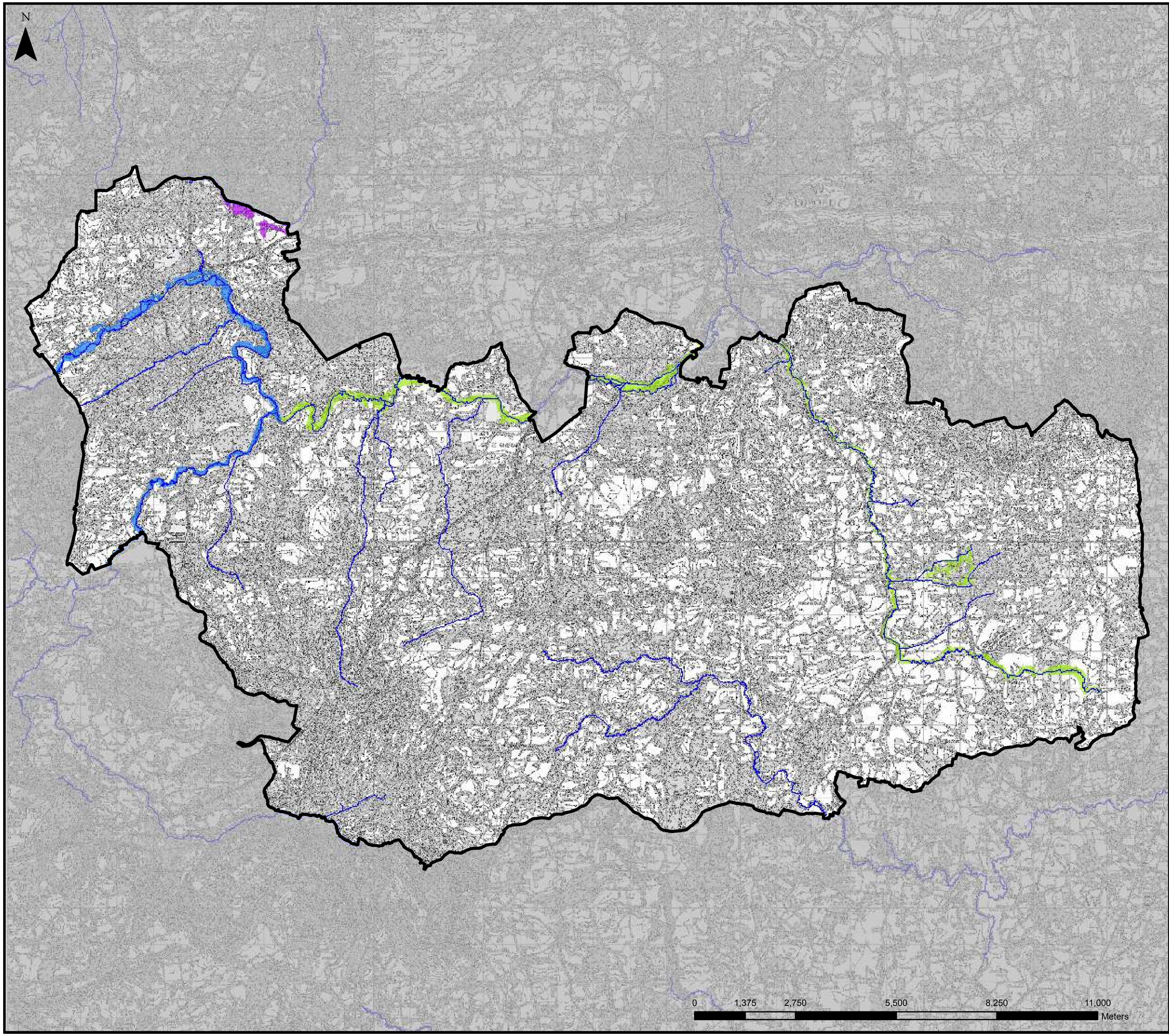

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Legend

Main River

Borough Administrative Boundary

Detailed Model. 1 in 100 year (+20%) flood outline : Climate Change Scenario

Lower Wey (2009)

Upper Wey (2006)

River Blackwater (2007) - defended

Map shows defended outlines from the Lower Wey (2009), Upper Wey (2006) and River Blackwater (2007) Hydraulic Modelling Studies

Notes

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Figure 6
Detailed Fluvial Flood Risk incorporating Climate Change

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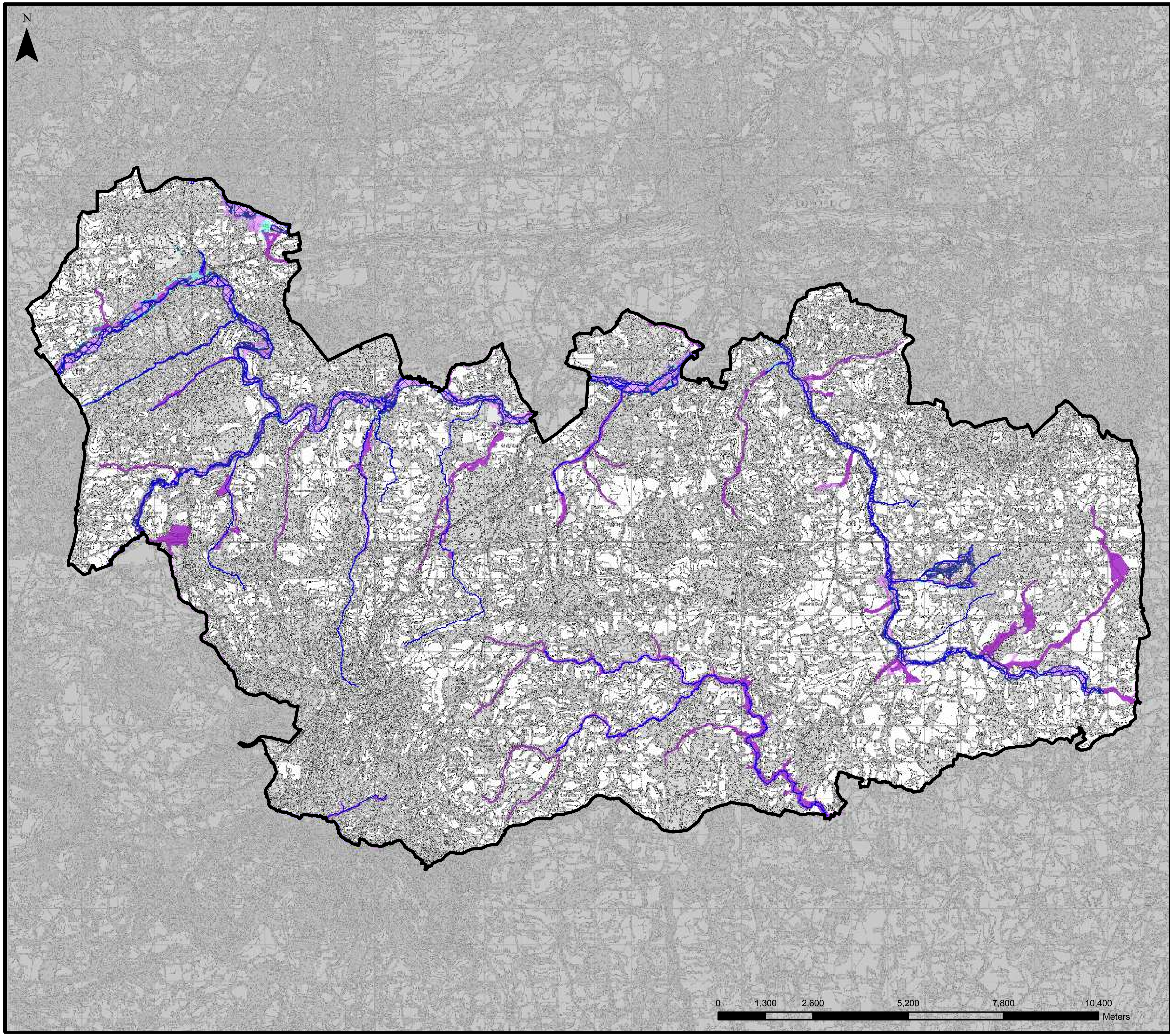

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Legend

Main River

Borough Administrative Boundary

SFRA Flood Zones*

SFRA Flood Zone 3b (hydraulic modelling exists)

SFRA Flood Zone 3a (modelling exists) /SFRA Flood Zone 3b (no modelling exists)

SFRA Flood Zone 3 - climate change

SFRA Flood Zone 2 (for both modelled and unmodelled)

* Categorisation of flood zone dependent on presence of Hydraulic Modelling flood extents, see table below.

SFRA Flood Zone	Hydraulic modelling exists along watercourse	No hydraulic modelling along watercourse
SFRA Flood Zone 3b	5% AEP (1 in 20 year) event	EA Flood Zone 3
SFRA Flood Zone 3a	1% AEP (1 in 100 year) event	n/a
SFRA Flood Zone 3 – climate change	1% AEP (1 in 100 year) + climate change event	
SFRA Flood Zone 2	0.1% AEP (1 in 1000 year) event	EA Flood Zone 2

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Figure 7
SFRA Fluvial Flood Zones

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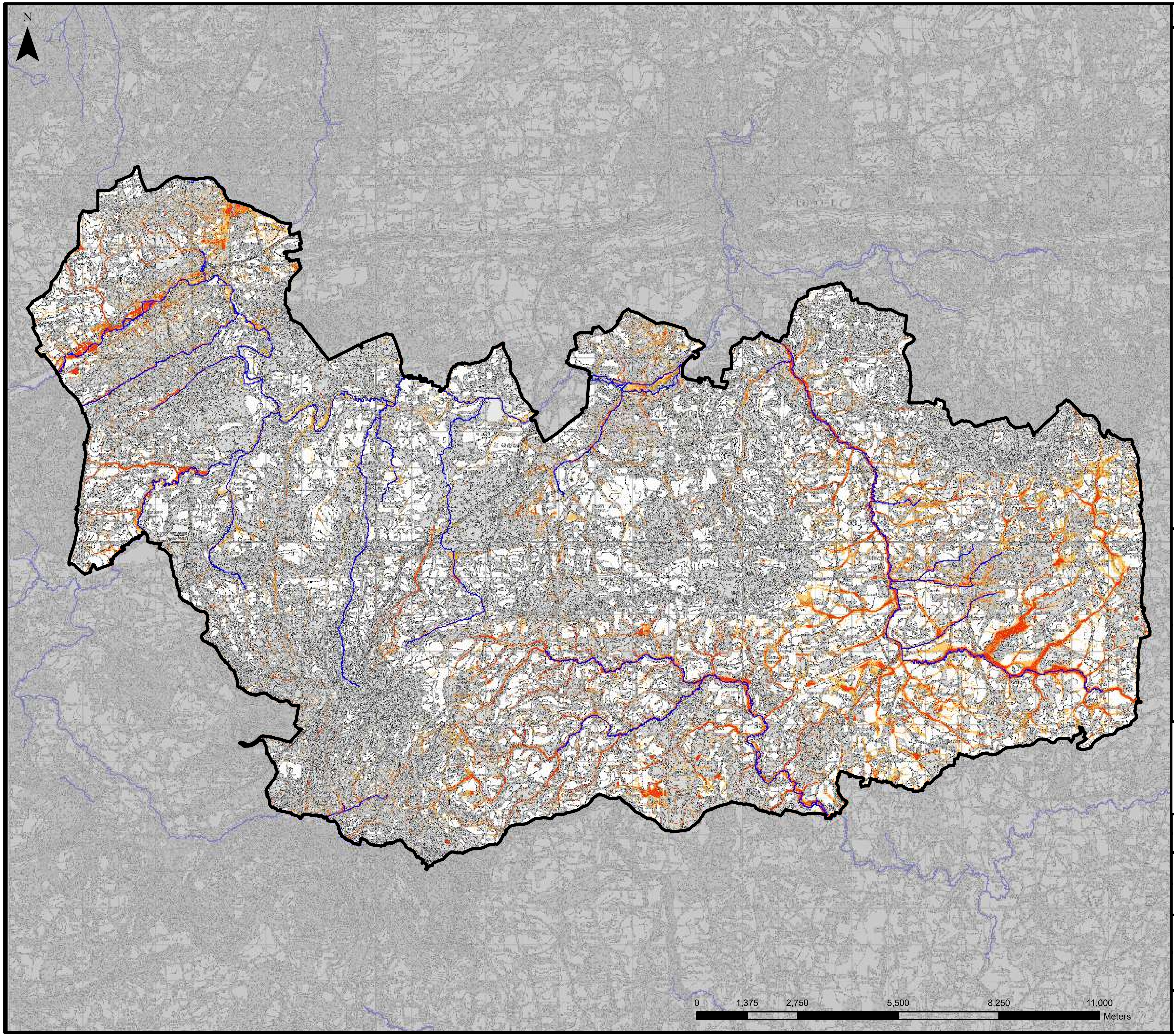

Legend

- Main River
- Borough Administrative Boundary
- uFMfSW 30 AEP
- uFMfSW 100 AEP
- uFMfSW 1000 AEP

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Figure 8A
Surface Water
Flood Risk - Extent

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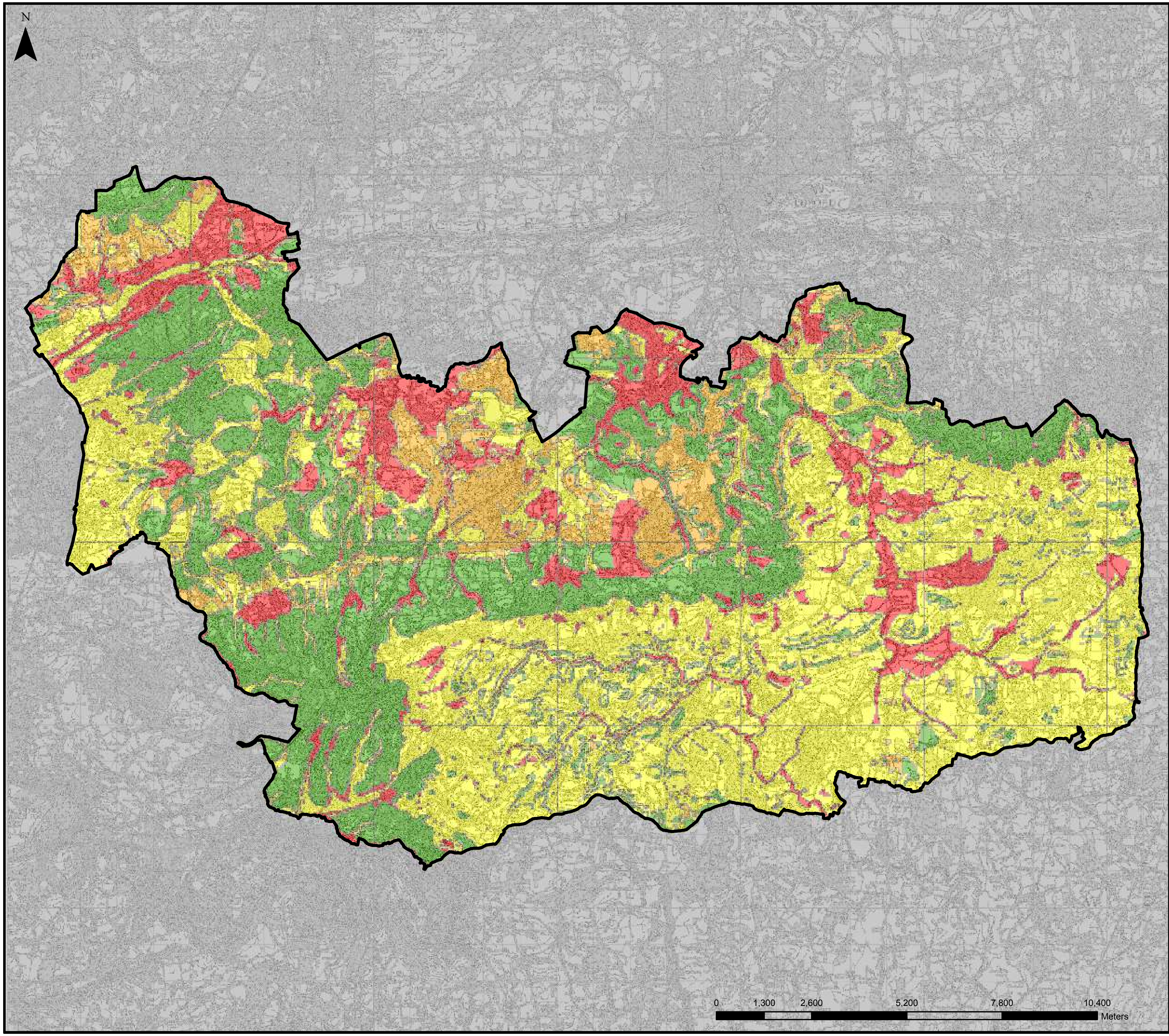

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

Borough Administrative Boundary

Drainage Summary

- Highly compatible for infiltration SuDS
- Opportunities for bespoke infiltration SuDS
- Probably compatible for infiltration SuDS
- Very significant constraints are indicated

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

Figure 9
Infiltration SuDS
Suitability Map

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig9	-

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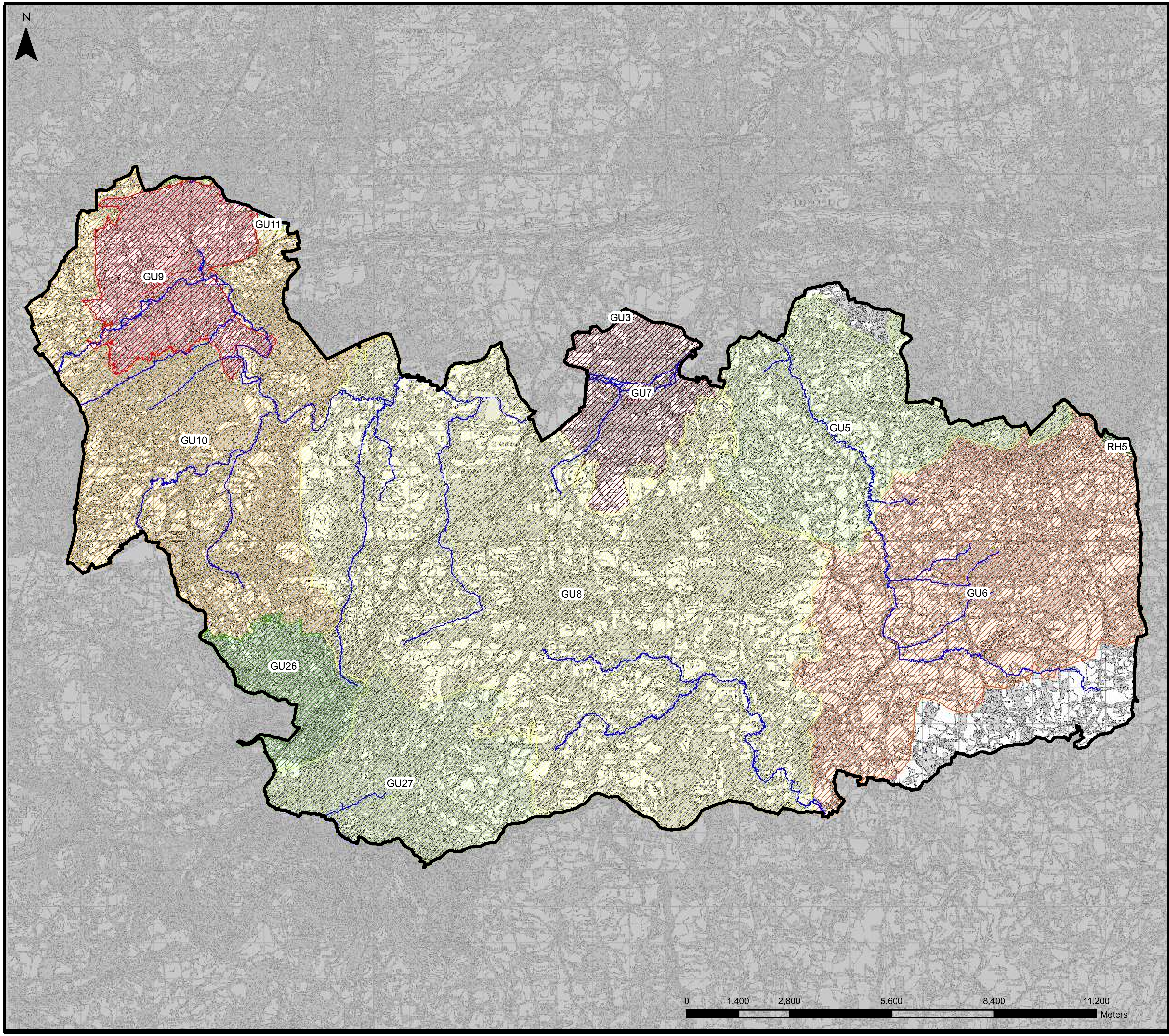

Legend

Main River

Borough Administrative Boundary

No. of Sewer Flood Records*

2
3
4
8
12
16
24
27
29

*Provided by Waverley Borough Council

Notes

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Waverley BOROUGH COUNCIL

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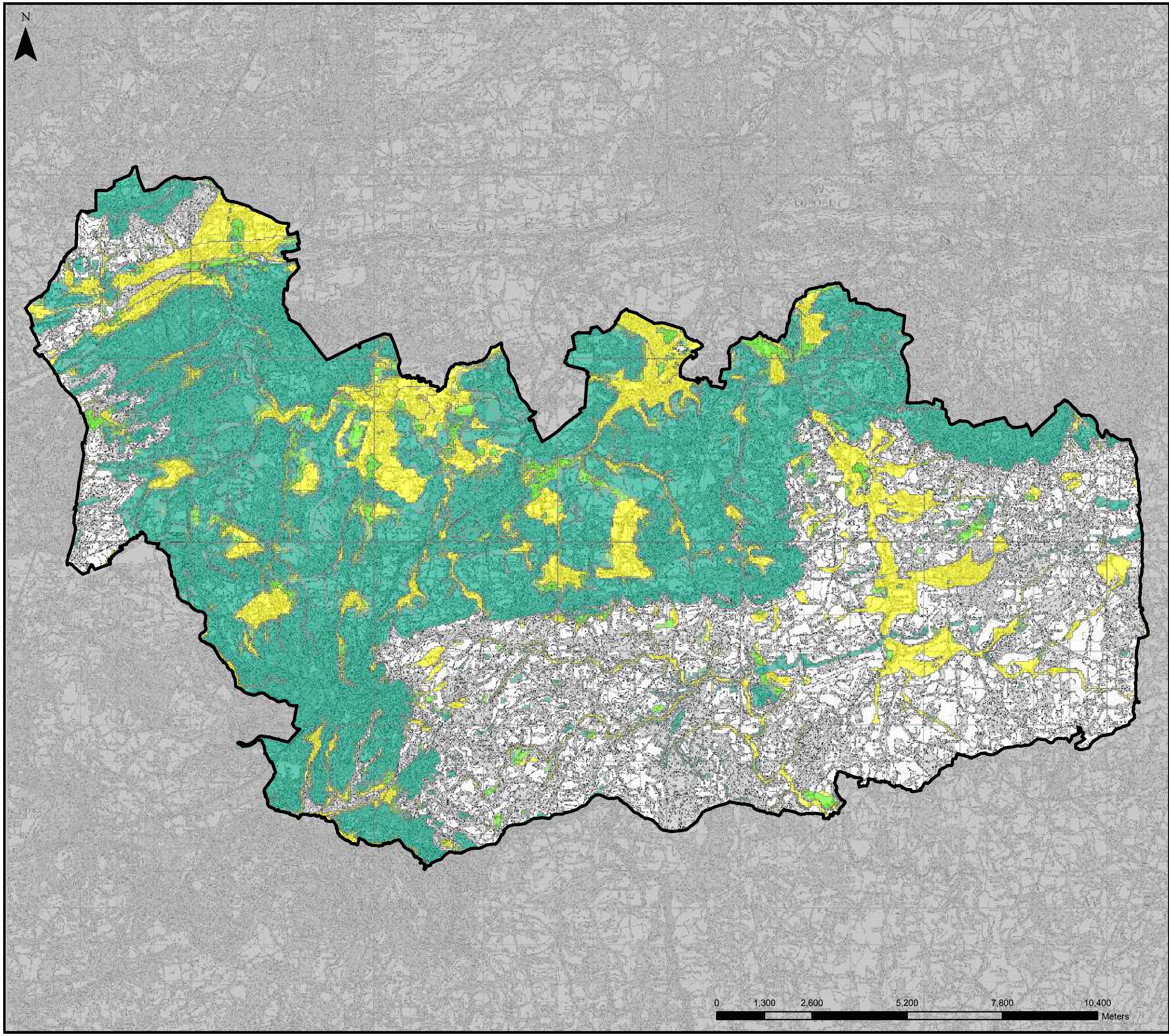
Figure 10
Historical Sewer Flooding Incidents

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig10	-



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

Borough Administrative Boundary

Susceptibility to Groundwater Flooding*

- Limited potential for groundwater flooding to occur
- Potential for groundwater flooding of property situated below ground level
- Potential for groundwater flooding to occur at surface

*British Geological Survey data

Notes

Waverly SFRA

Waverley Borough Council

Scale at A3	Date	Drawn by	Approved by
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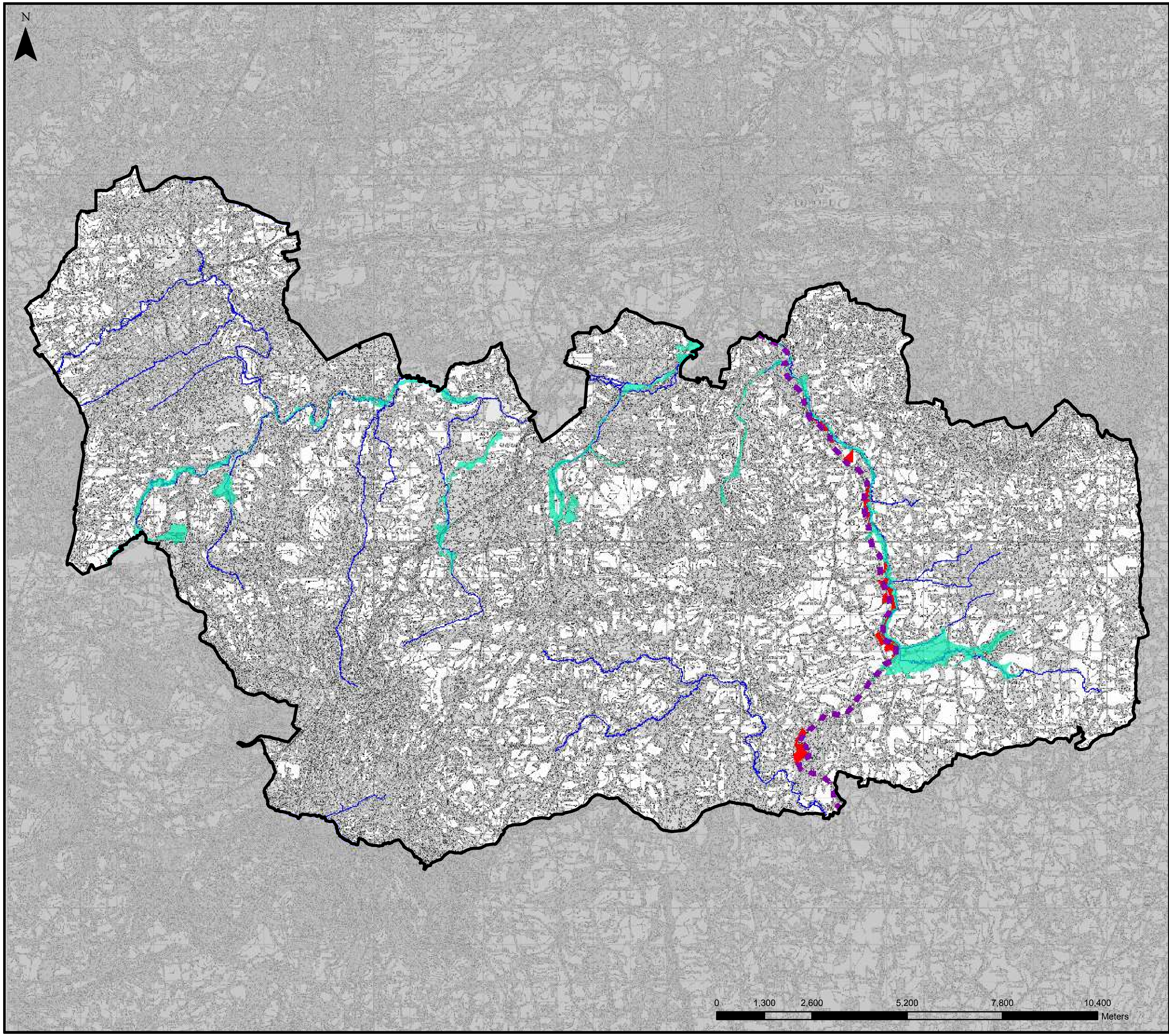
Figure 11
Susceptibility to Groundwater Flooding

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig11	-



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Legend

- Main River
- Borough Administrative Boundary
- Wey and Arun Canal
- Reservoir Flood Map Maximum Flood Outline
- Canal Breach Maximum Flood Outline*

*Data extracted from 2009 Capita SFRA, determined using analysis of embanked sections and stretches where the canal is higher than adjacent land

Notes

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Waverley BOROUGH COUNCIL

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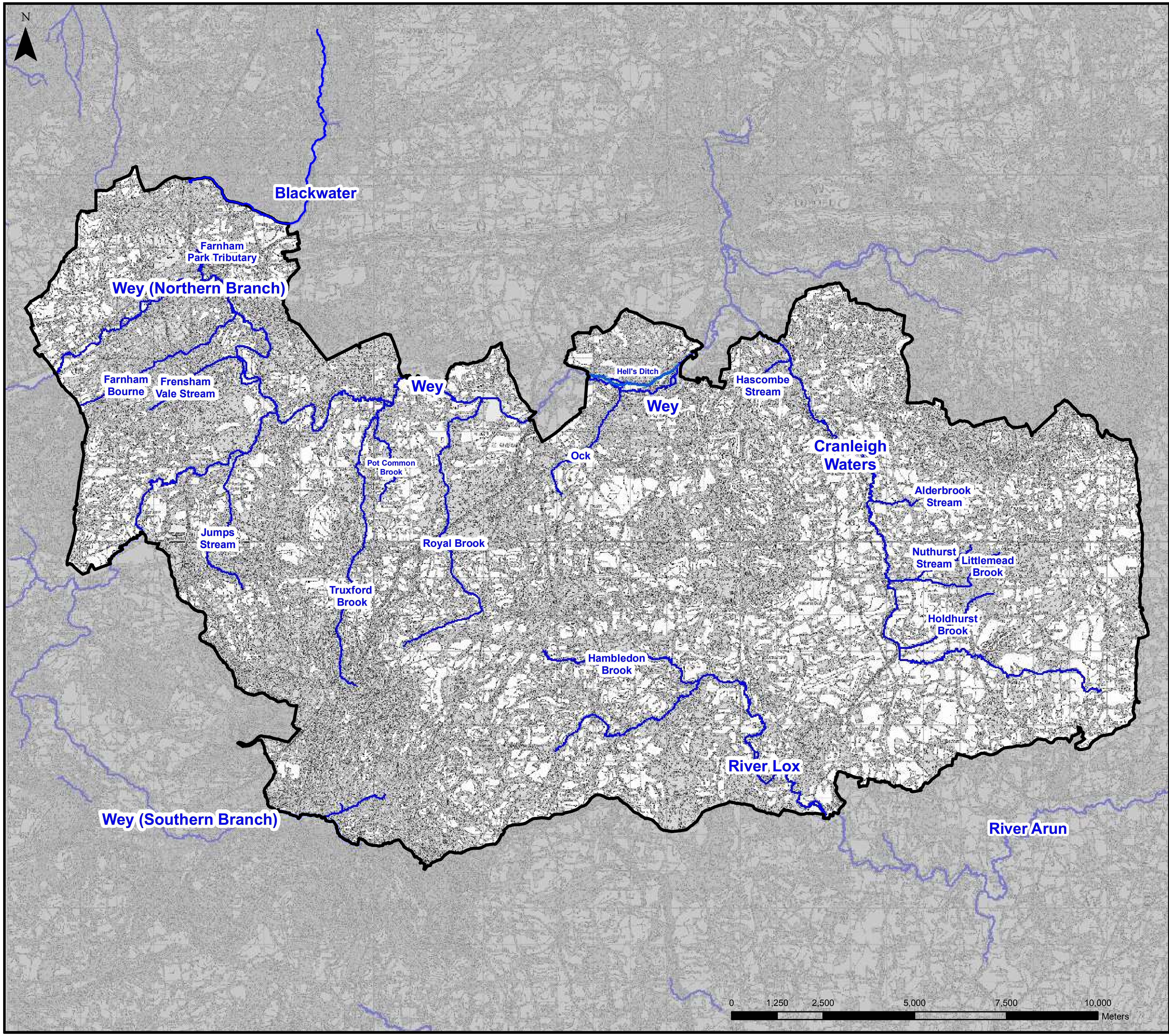
Figure 12
Flood Risk
from Artificial Sources

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig12	-



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Legend

- Main River
- Borough Administrative Boundary

Notes

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Figure 1
Study Area

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

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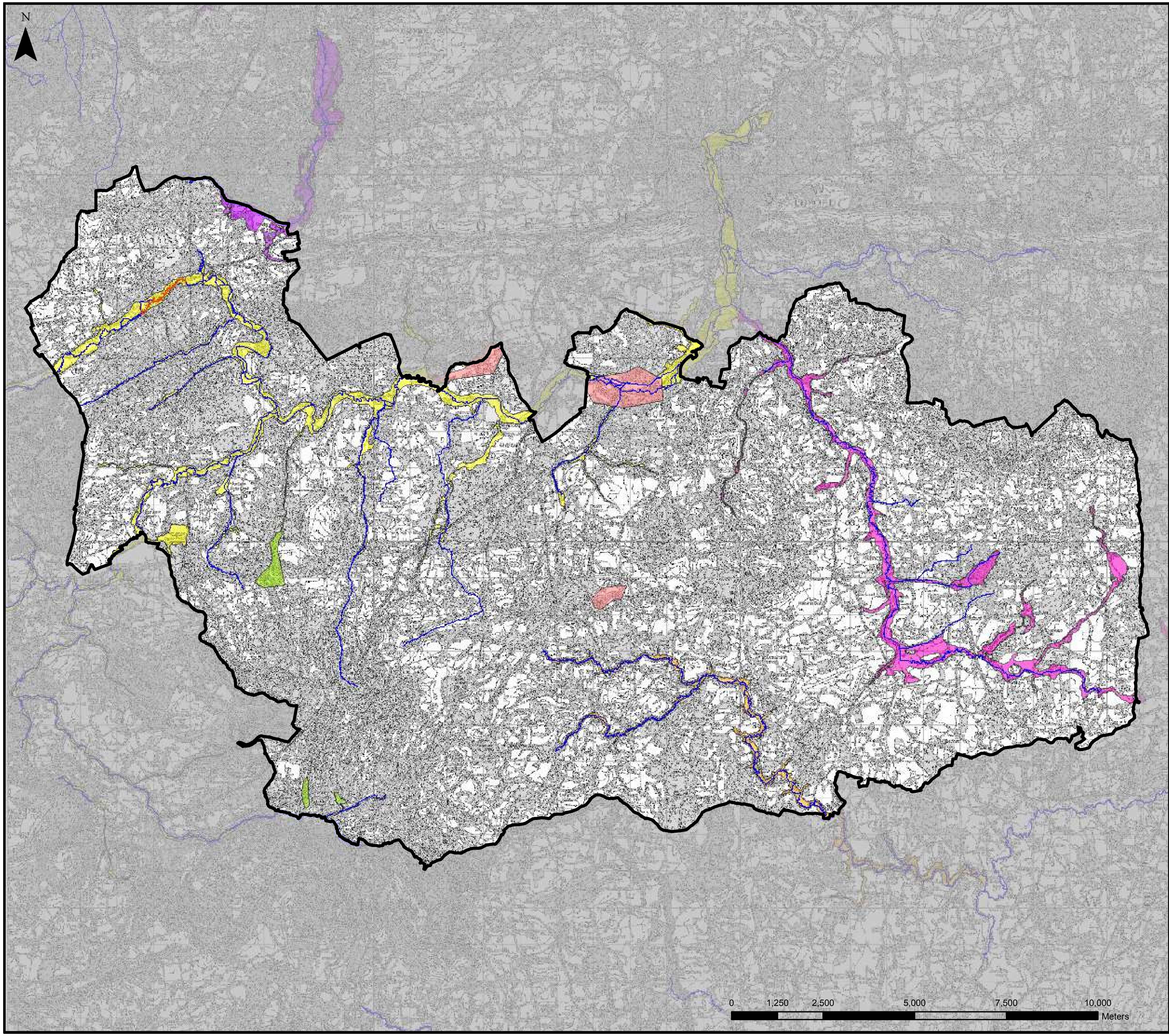
CS078301/Fig1	-



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Legend

- Main River
- Borough Administrative Boundary
- Flood Defences

Flood Alert Areas

- Cranleigh Waters
- Groundwater flooding in Godalming, Shackleford and Hambledon areas
- Groundwater flooding in the Haslemere and Churt areas
- Loxwood Stream/River Lox
- River Blackwater and The Cove Brook
- Upper River Wey

Note, these maps are available on the Environment Agency Website; http://maps.environment-agency.gov.uk/wiyby/wiybyController?topic=fwa&layerGroups=default&lang=_e&ep=map&scale=5&x=531500&y=181500#x=531500&y=181500&lg=1,2,&scale=5

Notes

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Figure 2
Flood Alert Areas and Defences

Consultant

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Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

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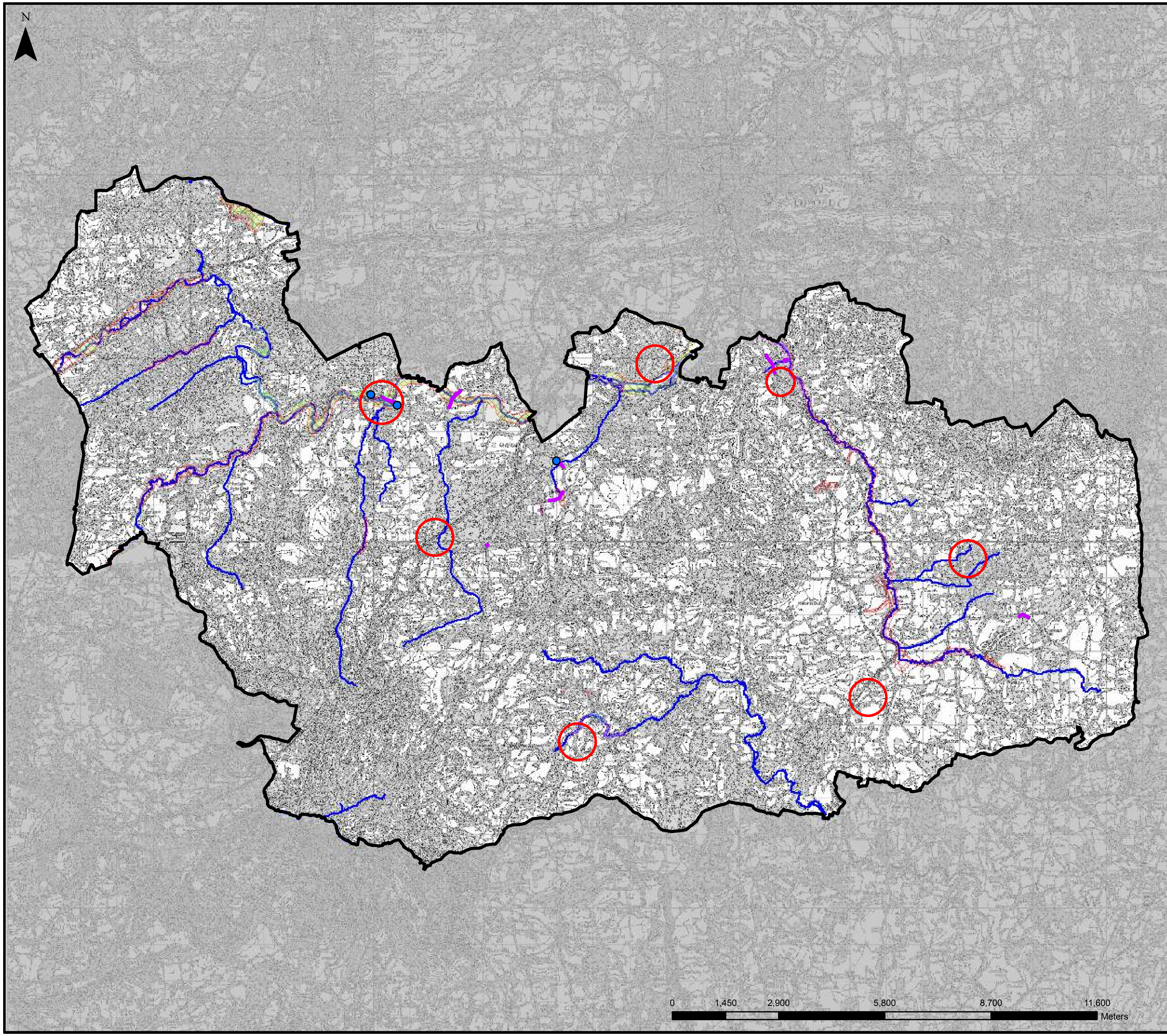
CS078301/Fig2	-



Legend

- Main River
- Borough Administrative Boundary
- Historical Fluvial Flood events*
- Flood incidents on Roads**

Recorded Flood Outlines***

- 1947
- 1960
- 1968
- 1974
- 1979
- 1981
- 1990
- 2000
- 2003

*Data based on reports and correspondence with Parish Councils
**Data acquired from Surrey County Council Wetspots data
*** Environment Agency data grouped by year of flooding event

Notes

Waverly SFRA

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Scale at A3	Date	Drawn by	Approved by
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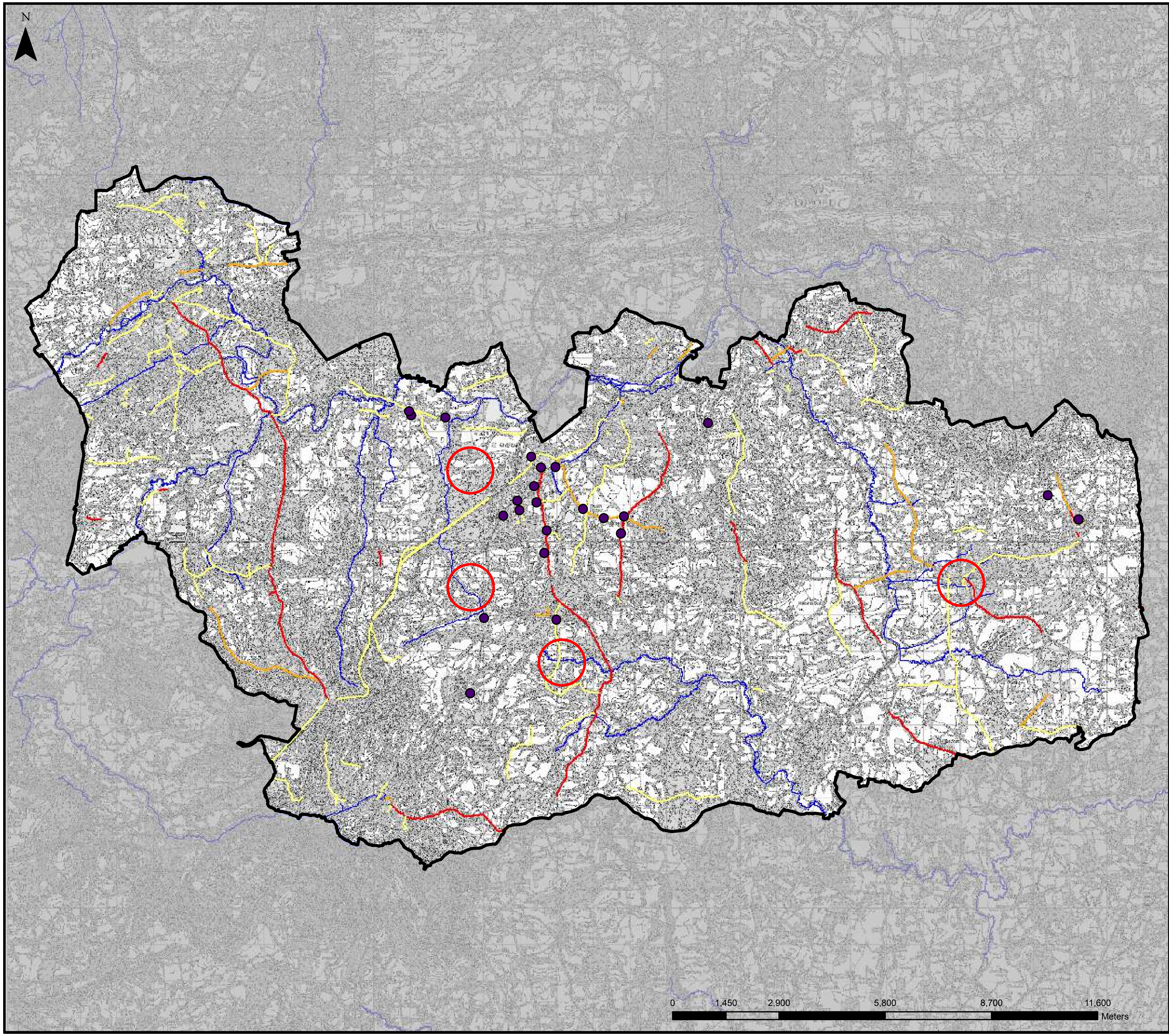
Figure 3A
Historic Flooding - Fluvial

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig3A	-



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Main River
- Borough Administrative Boundary
- Historical Surface Water flood events*

No. of flood incidents on road**

- 1
- 2
- 3

* Data extracted from discussion with Parish Councils
** Data summarised from Surrey County Council Wetspot database

Notes

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Waverly SFRA

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Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

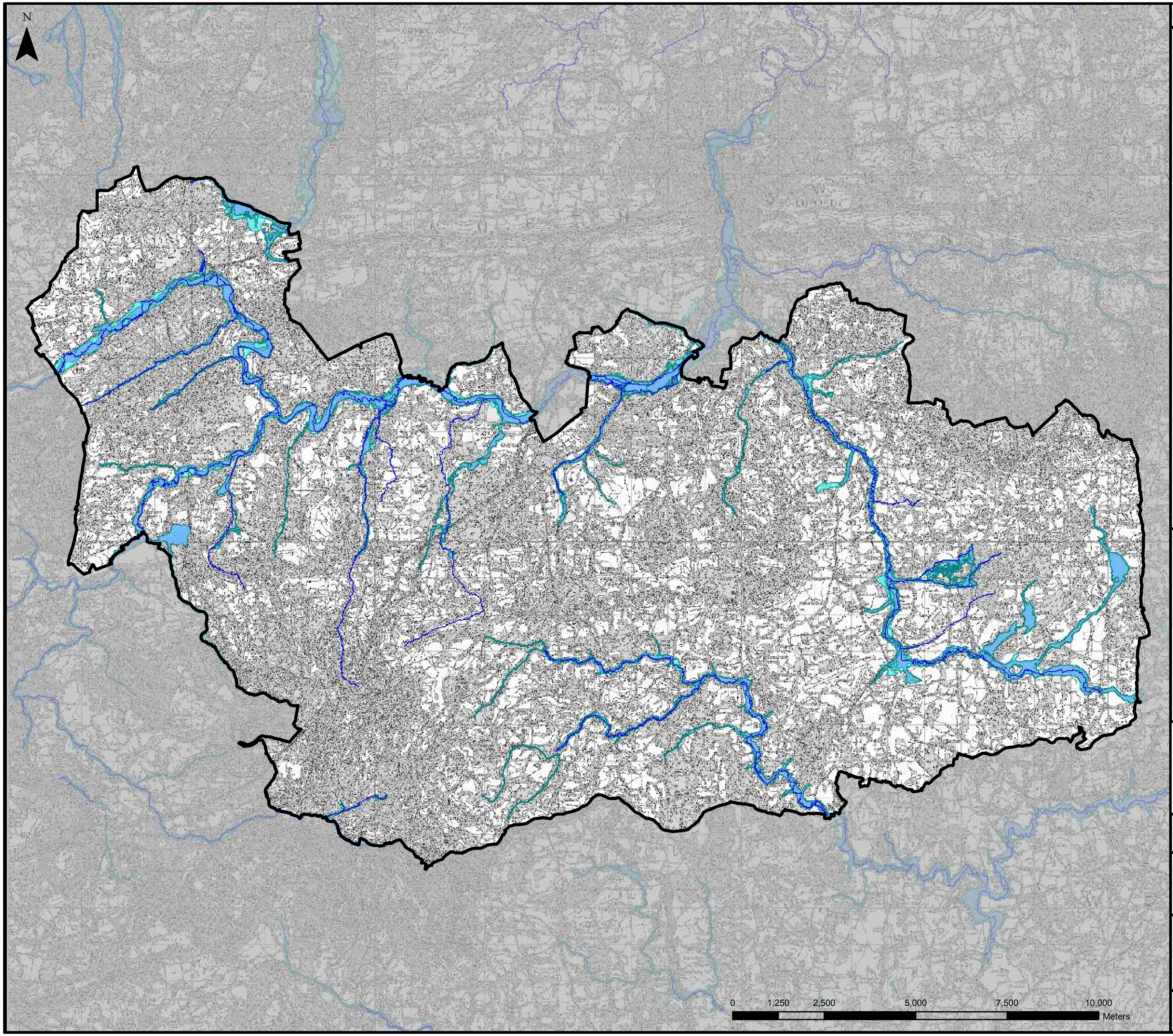
Figure 3B
Historic Flooding - Surface Water

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig3B	-



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Legend

- Main River
- Borough Administrative Boundary
- Environment Agency Flood Zone 2
- Environment Agency Flood Zone 3

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
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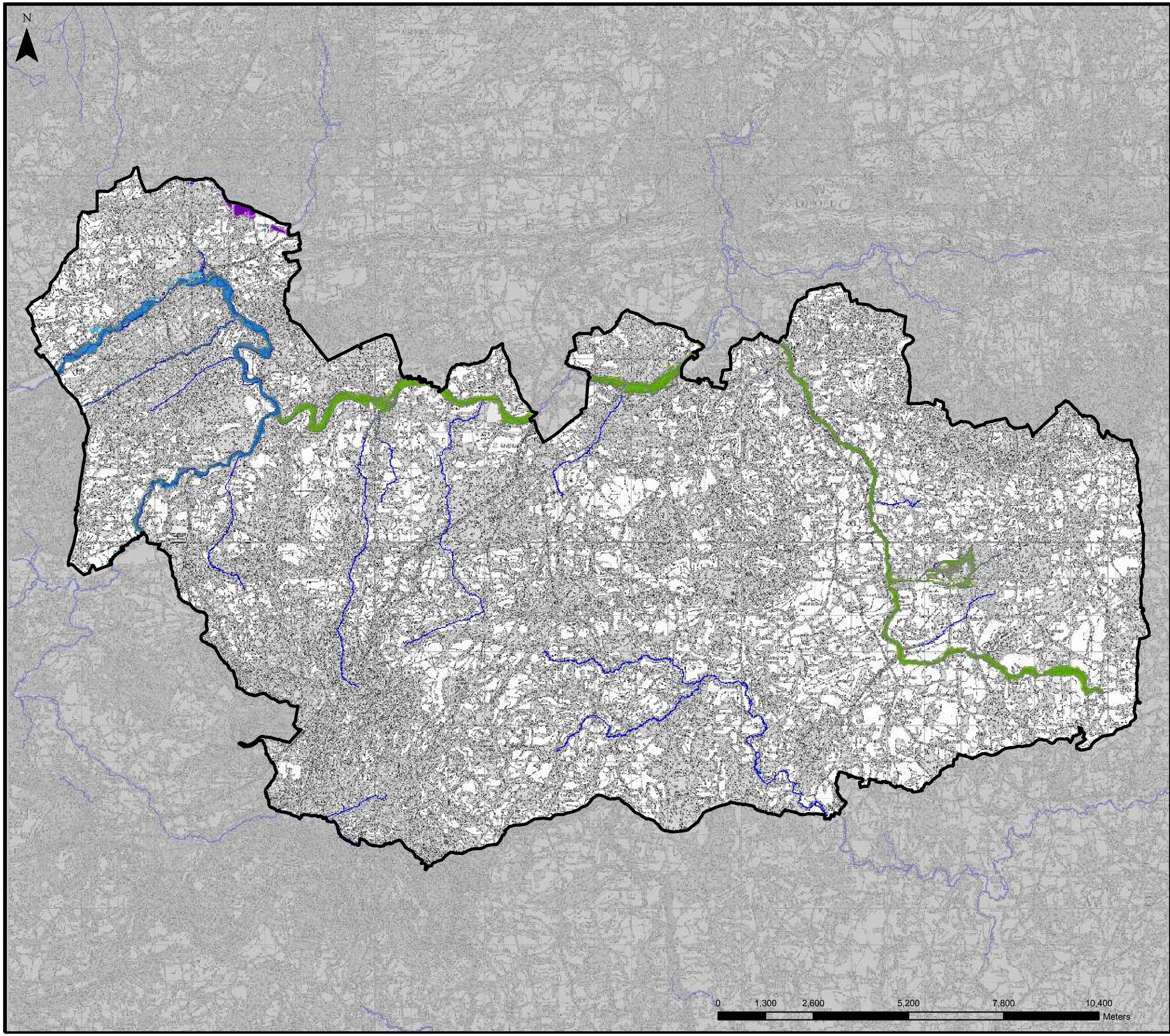
Figure 3
Environment Agency
Flood Maps for Planning

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig3	-



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THE PURPOSE INTENDED

Legend

Main River

Borough Administrative Boundary

Detailed Model Flood Extents

River Blackwater (2007)

1 in 20yr - defended

1 in 100yr - defended

Lower Wey (2009)

1 in 20yr

1 in 100yr - defended

1 in 1000yr - defended

Upper Wey (2006)

1 in 20yr

1 in 100yr

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

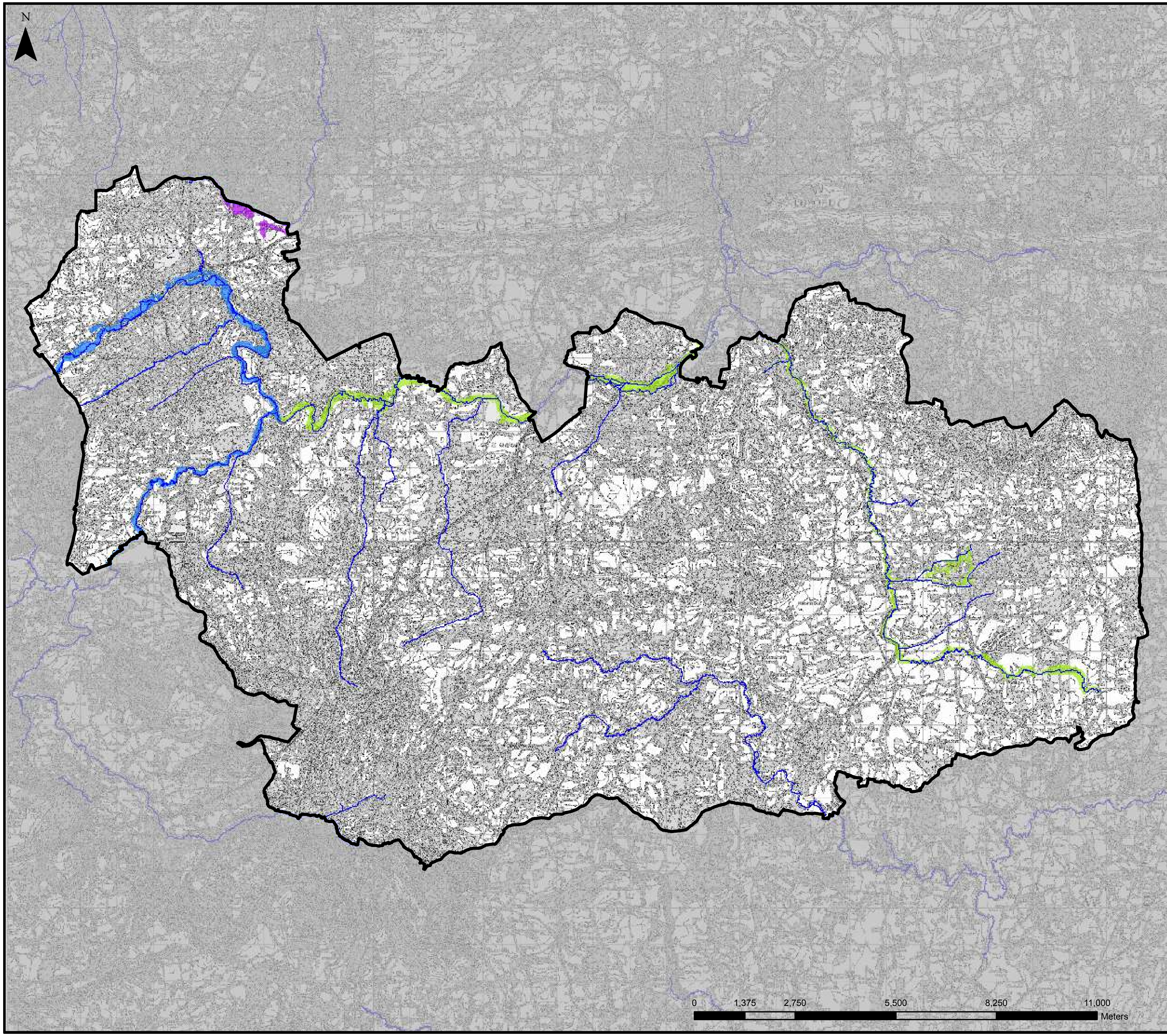
Figure 5
Detailed Hydraulic Model
Fluvial Flood Outlines

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig5	-



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Legend

Main River

Borough Administrative Boundary

Detailed Model. 1 in 100 year (+20%) flood outline : Climate Change Scenario

Lower Wey (2009)

Upper Wey (2006)

River Blackwater (2007) - defended

Map shows defended outlines from the Lower Wey (2009), Upper Wey (2006) and River Blackwater (2007) Hydraulic Modelling Studies

Notes

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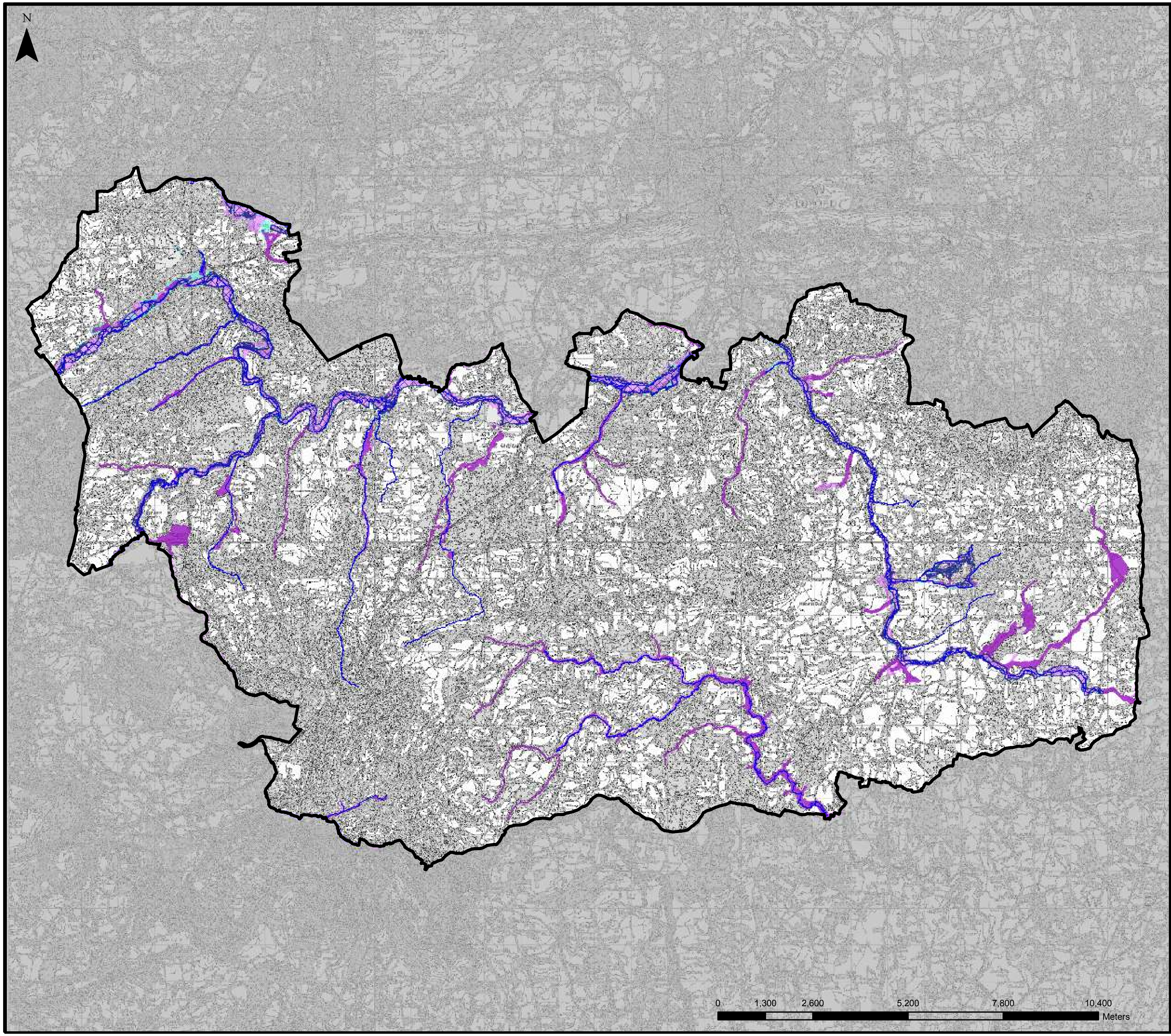
Figure 6
Detailed Fluvial Flood Risk incorporating Climate Change

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig6	-



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Legend

Main River

Borough Administrative Boundary

SFRA Flood Zones*

SFRA Flood Zone 3b (hydraulic modelling exists)

SFRA Flood Zone 3a (modelling exists) /SFRA Flood Zone 3b (no modelling exists)

SFRA Flood Zone 3 - climate change

SFRA Flood Zone 2 (for both modelled and unmodelled)

* Categorisation of flood zone dependent on presence of Hydraulic Modelling flood extents, see table below.

SFRA Flood Zone	Hydraulic modelling exists along watercourse	No hydraulic modelling along watercourse
SFRA Flood Zone 3b	5% AEP (1 in 20 year) event	EA Flood Zone 3
SFRA Flood Zone 3a	1% AEP (1 in 100 year) event	n/a
SFRA Flood Zone 3 – climate change	1% AEP (1 in 100 year) + climate change event	
SFRA Flood Zone 2	0.1% AEP (1 in 1000 year) event	EA Flood Zone 2

Notes

Waverly SFRA

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Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

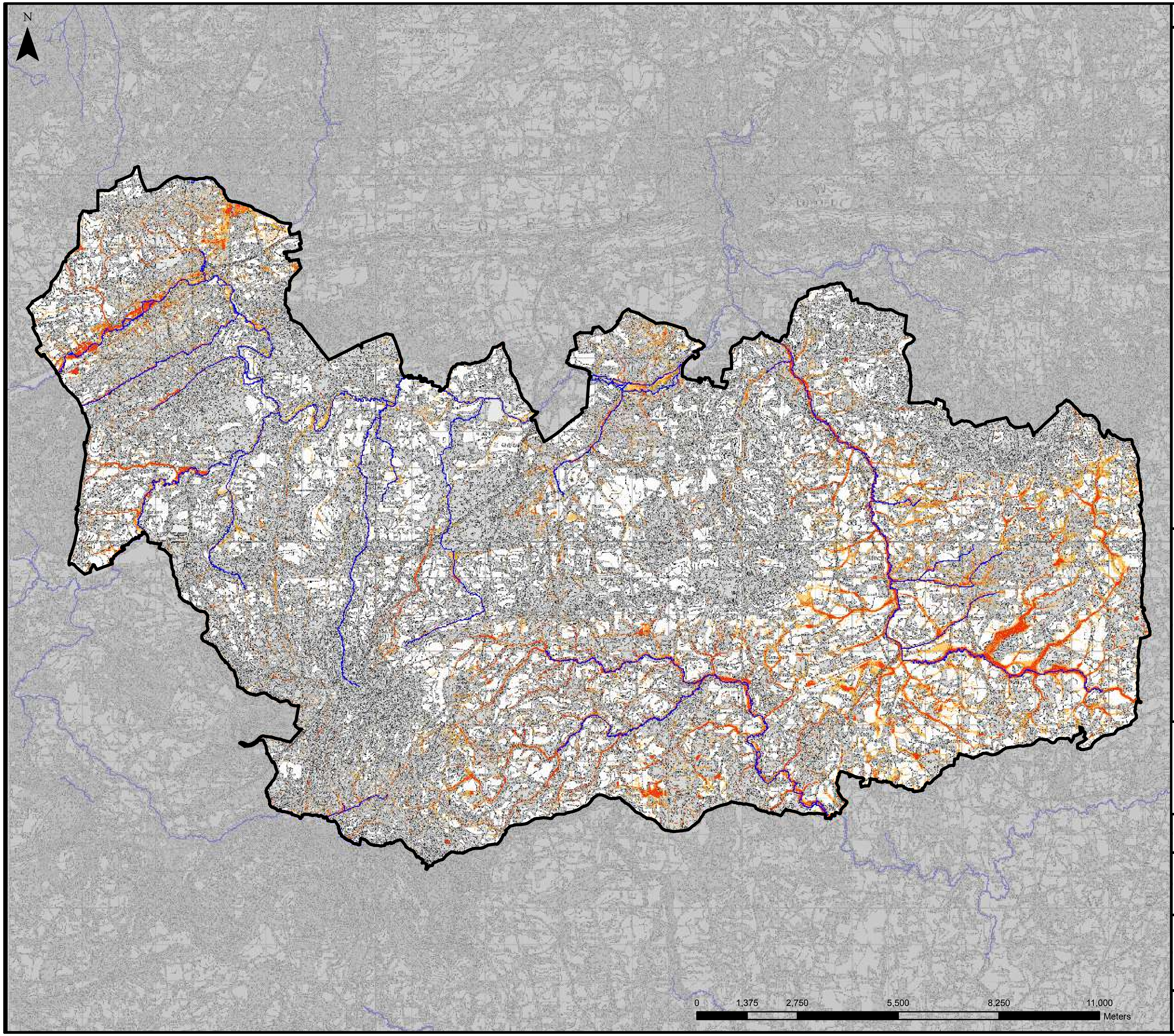
Figure 7
SFRA Fluvial
Flood Zones

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig7	-



Legend

- Main River
- Borough Administrative Boundary
- uFMfSW 30 AEP
- uFMfSW 100 AEP
- uFMfSW 1000 AEP

Notes

Waverly SFRA

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Scale at A3	Date	Drawn by	Approved by
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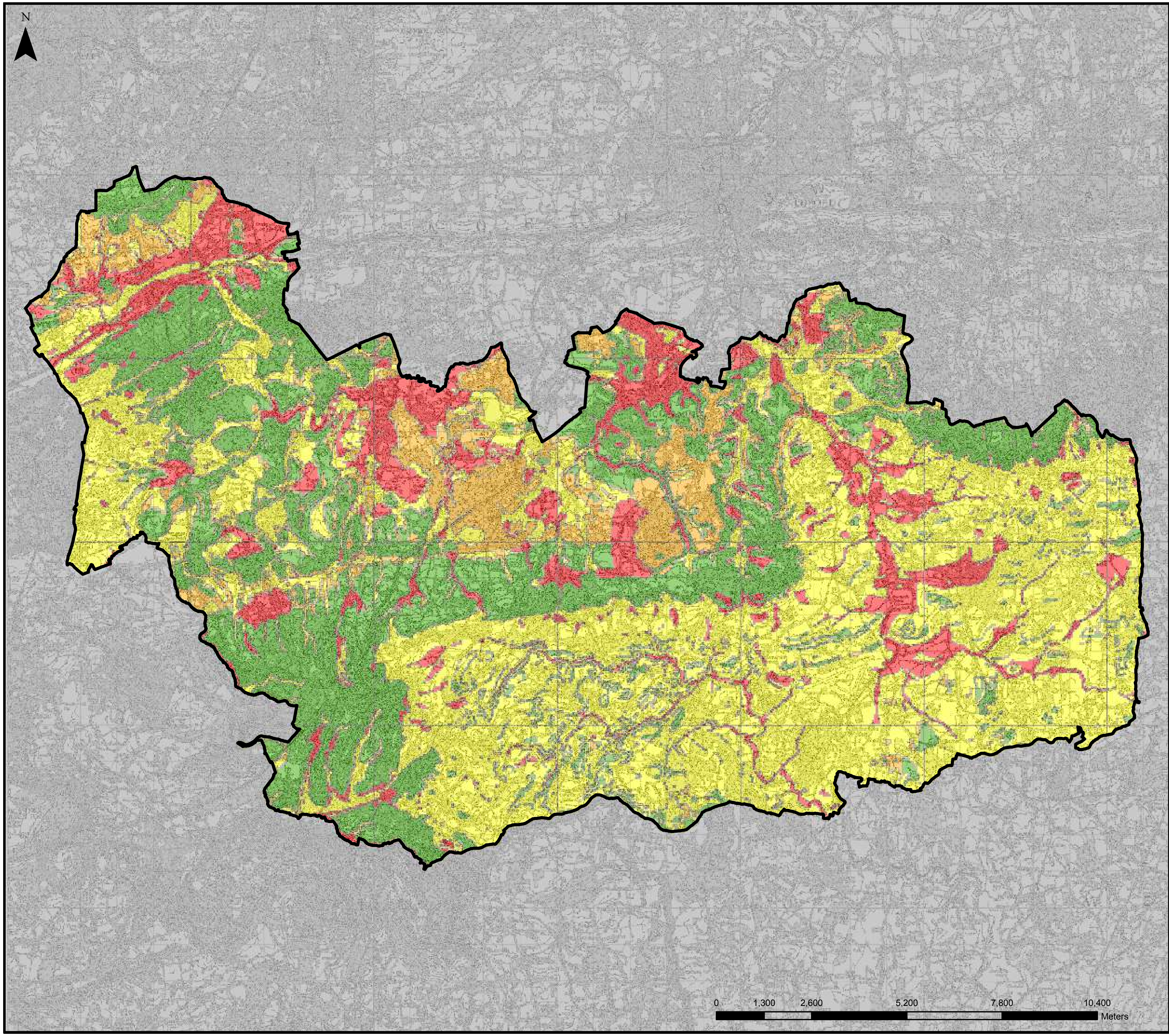
Figure 8A
Surface Water
Flood Risk - Extent

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig8A	-



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Legend

Borough Administrative Boundary

Drainage Summary

- Highly compatible for infiltration SuDS
- Opportunities for bespoke infiltration SuDS
- Probably compatible for infiltration SuDS
- Very significant constraints are indicated

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

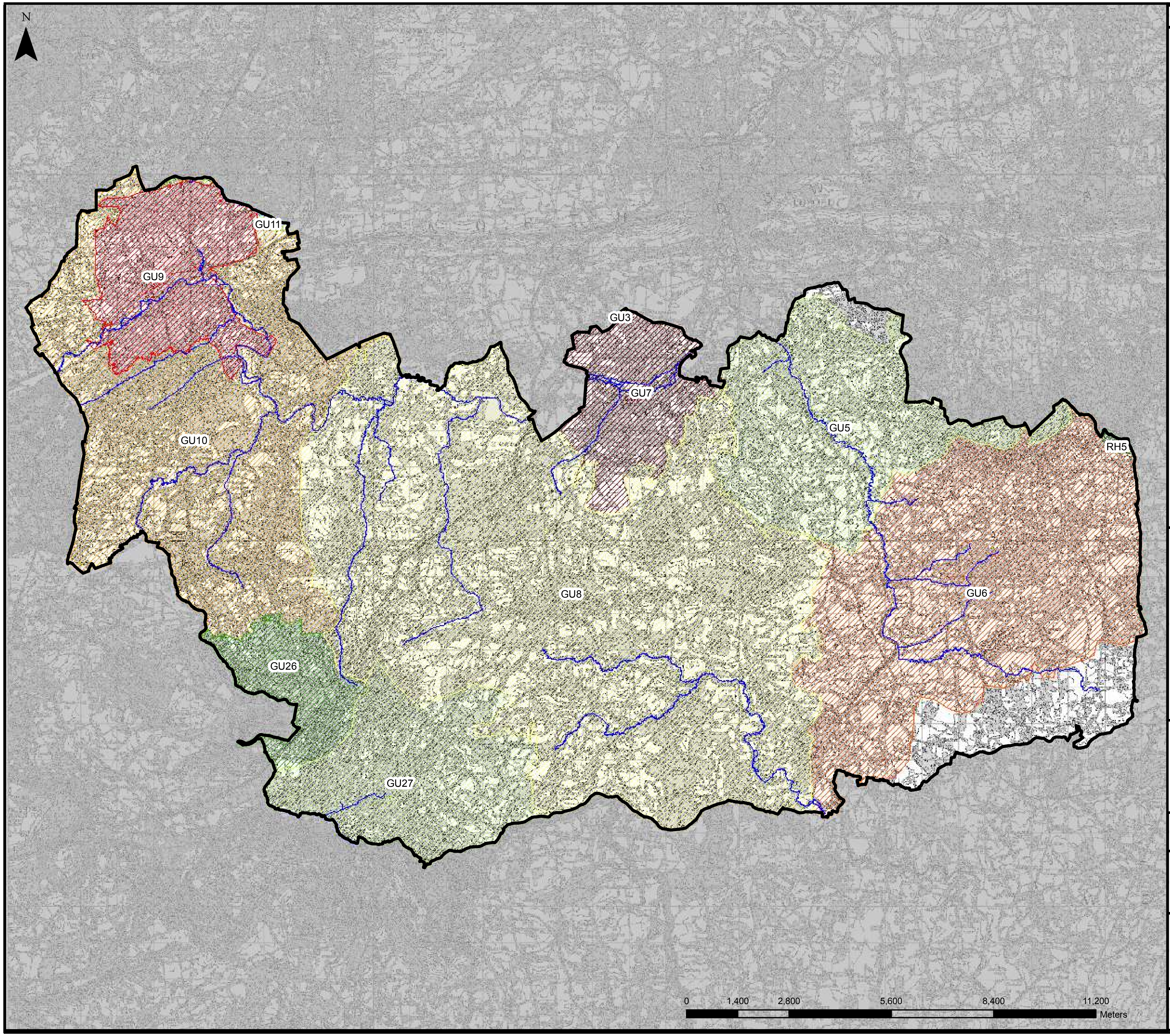
Figure 9
Infiltration SuDS
Suitability Map

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig9	-



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Legend

Main River

Borough Administrative Boundary

No. of Sewer Flood Records*

2
3
4
8
12
16
24
27
29

*Provided by Waverley Borough Council

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

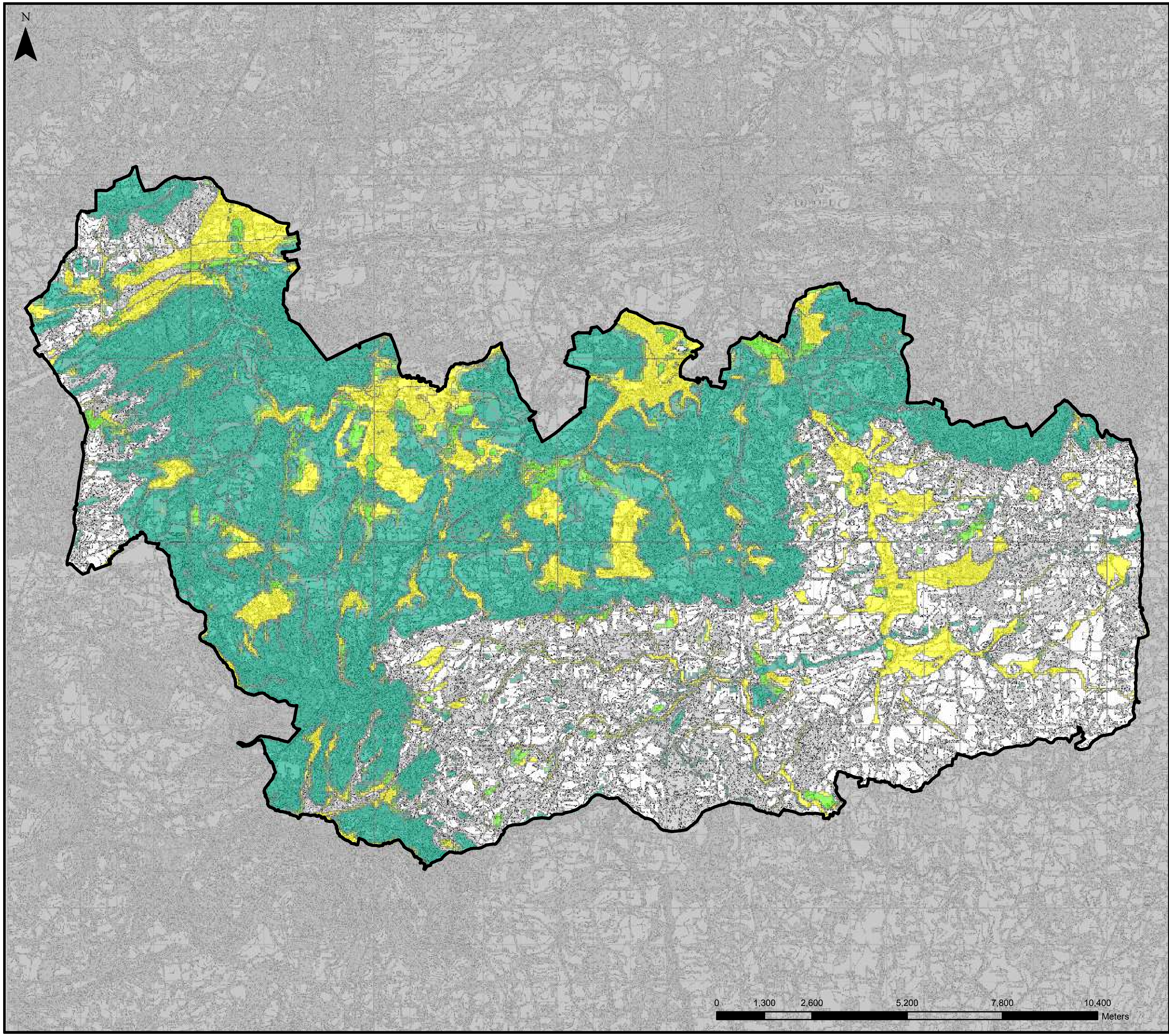
Figure 10
Historical Sewer Flooding Incidents

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig10	-



Legend

Borough Administrative Boundary

Susceptibility to Groundwater Flooding*

- Limited potential for groundwater flooding to occur
- Potential for groundwater flooding of property situated below ground level
- Potential for groundwater flooding to occur at surface

*British Geological Survey data

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

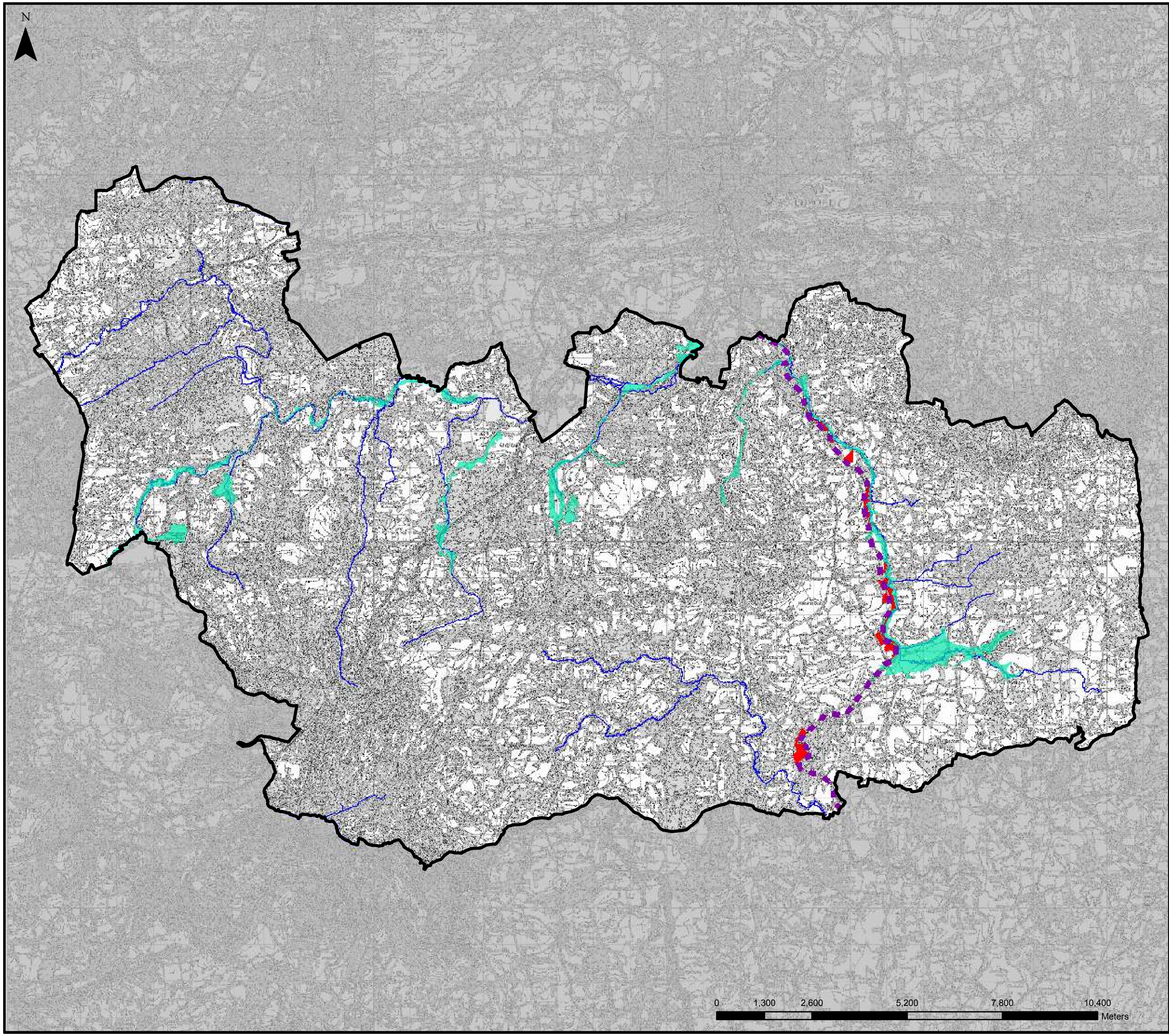
Figure 11
Susceptibility to Groundwater Flooding

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig11	-



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Main River
- Borough Administrative Boundary
- Wey and Arun Canal
- Reservoir Flood Map Maximum Flood Outline
- Canal Breach Maximum Flood Outline*

*Data extracted from 2009 Capita SFRA, determined using analysis of embanked sections and stretches where the canal is higher than adjacent land

Notes

Waverly SFRA

Waverley BOROUGH COUNCIL

Scale at A3	Date	Drawn by	Approved by
1:100,000	July 2015	HT	NS

Figure 12
Flood Risk
from Artificial Sources

Consultant

CAPITA

Capita
Capita House
Wood Street
East Grinstead
RH19 1UU

DRAWING NUMBER	REV
CS078301/Fig12	-