



Redditch Borough Council and Bromsgrove District Council Level 2 Strategic Flood Risk Assessment

Final Report

June 2012

Redditch Borough Council and Bromsgrove District Council

Level 2 Strategic Flood Risk Assessment

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Level 2 Strategic Flood Risk Assessment Final Report

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Glossary

Annual Probability of Occurrence	The probability that a given flood event will occur in any one year (for example, a flood with a 1% annual probability of occurrence occurs, on average, once in every 100 years). Also referred to as an “annual probability flood”.
Catchment	The catchment at a particular point is the area of land which drains to that point.
DCLG	Department of Community and Local Government.
Deculverting	Removal, or partial removal, of culvert/pipe to return watercourse to open channel.
DEFRA	Department for Environment, Flood and Rural Affairs.
Development	“The carrying out of building, mining, engineering, or other operations in, on, over, or under, land or the making of any material change in the use of any building or other land” (Town and Country Planning Act 1990).
Discharge	The rate of flow of water measured in terms of volume over time. Discharge and flow are interchangeable terms.
Drain	Defined under statute (Public Health Act 1875) as a conduit that drains a ‘single curtilage’; for most purposes this means single property. It includes both foul and surface water.
DSM	Digital Surface Model (includes buildings and structures).
DTM	Digital Terrain Model (excludes buildings and structures).
Environment Agency	Statutory consultee for flood-related issues associated with the planning process and responsible for issuing flood defence consents.
FEH	Flood Estimation Handbook provides guidance on rainfall and river flood frequency estimation.
Flood Behaviour	The pattern/characteristics/nature of a flood. The flood behaviour is often presented in terms of the peak average velocity of floodwaters and the peak water level at a particular location.
Flood Defence	A structure built and maintained to protect property from flooding (e.g. bunds, storage, etc.).
Floodplain	Land adjacent to a watercourse which is periodically inundated due to floodwaters, that is ‘flood prone land’. Floodplains are a natural formation created by the deposition of sediment during floods.
Flood Storage	Floodplain area which is important for the temporary storage of flood waters during a flood.

Flood Zone Map	Map showing the delineation of flood risk zones (i.e. areas of 'low', 'medium' or 'high' flood risk) for England and Wales (i.e. Flood Zones 1, 2 and 3).
Flow Path	Route taken by flowing water.
Flood and Water Management Act 2010	Legislation, the aim of which is to improve both flood risk management and the way we manage our water resources.
Historic Flood	A flood which has previously occurred.
Hydraulic	The term given to the study of water flow in rivers, estuaries and coastal systems.
Hydraulic Model	A computer simulation that routes runoff through a river channel to describe the behaviour of water within a river system, including depths and flows within the channel and floodplain areas.
Hydraulic Structure	Constructed features that impact on the flood behaviour in a system (e.g. <i>levee, weir, roadway, bridge</i>).
Hydrograph	A graph showing how a watercourse's depth or discharge changes with time.
LiDAR (<u>L</u>ight <u>D</u>etection and <u>R</u>anging)	A method of detecting distant objects and determining their position, velocity, or other characteristics by analysis of pulsed laser light reflected from their surfaces. For this study, LiDAR refers to the collection of surface elevation data.
Local Development Framework (LDF)	Documents which collectively set out the spatial planning strategy for development and land use within a Local Planning Authority area.
Local Land Drainage Authority	Authority who implements powers and responsibilities as outlined in Land Drainage Act 1991 for Ordinary Watercourses. Responsibilities are, essentially, to ensure that "the proper flow of water" is not impeded; <u>Permissive Powers</u> are available for the LLDA to undertake flood relief or maintenance works. Redditch Borough Council and Bromsgrove District Council as Local Land Drainage Authority.
Local Planning Authority (LPA)	The local government body responsible for formulating planning policies (in a Local Development Framework), controlling development through determining planning applications and taking enforcement action when necessary.

Main River	<p>“A watercourse on a main river map and includes any structure or appliance for controlling or regulating the flow of water into, in or out of the channel which: (a) is a structure or appliance situated in the channel or in any part of the banks of the channel; and (b) is not a structure or appliance vested in or controlled by an internal drainage board” (S.113(1) Water Resources Act 1991 (WRA 1991), and see S.137(4) WRA 1991).</p> <p>Or some system, defined by the Environment Agency, where there may be a significant consequence if there is a failure.</p>
Ordinary Watercourse	All watercourses which are not designated as Main Rivers are identified as Ordinary Watercourses.
Peak Discharge, Flood Level, Flow or Velocity	The maximum discharge, flood level, flow or velocity occurring during a flood event.
Primary Land Drainage Authority	The Environment Agency is the Primary Land Drainage Authority with full responsibilities for Main Rivers. All Permissive Powers exercised by a Local Land Drainage Authority are subject to supervision by the Environment Agency.
Public Sewer	<p>A sewer may have been adopted by the Sewerage Authority or else vested in that authority by virtue of Public Health Act 1936. This Act declared that all sewers commissioned prior to the enactment (1 October 1937) were to become designated Public Sewers (known as S.24 sewers).</p> <p>Severn Trent Water Ltd. is the sewerage undertaker for this region.</p>
Riparian Owner	Under common law you are the riparian owner of any watercourse within or adjacent to the boundaries of your property. With this come responsibilities for managing the watercourse appropriately.
Runoff	Water from rainfall, snow melt or irrigation that flows over the ground surface and returns to watercourses.
SuDS Approving Body (SAB)	Local authority responsible for approving and adopting SuDS.
Sewer	Defined under statute as a conduit, which is not a drain, i.e. serves more than one curtilage (property).
SoP	Standard of Protection.
SUDS	Sustainable Drainage Systems.
Sustainable Development	“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs” (The World Commission on Environment and Development, 1987).

Watercourse

“Includes all rivers and streams and all ditches, drains, cuts, culverts, dikes, sluices, sewers (other than Public Sewers within the meaning of the Water Industry Act 1991) and passages, through which water flows.”

- Extract Land Drainage Act 1991 S.72.

- For the purposes of this report the term watercourse is restricted to the historic system of channels which have formed naturally or constructed to drain land. It includes open channels that have subsequently been culverted.

Windfall Development

Windfall sites are those which have not been specifically identified as available in the local plan process. They comprise previously-developed sites that have unexpectedly become available.

1 Summary

1.1 Introduction

1.1.1 This Level 2 Strategic Flood Risk Assessment (SFRA) has been carried out in accordance with the requirements of National Planning Policy Framework (NPPF), Planning Policy Statement 25: Development and Flood Risk (PPS25) and Planning Policy Statement 25: Development and Flood Risk Practice Guide. The aim of which is to direct development away from areas at highest risk of flooding. When this has not been possible, policies and guidance have been recommended to allow development in these areas when it has been proven that they will be safe for the lifetime of the development and they will not increase flood risk elsewhere.

1.1.2 This document has been prepared to consider all sources of flooding.

1.1.3 It should be noted that some watercourses change name along their route, but for ease of reference and consistency Ordnance Survey (OS) naming convention will be adopted throughout this Level 2 SFRA.

1.2 Fluvial Flood Risk

1.2.1 Hydraulic modelling was carried out to determine the fluvial flood risk at 18 sites (Table 1-1), which were identified by Bromsgrove District and Redditch Borough Councils.

Table 1-1 List of Sites Considered

Bromsgrove District Council Area		Redditch Borough Council Area	
BDC 20 Perryfields Road, Bromsgrove	BDC81 Norton Farm, Birmingham Road, Bromsgrove	2010/09 RO Alexandra Hospital	2010/14 Foxlydiate Green Belt
BDC35B Kidderminster & Stourbridge Road, Hagley	BDC188 Rose Cottage, Thickenall Cottage & land rear of Western Road, Hagley	2010/10 A435 ADR	EL63 (IN67) North of Red Ditch
BDC 49 Gallows Brook Pig Farm, Kidderminster Road, Hagley	BDC 189 Strathearn, Western Road, Hagley	2010/11 Brockhill ADR	St 8 Edward Street
BDC51 Land at Algoa House, Western Road, Hagley	Site 2 Ravensbank Business Park*	2010/12 Webheath ADR	St10 Town Centre, Church Street/Northwest Quadrant
BDC80 Whitford Road, Bromsgrove		2010/13 Brockhill Green Belt	

* Falls within Bromsgrove District, but allocated to meet the needs of Redditch

1.2.2 This modelling was then used to determine whether the sites were located in Flood Zones 1, 2, 3a or 3b, to allow the sites to be sequentially tested and to generate an understanding of the extent of the flooding and the associated hazards. A Sequential Test was carried out, based upon the guidance contained in Tables D.1, D.2 and D.3 of PPS25. Table 1-2 summarises the flood risk at each site and whether the proposed use was considered to be suitable. The flood risk at each development site was reviewed to determine whether there were suitable alternative sites which could accommodate the development, which was at lower risk of flooding.

1.2.3 It should be noted that it was agreed, with the Environment Agency, that if flooding occurs in less than 5% of the site, this is considered minor for the purposes of the Sequential Test. This allowed the Sequential Approach to be applied within each of these sites, i.e. directing development to lower risk areas within each of the sites. For high risk sites where there was no suitable alternative, an Exception Test was applied.

Table 1-2 Flood Risk at Each Site

	Site Ref	Category of Proposed Development	Highest Risk Flood Zone Within the Site	Suitability of Proposed Development in Relation to Flood Risk
Bromsgrove District Council	BDC 20 Perryfields Road	More vulnerable	3b	Very small section within a high risk flood zone, built development in this area should be avoided. Development should be directed to areas at lower risk within the site.
	BDC35B Kidderminster & Stourbridge Road, Hagley	Less/ more vulnerable	3b	Approximately 2.6% lies in Flood Zone 3a and 1.8% in Flood Zone 3b, built development in these areas should be avoided. Development should be directed to areas at lower risk of flooding within the site.
	BDC 49 Gallows Brook Pig Farm, Kidderminster Road, Hagley	Less/ more vulnerable	3b	Approximately 1.6% lies in Flood Zone 3b and built development in this area should be avoided. Development should be directed to areas at lower risk of flooding within the site.
	BDC51 Land at Algoa House, Western Road, Hagley	Less/ more vulnerable	3b	Approximately 3.3% lies in Flood Zone 3a and 1.1% in Flood Zone 3b so built development in these areas should be avoided. Development should be directed to areas at lower risk of flooding within the site.
	BDC80 Whitford Road, Bromsgrove	More vulnerable	3b	Less than 0.1% of the site lies in Flood Zone 3a and less than 0.1% in Flood Zone 3b, built development in these areas should be avoided. Development should be directed to areas at lower risk of flooding within the site.
	BDC81 Norton Farm, Birmingham Road, Bromsgrove	More vulnerable	1	No issue with fluvial flooding
	BDC188 Rose Cottage, Thicknall Cottage & land rear of Western Road, Hagley	Less/more vulnerable	3b	Less than 0.1% lies in Flood Zone and less than 0.1% in Flood Zone 3b. Built development in these areas should be avoided. Development should be directed to areas at lower risk of flooding within the site.
	BDC 189 Strathearn, Western Road, Hagley	Less/more vulnerable	3b	6.8% of the site lies in Flood Zone 3a and 5.3% in Flood Zone 3b, built development in these areas should be avoided. Development must be directed to areas at lower risk of flooding within the site.
	Site 2 Ravensbank Business Park¹	Less vulnerable	3b	A small section (3%) lies in Flood Zone 3a, while 2% lies in Flood Zone 3b. Built development in these areas should be avoided and directed to areas at lower risk of flooding within the site.

¹ Falls within Bromsgrove District but allocated to meet the needs of Redditch

	Site Ref	Category of Proposed Development	Highest Risk Flood Zone Within the Site	Suitability of Proposed Development in Relation to Flood Risk
Redditch Borough Council	EL 63 (IN67) North of Red Ditch, Enfield	More vulnerable	3b	Approximately 5.3% of the site is located in a high risk flood zone; built development in these areas should be avoided. Development must be directed to areas at lower risk of flooding within the site.
	2010/09 RO Alexandra Hospital	More vulnerable	1	No fluvial flooding issues
	2010/10 A435 ADR	Less/more vulnerable	2	4.8% of the site lies within Flood Zone 3a. Built development should be avoided in this area and directed to areas at lower risk of flooding where possible, but the proposed uses are suitable for this category of flood zone.
	2010/11 Brockhill ADR	More vulnerable	1	No fluvial flooding issues
	2010/12 Webheath ADR	More vulnerable	3b	A small section (2.1%) lies in Flood Zone 3a and 1.6% in Flood Zone 3b; development in these areas should be avoided. Built development should be directed to areas at lower risk of flooding within the site.
	2010/13 Brockhill ADR	More vulnerable	3b	1.1% of the site lies Flood Zone 3a and 0.01% in Flood Zone 3b, built development in these areas should be avoided. Development should be directed to areas at lower risk of flooding within the site.
	2010/14 Foxlydiate Green Belt	More vulnerable	1	No fluvial flooding issues
	St 8 Edward Street	Less vulnerable	1	No fluvial flooding issues
	St 10 Town Centre, Church Street/ Northwest Quadrant	Less vulnerable	1	No fluvial flooding issues

Minor flooding issue = green

More significant flooding issue = red

1.2.4 One site was carried forward for Exception Testing as no suitable alternative sites were identified during the Sequential Test:

- BDC189 Strathearn, Western Road Hagley.²

² It should be noted that modelling EL 63 (IN67) North of Red Ditch, Enfield, had identified that approximately 5.3% lies in a high risk flood zone. However, due the strategic nature of this assessment and the predicted figure being only marginally above the Environment Agency's cut off point of 5% (which it considers as minor flooding), it was not considered appropriate to carry forward this site this for Exception Testing.

- BDC189 Strathearn, Western Road Hagley.²

- 1.2.5 This involved carrying out an assessment to determine whether the site had wider sustainability benefits, which outweigh flood risk, and whether it could be designed to be safe for the lifetime of the development.
- 1.2.6 Approximately 6.8% of the site at Strathearn, Western Way, Hagley (BDC189) is located in a high risk flood zone (Flood Zones 3a and 3b). Development must be directed to areas at lower risk. It is essential no development takes place in the area identified as being in Flood Zone 3. However, the majority is located in Flood Zone 1, which is considered suitable for all types of development. To ensure safety for the lifetime of the development, floor levels should be at least 600mm above the predicted 1 in 100 year plus climate change flood level and all residents must be informed of safe access/egress routes. Assessments carried out as part of the Bromsgrove Strategic Housing Land Availability Assessment (SHLAA) have identified numerous sustainability benefits by locating this site in the area proposed. However, as BDC189 (combined with BDC35B, BDC49, BDC51 and BDC188) can be used for mixed use employment, recreational uses and housing, with only minor intrusion by Flood Zone 3, development could proceed, subject to application of the Sequential Test to the site layout.
- 1.2.7 This SFRA has also provided recommendations for site specific flood risk assessment and provides guidance on what should be considered when preparing these documents. The potential impacts of climate change have been considered throughout this document and guidance provided on how to take account of this during site design, such as incorporating suitable finished floor levels.
- 1.2.8 Opportunities should be sought, wherever possible, to provide multiple benefits when managing flood risk. For example, restoring a floodplain to improve ecological quality, deculverting watercourses not only as a flood risk measure but to provide amenity benefit and ensuring an appropriate distance is left undeveloped along the length of a watercourse to allow migration of the stream/river and to provide green corridors. This would be subject to local Byelaws and the functional floodplain extents. However, the Environment Agency usually requires a minimum of 5m from the top of bank for maintenance of defences.

1.3 Surface Water Flooding

- 1.3.1 **Surface water flooding is a risk at all sites** due to the nature of the catchment and the uncertainties with climate change. This SFRA has provided advice on what should be incorporated into planning policy to minimise this risk; provided guidance on mitigation measures which need to be included on all of the development sites which were considered; and provided guidance on what mitigation measures should be considered during the preparation of site specific flood risk assessments. A key recommendation of this assessment is that a Surface Water Management Plan (SWMP) is prepared as a matter of urgency.

It is recommended that Sustainable Drainage (SuDS) techniques are used wherever possible, not only to provide attenuation, but to provide water quality improvements and increased amenity value/habitat creation.

² It should be noted that modelling EL 63 (IN67) North of Red Ditch, Enfield, had identified that approximately 5.3% lies in a high risk flood zone. However, due the strategic nature of this assessment and the predicted figure being only marginally above the Environment Agency's cut off point of 5% (which it considers as minor flooding), it was not considered appropriate to carry forward this site this for Exception Testing.

1.4 Sewer Flooding

- 1.4.1 Information provided by Severn Trent Water Ltd (STWL) on known sewer flooding issues is included in this assessment (Section 8.8). Sites prone to sewer flooding are listed and these must be considered when carrying out a site specific flood risk assessment.

1.5 Groundwater Flooding

- 1.5.1 Groundwater flooding can often occur as a result of prolonged heavy rain. It is recommended that this should be considered when preparing site specific flood risk assessments. This is discussed in detail in Section 8.9.

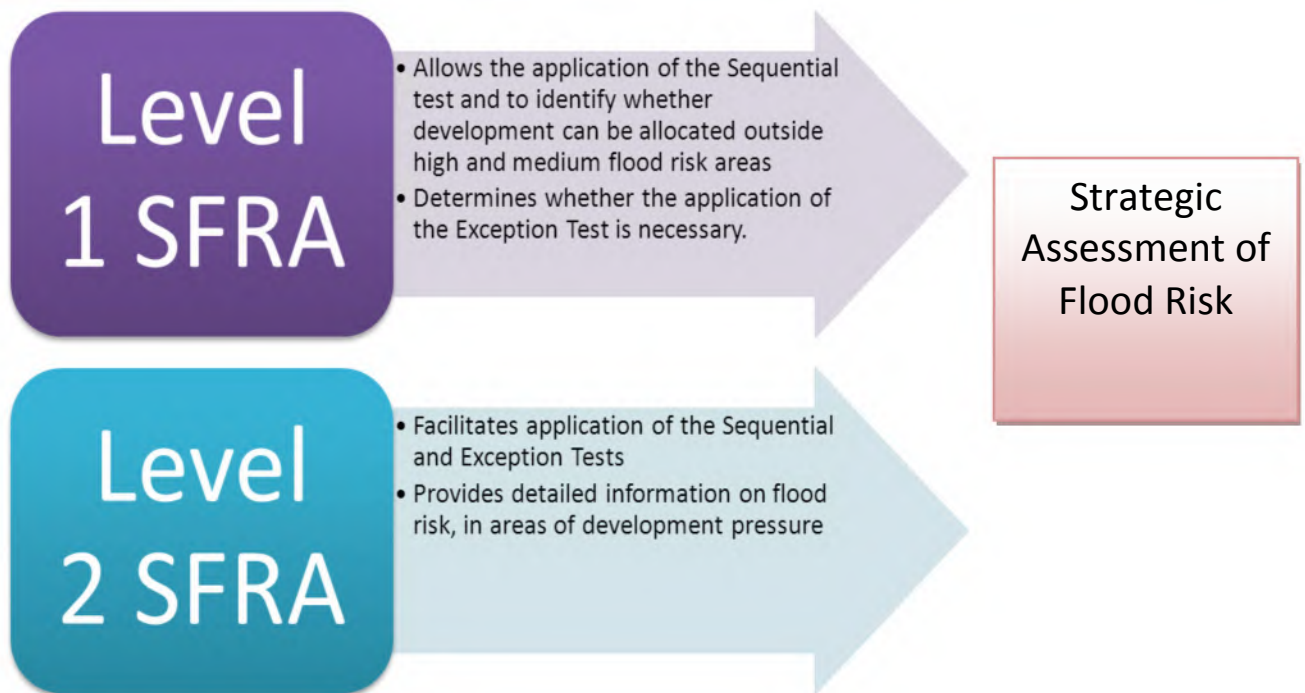
2 Introduction

2.1 Planning Context

- 2.1.1 Local Planning Authorities (LPAs) are required to produce Local Development Frameworks (LDFs) replacing the previous Local, Structure and Unitary Development Plans. LDFs contain a range of Local Development Documents (LDDs) that set out the spatial planning strategy for each local authority area.
- 2.1.2 Planning Policy Statement 25: Development and Flood Risk (PPS25) emphasises the active role that LPAs should have in ensuring that flood risk is considered in strategic land use planning. PPS25 encourages LPAs to undertake a Strategic Flood Risk Assessment (SFRA). SFRAs are one of a number of documents to be used as the evidence base for strategic land use planning decisions as part of the LDF.
- 2.1.3 The National Planning Policy Framework (NPPF) was published in March 2012 setting out the government's planning policy. **This does not alter the content of PPS25 and retains key elements of the planning policy statement.**

2.2 Planning Background

- 2.2.1 LPAs are responsible for granting planning permission for development under the Town and Country Planning Act 1990. Prior to making any decisions they are required to take into consideration all material planning considerations, such as planning policy statements, development frameworks and representations from consultees.
- 2.2.2 In accordance with PPS25, LPAs are required to demonstrate that due regard has been given to the issue of flood risk as part of the local development (LDF) planning process.
- 2.2.3 Accordingly, it is necessary for a SFRA to be prepared to classify the existing and future flood risk of all land within local authority boundaries and to provide the LPA with the evidence to sequentially test all proposed land allocations and windfall sites with a view to locating development in lower flood risk areas, where possible. In this context, this Level 2 SFRA provides the evidence base to inform land use planning applications within the boundaries of:
- Bromsgrove District Council (BDC); and
 - Redditch Borough Council (RBC).
- 2.2.4 The aim of this Level 2 SFRA is to inform the LDF and the planning process.
- 2.2.5 The PPS25 Practice Guide recommends that SFRAs are completed in two consecutive stages; this follows the iterative approach encouraged by PPS25 and provides Local Planning Authorities with sufficient tools throughout the LDF and SFRA process to inform and update decisions regarding development sites.



2.2.6 The Bromsgrove and Redditch Level 1 SFRA (2009) has been completed and various gaps in data have been identified which require to be addressed and verified, prior to the Examination in Public (EiP) of the Core Strategies. This Level 2 SFRA provides verification of all outstanding data and provides a robust assessment of the extent and nature of the risk of flooding to determine where development can and cannot be accommodated, in principle. Addressing outstanding information from the Level 1 SFRA included undertaking modelling to define flood risk along previously un-modelled watercourses (specified by Redditch Borough and Bromsgrove District Councils), redefine the functional floodplain where necessary and to define the predicted flood extent for all critical watercourses within defined development areas.

2.2.7 The growth and development scenarios considered for Bromsgrove District and Redditch Borough in this document were agreed with the Project Steering Group. The different scenarios for the District and the Borough are described in Table 2-1.

Table 2-1 Growth and Development Scenarios

Planning Area (2006-2026)	Scenario 1	Scenario 2
Bromsgrove		
<i>Number of dwellings</i>	6,000 (4,000 by 2021)	7,000 (4,000 by 2021)
<i>Employment land (ha)</i>	28 (28 by 2021)	28 (28 by 2021)
Redditch		
<i>Number of dwellings</i>	3,000	7,000
<i>Employment land (ha)</i>	27	68

2.3 Flood and Water Management Act

2.3.1 The Flood and Water Management Act 2010 has resulted in new powers and duties on the development of national and local strategies to deal with flood risk and reporting of flood risk. The Act implements Sir Michael Pitt's recommendation after the July 2007 floods, that new legislation was required on how we manage flooding. Under this Act, it is a requirement for the Environment Agency (EA) and Lead Local Flood Authorities to develop strategies for flood risk management. These local strategies will be supported by the planning process.

2.4 Level 2 SFRA Objectives

2.4.1 The overall objectives of the Level 2 SFRA are:

- consider the detailed nature of the flood hazard;
- provide the necessary evidence base to facilitate a sequential approach to site allocation within a flood zone;
- allow policies and practices to be developed to ensure that development in flood risk areas can satisfy the requirements of the Exception Test and to incorporate such policies/practices into the LDD; and
- advise and inform developers of their obligations under NPPF and PPS25 in relation to sustainable development and flood risk.

2.5 Objectives of This Study

2.5.1 This document provides supplementary information to support the Level 1 SFRA, filling in gaps and providing detailed information to allow the Sequential and Exception Tests to be applied, where applicable. It should be noted that not all potential development sites were assessed and not all watercourses were modelled; only sites described in Table 2-2 were investigated, on instruction by Redditch Borough Council and Bromsgrove District Council. Flooding has been assessed in line with the requirements of a Level 2 SFRA as detailed in PPS25 and the supporting Practice Guidance. Hydraulic modelling has been completed to understand the detailed nature of fluvial flooding providing flood risk and flood hazard mapping for sites that require further detailed investigation. Recommendations on the application of sustainable drainage techniques have also been provided.

2.5.2 The SFRA assesses the risk of flooding at a strategic level, to inform the spatial planning process and by applying a sequential approach for future land use. The level of detail and accuracy is in accordance with this strategic objective, NPPF and PPS25.

Table 2-2 Development Sites Included for Assessment

Site Reference	Site Name	Capacity	Watercourse	Local Authority
BDC20	Perryfields Road, Bromsgrove	1110 residential units ¹	Battlefield Brook	Bromsgrove District Council
BDC35B	Kidderminster & Stourbridge Road Hagley	120 residential units ¹	Gallows Brook	
BDC49	Gallows Brook Pig Farm, Kidderminster Road, Hagley	26 residential units ¹	Gallows Brook	
BDC51	Land at Algoa House, Western Road, Hagley	18 residential units ¹	Gallows Brook	
BDC80	Whitford Road, Bromsgrove	470 residential units ¹	Battlefield Brook	
BDC81	Norton Farm, Birmingham Road, Bromsgrove	270 residential units ¹	Spadesbourne Brook	
BDC188	Rose Cottage, Thicknall Cottage and land rear of Western Road, Hagley	15 residential units ¹	Gallows Brook	
BDC189	Strathearn, Western Road, Hagley	40 residential units ¹	Gallows Brook	
Site 2	Ravensbank Business Park ³	N/A	Blacksoils Brook and tributaries	
2010/09	RO Alexandra Hospital	145 residential units 1.76Ha employment land	River Arrow	Redditch Borough Council
2010/10	A435 ADR	360 residential units 10.44Ha employment land	Tributaries of Ipsley Brook	
2010/11	Brockhill ADR	425 residential units ²	Red Ditch	
2010/12	Webheath ADR	600 residential units ²	Tributary of Swan's Brook	
2010/13	Brockhill Green Belt	400 residential units	Red Ditch	
2010/14	Foxlydiate Green Belt	230 (DPD Consultation refers to 150) residential units	Batchley Brook	
EL63 (IN67)	North of Red Ditch, Enfield	N/A	Red Ditch	
St 8	Edward Street	N/A	Batchley Brook	
St 10	Town Centre, Church Street/Northwest Quadrant	N/A	Batchley Brook	

Total = 18 sites. Redditch Borough Council = 9, Bromsgrove District Council = 9

¹ Strategic Housing Land Availability Assessment for Bromsgrove Council – January 2011

² Strategic Housing Land Availability Assessments for Redditch Borough_ April 2010

³ Ravensbank Business Park falls within Bromsgrove District but is proposed for development to meet the needs of Redditch

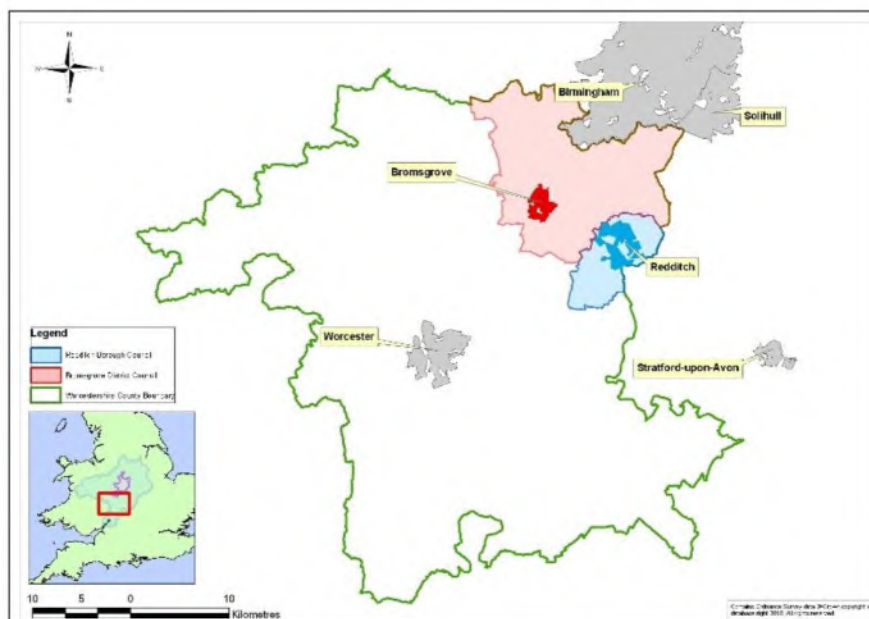
- 2.5.3 Drawing 001 showing the location of these proposed development sites is included in Appendix 1.
- 2.5.4 The study objectives, which have been agreed with the Councils and align with the requirements of NPPF and PPS25, are as follows:
- definition and mapping of the floodplain across all flood zones and the functional floodplain, where this is required;
 - distribution of flood risk from all sources of flooding;
 - identification of critical drainage areas and the need for SWMPs;
 - identification and mapping of areas of high runoff;
 - identification and mapping of areas at risk of flooding from land management practices;
 - definition of the nature of the flood hazard within a flood zone including flood probability, flood depth, flood velocity and rate of onset of flooding;
 - detailed appraisal of flood risk at potential development sites;
 - guidance on appropriate policies for sites which could satisfy parts 1 and 2 of the Exception Test, and the requirements that would be necessary for a flood risk assessment supporting a planning application;
 - guidance on the preparation of flood risk assessments for sites of varying risk across the flood zones, including information about the use of sustainable drainage techniques;
 - an appraisal of existing flood defence infrastructure and identification of requirements for further infrastructure, including identification of suitable measures; and
 - meaningful recommendations to inform policy, development control and technical issues.

2.6 Local Context

- 2.6.1 Several rivers have their headwaters within the District and Borough, resulting in rapid localised flash flooding. However, major flooding reported in the main rivers in Worcestershire has not occurred in Bromsgrove or Redditch, with flooding generally attributed to lack of capacity through inadequate maintenance and rapid runoff from highways. There have been reports of sewer flooding in urbanised areas due to combined and surface water drainage systems becoming surcharged. Some of these occurrences are attributable to overland runoff from the undeveloped areas which flow into highways drains and sewers rapidly exceeding capacity.

Bromsgrove

- 2.6.2 Bromsgrove is situated in Worcestershire, approximately 13 miles south west of Birmingham city centre. The town itself is situated close to where the M5 and M42 motorway corridors converge. Bromsgrove District Council serves a population of approximately 93,400 residents (Office of National Statistics 2010) and covers an area of approximately 218 km². The district consists of both urban conurbations and rural communities. A third of the population lives in Bromsgrove town, with other population clusters centred in Hagley, Rubery and Wythall.
- 2.6.3 Birmingham Plateau and Clent and Lickely Hills are located to the north of the area. The headwaters of 3 main rivers are located within the District:
- River Salwarpe;
 - Gallows Brook; and
 - River Arrow.
- 2.6.4 Localised small - scale flash flooding has occurred in Bromsgrove District due to the rapid response of the catchments.



Redditch

- 2.6.5 Redditch is located to the immediate south of Bromsgrove District, bordering Wychavon District Council to the south and Warwickshire County/Stratford on Avon District Council to the east. The primary settlement is Redditch with over 90% of the Borough population. The remainder of the borough is rural.
- 2.6.6 The primary watercourses within Redditch are:
- River Arrow draining the north eastern section of the district; and
 - Swans Brook and The Wharrage, which drain the south western rural catchment.

The catchments are sub-divided by a ridge, separating the watersheds, defined by the routes of Birchfield Road and Evesham Road.

- 2.6.7 Rapid flash flooding has previously been reported in local watercourses draining to the River Arrow, primarily Batchley Brook, which flows through the north west of Redditch towards the River Arrow. However, much of this is localised within areas of the borough. Further information is available in the Level 1 SFRA.

2.7 Sequential Test

- 2.7.1 The Sequential Test (PPS25) aims to direct vulnerable development towards areas of lower flood risk. The Sequential Test should demonstrate where there are sites available in areas of a lower probability of flooding. Following on from the Level 1 SFRA, this Level 2 SFRA provides supporting evidence (including flood extents, velocities, depths and details of length of predicted inundation) for sites previously identified by Redditch Borough and Bromsgrove District Councils. This Level 2 SFRA also recommends that a sequential approach is applied within a site boundary to prevent more vulnerable land uses occurring in areas of high flood risk.

2.8 Exception Test

- 2.8.1 Following application of the Sequential Test, if it is not possible for the development to be located in Flood Zone 1 or 2, the Exception Test can be applied, but this must be consistent with other sustainability objectives.
- 2.8.2 The Exception Test allows for managing flood risk while still enabling necessary development to proceed.
- 2.8.3 In accordance with PPS25, for the Exception Test to be passed, a development must satisfy all of the following three criteria:
1. The development provides **wider sustainability benefits** to the community that outweigh the flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission stage', the benefits of the development should contribute to the Core Strategy Sustainability Appraisal.
 2. The development should be **on developable previously-developed land** (commonly known as 'Brownfield land') or, if it is not on previously-developed land, it should be shown that there are no reasonable alternative sites on developable previously-developed land.
 3. A Flood Risk Assessment (FRA) must demonstrate the development will be **safe**, without increasing flood risk elsewhere and, where possible, will reduce the flood risk overall.

2.9 SFRA as a Living Document

- 2.9.1 It is important to recognise that this SFRA is a 'living' document. This means that the document will be updated as new data becomes available, in order to ensure that the best available information is used to guide the site selection process.
- 2.9.2 Accordingly, it is proposed that the SFRA outputs should be revised periodically in light of the latest available information.
- 2.9.3 This Level 2 SFRA should be read in conjunction with the Level 1 SFRA and WCS.

3 Methodology

3.1 Growth and Development

3.1.1 Two growth and development scenarios have been identified for Redditch Borough and Bromsgrove District, as outlined in Table 3-1. The scenarios assume a housing and employment requirement for the period 2006 – 2026 with an intermediate projection at 2021.

3.1.2 The following annual requirements apply to Bromsgrove District:

- 289.9 new dwellings from 2010 to 2021; thereafter, 400 new dwellings every year between 2021 and 2026 – Scenario 1;
- 0.06 ha of new employment land every year to 2021 – Scenario 1 and Scenario 2; and
- 289.9 new dwellings every year from 2010 to 2021; thereafter, 600 new dwellings every year between 2021 and 2026 – Scenario 2.

3.1.3 The following annual requirements apply to Redditch Borough:

- 176 new dwellings every year to 2026 – Scenario 1;
- 4.3 ha of new employment land every year to 2026 – Scenario 1 and Scenario 2; and
- 412 new dwellings every year to 2026 – Scenario 2.

Table 3-1 Growth and Development Scenarios

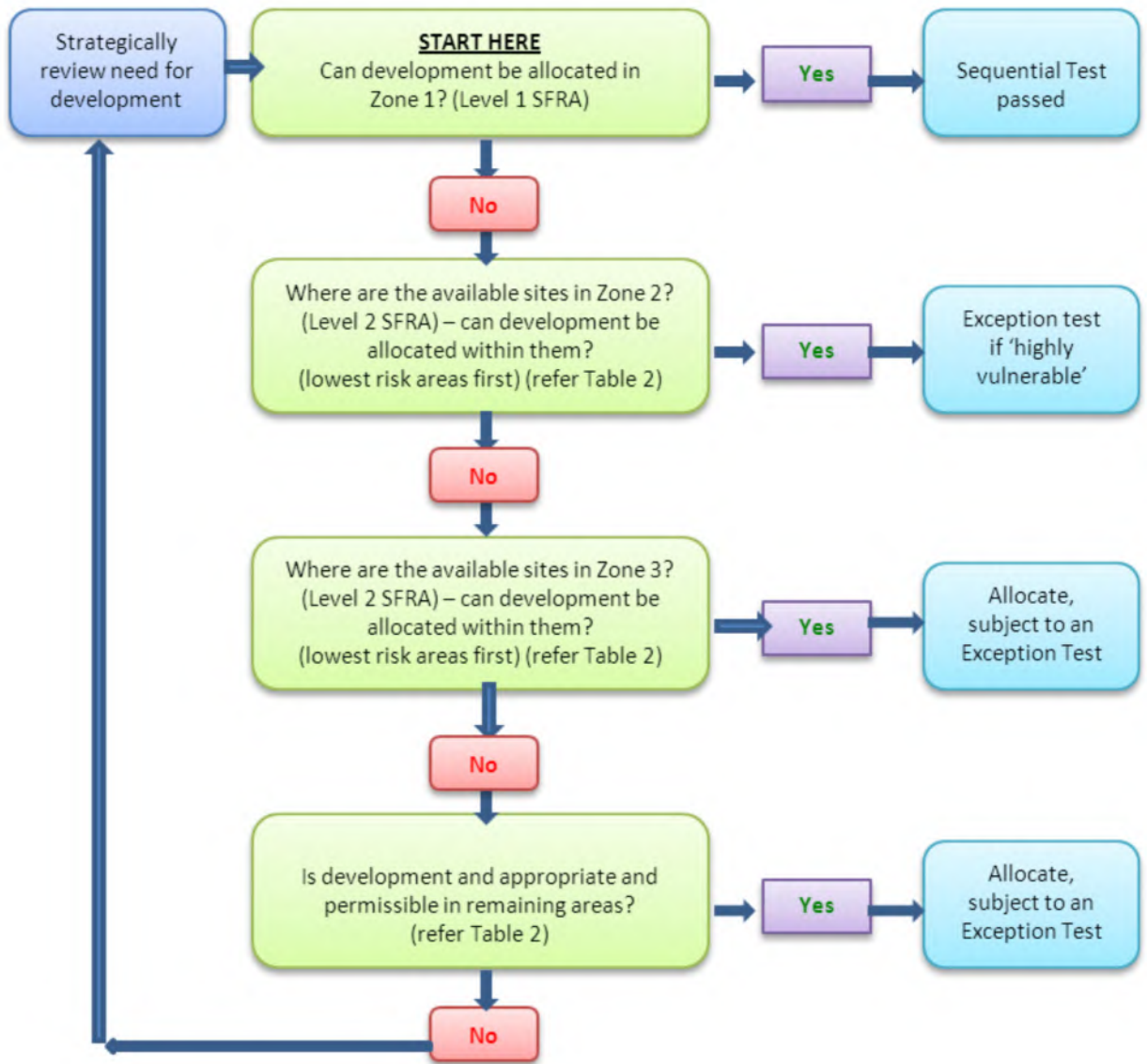
Planning Area (2006-2026)	Scenario 1	Scenario 2
Bromsgrove		
<i>Number of dwellings</i>	6,000 (4,000 by 2021)	7,000 (4,000 by 2021)
<i>Employment land (ha)</i>	28	28
Redditch		
<i>Number of dwellings</i>	3,000	7,000
<i>Employment land (ha)</i>	27	68

3.2 Application of the Sequential Test

3.2.1 PPS25 outlines the requirement for a sequential risk based approach to be adopted for determining the suitability of land for development in flood risk areas (either through fluvial, coastal, sewer, groundwater and/or surface water flooding mechanisms). Central to this approach is the application of a Sequential Test to prioritise sites in order of flood risk probability and suitability for development. A flow chart illustrating the process of the Sequential Test is shown in Figure 3-1.

3.2.2 The test is used to assess what land is available for development and direct development to areas of lowest risk in the first instance. Where development is proposed within either medium (Zone 2) or high (Zone 3) flood risk zones, PPS25 requires the LPA to undertake the Sequential Test to demonstrate that there are no reasonable alternative development sites in areas of lower risk. However development of sites within flood risk areas must take account of how development impacts can be mitigated as well as the probability of the flood risk. These factors are considered through the application of the Exception Test.

Figure 3-1 Application of the Sequential Test



(Source: Figure 4.1 in Communities and Local Government: Planning Policy Statement 25: Development and Flood Risk Practice Guide, December 2009)

- 3.2.3 A LPA allocating land for development must demonstrate that it has considered the range of possible site options in conjunction with the flood risk information contained within this SFRA and the vulnerability of proposed development, and applied the Sequential Test (and where necessary the Exception Test) in the site allocation process. Evidence should be provided throughout the Sustainability Appraisal process.
- 3.2.4 A Sequential Test was carried out in accordance with the requirements of PPS25, for the agreed proposed development sites listed in Table 2-2. It should be noted that the sites which were included for sequential testing were provided solely for the purposes of determining flood risk at these locations.

Figure 3-2 Flood Risk Vulnerability Categories



For examples of development types see Table 3-2

- 3.2.5 In assessing the suitability of the development proposals, the SFRA has adopted the PPS25 classification of different types of development into five (5) flood risk vulnerability categories. These categories are described in Figure 3-2 (further information is given in Table 3-2).
- 3.2.6 The compatibility between the flood zones and different development categories is shown in Table 3-2. This table defines the scenarios in which development is considered appropriate, subject to passing the Sequential and Exception Tests, or is not permitted based on the requirements of PPS25.
- 3.2.7 A ‘traffic light’ system has been adopted by this SFRA to mirror the decision matrix provided within PPS25. This traffic light assessment is provided in Table 3-2 and highlights areas where the:
- development type is permissible under PPS25;
 - development type is permissible subject to passing an Exception Test; and
 - development type is not permitted by PPS25.

Table 3-2 Compatibility between Flood Vulnerability of Development and Flood Zones (Source: Adapted from Table D.3 in Communities and Local Government (2006))

Flood Risk Vulnerability Classification	Essential Infrastructure ¹	Water Compatible Development ²	Highly Vulnerable Development ³	More Vulnerable Development ⁴	Less Vulnerable Development ⁵
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception test required	✓	✓
Zone 3a	Exception test required	✓	x	Exception test required	✓
Zone 3b	Exception test required	✓	x	x	x

Key:

- ✓ - Development is appropriate
- x - Development is not permitted

¹ Includes essential transport infrastructure

² Includes flood control infrastructure, water based recreation, amenity open space

³ Includes emergency services infrastructure, basement dwellings

⁴ Includes housing, residential institutions, hotels, hospitals, landfill sites used for waste management facilities for hazardous waste

⁵ Includes shops, offices, general industry

3.2.8 When undertaking the Sequential Test, PPS25 specifies the LPA should focus on:

- development vulnerability;
- defining the evidence base.

Development Vulnerability

3.2.9 The LPA should firstly consider whether the flood risk vulnerability classification of the proposal is appropriate for the flood zone.

3.2.10 If the development is identified as being appropriate, the next step is to identify reasonable available sites within a lower flood risk zone and identify the geographic area of search over which the test is to be applied.

Defining the Evidence Base

3.2.11 At the local level, the geographical area of search over which the test is to be applied will typically be the whole LPA area. However, in defining this particular search area, the evidence base documents were produced jointly due to the proximity of Redditch to Bromsgrove District Council's boundary and the need to consider housing numbers and allocations 'cross-boundary' rather than in isolation.

Comparing Sites

3.2.12 This SFRA provides information that should be used by the Local Planning Authority to compare the flood risk between reasonably available sites. Other planning considerations, such as development plan status, constraints to the delivery of the development and other potential impacts of the development should also be considered.

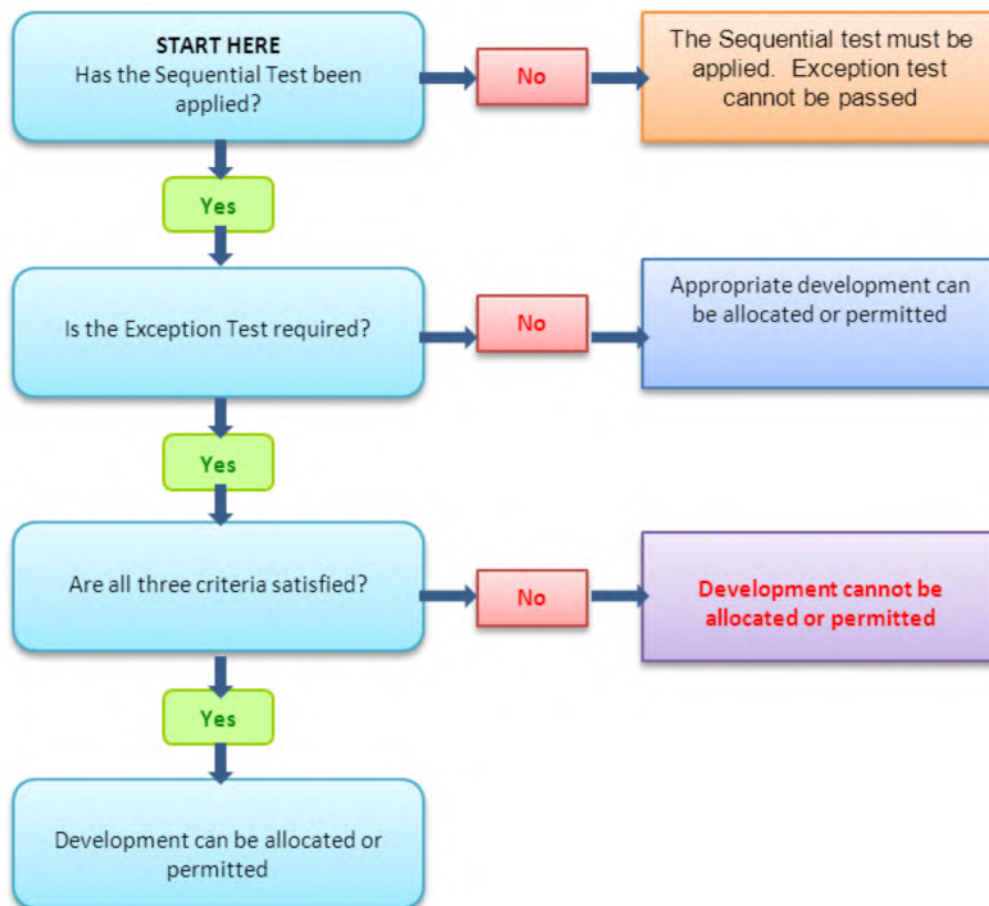
Application of the Exception Test (where applicable)

3.2.13 The final issue to be considered by the LPA is whether alternative sites are less suitable, taking into account other planning issues. If the alternative sites are deemed less appropriate, the original site should be considered with the application of the Exception Test.

3.3 Application of the Exception Test

3.3.1 Where the Sequential Test has not identified alternative sites in low flood risk areas, and continuing development is necessary to meet the needs of the community, and/or provides wider sustainability benefits, the Exception Test is used to assess the safety of that potential development in Flood Zones 2 and 3, A flow chart illustrating the process of the Exception Test is shown in Figure 3-3.

Figure 3-3 Application of the Exception Test



(Government Planning Policy Statement 25: Development and Flood Risk Practice Guide, December 2009)

- 3.3.2 For the Exception Test to be passed, a development must satisfy all of the following three criteria:
1. The development provides **wider sustainability benefits** to the community that outweigh the flood risk, informed by a SFRA where one has been prepared. If the DPD has reached the 'submission stage', the benefits of the development should contribute to the Core Strategy Sustainability Appraisal.
 2. The development should be **on developable previously-developed land** (commonly known as 'Brownfield land') or, if it is not on previously-developed land, it should be shown that there are no reasonable alternative sites on developable previously-developed land.
 3. A Flood Risk Assessment (FRA) must demonstrate the development will be **safe**, without increasing flood risk elsewhere and, where possible, will reduce the flood risk overall.

4 Flood Risk Vulnerability of Developments

4.1 Introduction

4.1.1 Flooding results from a range of mechanisms (acting in combination or isolation) including fluvial, sewer and surface water sources, as well as blockages of hydraulic structures. Groundwater flooding is not considered a significant issue. Key flooding issues in the District and Borough include:

- widespread and rapid onset of surface water and sewer flooding;
- flash flooding from ordinary watercourses;
- limited main river flooding from Swan's Brook and the Bow Brook in Redditch;
- a history of flooding in Belbroughton because of badly maintained watercourses and from the canal; and
- surface water flooding due to land management practices, farming intensity and soil compaction which results in an increase in the rate/speed of runoff in the catchment.

4.2 Development Suitability in Flood Zone 1 – Low Probability

4.2.1 The flood risk in Flood Zone 1 is considered to be low, but this should not be interpreted as there being no constraints to development of land within this zone. In the first instance the Sequential Test requirement should be met, with consideration to the vulnerability classification of the development.

4.2.2 Development proposals on sites greater than, or equal to, one hectare in area are considered to be at risk of flooding from other sources (e.g. surface water flooding) and have the potential to increase flood risk in adjoining areas through the addition of hard surfaces and the effect of the development on overland flow paths. Accordingly, a site-specific FRA must be prepared for these proposals to consider these factors and other local considerations, such as sustainable drainage techniques.

4.3 Development Suitability in Flood Zone 2 – Medium Probability

4.3.1 Flood Zone 2 is considered suitable for most development except highly vulnerable uses such as police and fire stations. Subject to the Sequential Test being applied, highly vulnerable development in Flood Zone 2 is only permitted through the application of the Exception Test. A site-specific flood risk assessment will be required for all development in Flood Zone 2.

4.4 Development Suitability in Flood Zone 3a – High Probability

4.4.1 Water-compatible and less vulnerable land uses are appropriate in this zone, however highly vulnerable land uses should not be permitted. More vulnerable uses and essential infrastructure should only be permitted in the zone if the development passes the Sequential and Exception Tests. If permitted, essential infrastructure should be designed and constructed in order to remain operational during major flood events.

4.4.2 All development proposals in this zone should be accompanied by a FRA.

- 4.4.3 The policy aims for this zone, as set out in PPS25, are to seek opportunities to:
- **reduce** the overall flood risk to the area through layout/design and sustainable drainage techniques;
 - **relocate** existing development to land of lower flood risk; and
 - **restore** the functional floodplain in order to restore flood water pathways and space for flood water storage. (Communities and Local Government, 2006).

4.5 Development Suitability in Flood Zone 3b – Functional Floodplain

- 4.5.1 Only water-compatible uses and essential infrastructure should be permitted in this zone, if it passes the Exception Test. It should be designed and constructed to:
- remain **operational and safe** for users in times of flood;
 - result in **no net loss** of floodplain storage;
 - **not impede** water flows; and
 - **not increase flood risk** elsewhere across the floodplain.
- 4.5.2 All development proposals within this zone that are deemed appropriate based on the flood zone and development vulnerability compatibility should be accompanied by a FRA. The policy aims for this zone, as set out in NPPF and PPS25, are to seek opportunities to:
- **reduce** the overall flood risk to the area through layout/design and sustainable drainage techniques; and
 - **relocate** existing development to land of lower flood risk.

4.6 Other Sources of Flooding

- 4.6.1 When deciding whether a development type is suitable, it is essential that all sources of flooding are considered, including:
- pluvial/surface water runoff;
 - inadequate drainage systems;
 - sewer networks (surface water and foul);
 - groundwater; and
 - flooding from manmade structures e.g. canals and reservoirs.
- 4.6.2 Flooding mechanisms in the Borough and District and the implications for development must be taken into account at early stages in the development.

5 Defining Flood Risk Hazards in Areas of Development Pressure

5.1 Introduction

5.1.1 In order to address Part C of the Exception Test, the nature of the flood hazard within flood zones must be understood, this was achieved by determining:

- flood probability;
- flood depth;
- flood velocity; and
- rate of onset of flooding.

5.2 Hydraulic Modelling

5.2.1 Modelled flood levels, flood outline mapping and/or flood zone mapping were available for a number of watercourses in the study area. Accordingly, there was a large volume of existing data that could be used to define the flood risk.

5.2.2 Different methodologies have been adopted for waterways where Environment Agency flood levels and flood outline mapping are available (i.e. 'mapped' watercourses), and for those areas where no detailed flood information is available (i.e. 'unmapped' watercourses).

5.2.3 The Level 1 SFRA provided flood zone mapping for the District and Borough for Environment Agency Main Rivers and watercourses with a catchment greater than 3km². This mapping was based on HEC-RAS and ISIS modelling of the River Salwarpe in the Bromsgrove District, and the Bow Brook, Swan's Brook (Elcocks Brook), Wixon Brook, The Wharrage (all four collectively referred to by EA as Shell Brook) and the River Arrow in Redditch Borough. The mapping was also based on the results of JFLOW modelling where other modelling results were not available.

5.2.4 A revised 1D/2D River Arrow model was also available, with an extended upstream extent, improved hydrological inputs and additional topographic data. This model was reviewed and deemed to be suitable for the purposes of analysing flood risk and mapping flood extents.

5.2.5 There were, however, a number of unmodelled watercourses near proposed development sites. It has been necessary to undertake more detailed modelling investigations to define the flood behaviour and associated flood risk along coarsely mapped (simple JFLOW modelling, which forms the basis of the flood map) or unmapped watercourses. Additional data was collected from observations during a site walkover survey and from local knowledge of flooding.

5.2.6 One of the key tasks of this Level 2 SFRA was to carry out additional modelling to define the flood risk along currently unmodelled watercourses in close proximity to the proposed development sites identified by Bromsgrove District and Redditch Borough Councils.

5.2.7 Additional modelling simulations were also required to simulate the 5%, 1%, 1% plus climate change and 0.1% events. Outputs of flow rates, peak flood levels, floodwater depths and flow velocities were produced for each cross-section (or node) within the model.

- 5.2.8 Flood mapping for fluvial flood risk was carried out, for the district and borough based on information supplied including LiDAR, local knowledge and historical data, as agreed with BDC, RBC and the EA. Mapping of flooding from other sources, such as groundwater and area susceptible to surface water is based on information supplied by the EA, LiDAR, hydrological data and hydrological analysis.
- 5.2.9 The water levels predicted by the models were mapped at each of the cross-section locations, for open channels, and onto the Digital Surface Model (DSM) for the culverted sections. These mapped levels were then converted into a water surface and 'mapped' on to the Digital Terrain Model (DTM) for the study area to create flood mapping for the modelled watercourses.

5.3 Flood Defence Infrastructure

- 5.3.1 Flood defences can consist of man-made structures, such as embankments, bunds, sluice gates, reservoirs and flood barriers, which are designed to prevent flooding of areas adjacent to the defence. It is important to appreciate that flood defences can only prevent flooding up to their design standard; they cannot prevent all flooding.
- 5.3.2 PPS25 considers defended areas to have some risk of flooding, and therefore sites within these areas must be assessed with respect to the adequacy of the defences. Accordingly, it should not be assumed that proposed new development in areas 'protected' by flood defences is acceptable.

5.4 Standard of Protection of Flood Defences

- 5.4.1 In accordance with the requirements of NPPF and PPS25 Practice Guidance, a Level 2 SFRA is required to provide the following strategic information in relation to flood defences;
- an appraisal of the current condition of flood defence infrastructure and of likely future flood management policy with regard to its maintenance and upgrade; and
 - an appraisal of the probability and consequences of overtopping or failure of flood risk management infrastructure including an appropriate allowance for climate change.
- 5.4.2 Flood defences reduce the risk of flooding, but do not eliminate flood risk completely. The reduction in flood risk that the defence provides depends on the standard of protection (SoP) and the performance and reliability of the defences. They are typically engineered structures designed to limit the impact of flooding. Where properties benefit from flood defences there is still a residual risk as a result of overtopping or failure. The consequences of failure can be rapid and significant if there is a major breach of flood defences. The areas immediately behind the flood defences are at high risk of rapid inundation and will be subject to fast flowing water, which increases the risk to human health and property disruption. Distance from flood defence infrastructure reduces the residual impact. Further information can be found in NPPF and PPS25: Development and Flood Risk Practice Guide and Risks to people behind defences. Flood Risk in Assessment Guidance for New Development Phase 2 R&D Technical report FD2320 (DEFRA, 2005).
- 5.4.3 Flood defences are generally designed and constructed to protect people and property from a given magnitude of flood, and may vary depending on the age of the structure, etc. For new defences, these issues and others are balanced through a cost benefit analysis to determine if investment in defence schemes can be justified.

- 5.4.4 For the purposes of this SFRA flood defences with a defence level return period of 1% annual probability (1 in 100) in any year and above were assessed, in accordance with EA requirements (See Appendix 2). It should be noted that the bund shown in Photographs 21 to 23 (Appendix 2) on the Sugar/Spadesbourne Brook is not an Environment Agency constructed or maintained flood defence structure. As noted in paragraph 5.4.6 the structural integrity of these defences has not been undertaken. This would need to be assessed further as part of any site specific FRA.
- 5.4.5 MWH undertook visual inspections of a number of flood defences on 5th August 2011. Our findings are given below in our general comments on each watercourse (photographs of the site walkover survey are included on Drawing 002, Appendix 2).
- 5.4.6 MWH has not carried out any historic investigations regarding the building of any flood defences and we have not carried out any site/ground investigation to determine the construction or the structural condition. We cannot therefore accurately and confidently determine the structural condition and suitability of any structures for flood defence purposes. Consequently, we recommend that an appropriate survey is carried out within 6 – 12 months to confirm whether defences are fit for purpose, applying a risk-based assessment, with appropriate reference to the appropriate PFRAs. This should incorporate populating and reviewing the Asset Registers and Records in accordance with Schedule 1 of the FWMA 2010.
- 5.4.7 Any culverts should be internally surveyed using CCTV to provide an assessment of the internal condition grade in accordance with the guidance on the Sewer Risk Management web site (formerly the Sewerage Rehabilitation Manual). Culverts should be inspected within the next 6 – 12 months to assess their structural integrity and service condition, e.g. level of siltation and debris, etc., applying a risk-based assessment, with appropriate reference to the appropriate PFRAs. This should incorporate populating and reviewing the Asset Registers and Records in accordance with Schedule 1 of the FWMA 2010.
- 5.4.8 Inspection, assessment and maintenance schedules should be prepared, and implemented, for all relevant flood defence structures, including embankments, culverts, etc. This should be carried out by Bromsgrove District and Redditch Borough Councils within the next 12 – 18 months, to ensure that the baseline condition of any flood defence features is established. This will enable the Councils to instigate a programme to monitor performance and condition, and implement upgrades, replacement, or renovation, if necessary.
- 5.4.9 Weirs and millponds on the minor watercourses will have minimal, localised flood risk management impact and many of these structures are ad hoc, constructed by riparian owners to attenuate flows locally and/or create hydraulic features. Subsequently, we have not assessed the flood defence potential of these minor ancillary structures. Failure of these systems is unlikely to cause significant impact downstream to existing flood risk.
- 5.4.10 Where development is proposed behind raised flood defences additional analysis will be required as part of a site specific FRA to understand the potential increase in residual risk through loss of potential flood storage or the disruption of conveyance routes.
- 5.4.11 The Level 1 SFRA indicated that only the flood defences on the Sugar Brook in Bromsgrove would require additional analysis, relating to Development Site E8 and potentially the Policy Reference development sites located in proximity to the flood defences. No other flood defences are located in proximity to the development sites. There is no identified flooding associated with Sugar Brook in the Environment Agency's Flood Maps.

Red Ditch

- 5.4.12 No flooding is identified on the Environment Agency indicative Flood Maps, for the reach of Red Ditch identified for additional modelling and assessment.
- 5.4.13 There are some ad hoc, informal defences on the watercourse which may provide minimal protection, but are unlikely to have been designed and constructed to withstand sudden changes in hydrostatic pressure (due to rapid fluctuations in water level on one side of a flood defence). Many of these defences could potentially fail if breached, resulting in rapid inundation.
- 5.4.14 The watercourse has been culverted in places from simple road crossings to longer culverts to enable development. Based on observations of inlets/outlets the structural condition of culverts cannot be accurately determined. However, all channels and culverts should be cleaned to remove all silts and debris, to improve capacity and increase the SoP.
- 5.4.15 The rectangular culvert at the downstream end of Red Ditch immediately upstream with the confluence with Batchley Brook is approximately 2000 x 1750 mm and following hydraulic modelling there is capacity to provide protection to the 1% annual probability (1 in 100) chance in any year storm event.
- 5.4.16 The pond located to the north of Windsor Road is likely to offer some protection through attenuation and storage. Although this will be dependent on maintenance of the pond and the outlet, to ensure that the hydraulic control is optimised. Understanding of the operation and hydraulic influence of the pond on the watercourse will require further detailed analysis, which may be prudent to comprehensively assess risk to flooding in the catchment. This pond is the property of Mettis Aerospace Limited, and its level is monitored continuously, and reactive maintenance/controls deployed accordingly. Should there be a change of ownership, these measures will need to be reviewed to ensure continued best practice.

Unnamed Watercourse (2010/11, 2011/13 & EL63/IN67)

- 5.4.17 The unnamed watercourse adjacent to Lowans Farm is a minor tributary of Red Ditch and no flooding is identified on the Environment Agency Flood Maps.
- 5.4.18 There are no formal or informal flood defence structures on this watercourse. There are a number of ad hoc minor culverted field crossings that are partially blocked with silt and debris and/or in a poor structural condition. These piped crossings could contribute to local flooding issues. Based on observations of inlets/outlets the structural condition of culverts cannot be accurately determined. However, all channels and culverts should be cleaned to remove all silts and debris, to improve capacity and increase the SoP.

Unnamed Watercourse (2010/12)

- 5.4.19 The unnamed watercourse is a minor tributary of Blacksoils Brook and no flooding is identified on the Environment Agency Flood Maps.
- 5.4.20 There are no formal or informal flood defence structures on this watercourse. There are a number of ad hoc minor culverted field crossings that are partially blocked with silt and debris and/or in a poor structural condition. These piped crossings could contribute to local flooding issues. Based on observations of inlets/outlets the structural condition of culverts cannot be accurately determined. However, all channels and culverts should be cleaned to remove all silts and debris, to improve capacity and increase the SoP.

Gallows Brook

- 5.4.21 No flooding is identified on the Environment Agency Flood Maps, for the reach of Gallows Brook identified for additional modelling and assessment.
- 5.4.22 There are some ad hoc, informal defences on the watercourse which may provide minimal protection, but are unlikely to have been designed and constructed to withstand sudden changes in hydrostatic pressure (due to rapid fluctuations in water level on one side of a flood defence). Many of these defences could potentially fail if breached, resulting in rapid inundation.
- 5.4.23 The watercourse has been culverted in places from simple road crossings to longer culverts to enable development. Based on observations of inlets/outlets the structural condition of culverts cannot be accurately determined. However, all channels and culverts should be cleaned to remove all silts and debris, to improve capacity and increase the SoP.

River Arrow

- 5.4.24 The Environment Agency Flood Maps indicate flooding along the urbanised reach of the River Arrow, although this is primarily associated with the 0.1% (1 in 1000 year) annual probability, i.e. Flood Zone 2. Potential property flooding is predicted to the rear of Dolphin Road, Abbeydale; Meir Road/Old Forge Drive and Matchborough Way.
- 5.4.25 Informal earth embankment flood defences have been constructed at Papermill Farm near Brooklands Lane. The embankment has been constructed on an outside bend of the River Arrow and consequently was eroded/undermined. MWH has assessed the condition of this flood defence as 'fair/poor' in accordance with the guidance in the Environment Agency's Condition Assessment Manual. We would therefore recommend that further detailed assessment of the embankment is carried out, within the next 12 – 18 months, to establish the structural condition of the defence. This may require appropriate ground investigation to assess the construction, condition and serviceable asset life.

Blacksoils Brook/Church Hill Brook

- 5.4.26 The Environment Agency Flood Maps indicate flooding along the urbanised reaches of Blacksoils Brook, immediately upstream of the confluence with the River Arrow, through Arrow Valley Park; and Church Hill Brook through Moons Moat North Industrial Estate. This flooding is primarily associated with the 1% (1 in 100 year) annual probability, i.e. Flood Zone 3, High Probability.
- 5.4.27 The predicted flooding along Blacksoils Brook is predominantly located in open space within the Arrow Valley Park. However, flooding associated with Church Hill Brook is predicted within Moons Moat North Industrial Estate and the adjacent residential areas, located to the west of Church Hill Brook, i.e. Arley Close, Exhall Close and Loxley Close. Currently there is no flood risk mitigation associated with Church Hill Brook. The residential and commercial properties are not located within the Environment Agency's Flood Warning area; however Section 4.6.3 of the SFRA Level 1 noted the Environment Agency advised that, due to the flashy nature of the local watercourses, this would prove ineffectual in warning of potential flood risk issues.

Sugar Brook

- 5.4.28 Environment Agency Flood Maps indicate flooding along the urbanised reaches of Sugar Brook adjacent to the A38, immediately south of the junction with Charford Road. The route of the Sugar Brook is described in detail in the Level 1 SFRA.

5.4.29 The Level 1 SFRA describes previous repeated flooding:

- between Morrisons and the Indoor Bowls Centre beside the A38; and
- A38 and Sherwood Road were closed in July 2007.

5.4.30 Flooding was attributed to possible out of bank flow from the Brook, due to blocking of highway drains or exceedance of sewer capacity. A programme of maintenance of watercourses and drainage systems is likely to reduce any flooding issue.

5.4.31 Sustainable Drainage Systems (SuDS) were not considered as being flood defences, as they provide only provide mitigation against the negative impacts of urbanisation on urban runoff.

5.5 Requirement for Surface Water Management Plans

5.5.1 Section 4.8.4 of the Level 1 SFRA discussed the requirement for SWMPs for Bromsgrove District and Redditch Borough and Section 5.2.1 suggested that the need for any SWMPs be identified in the Level 2 SFRA.

5.5.2 SWMPs should be carried out in those areas where surface flooding, fluvial flooding, groundwater flooding, drainage system flooding and/or development is an issue. SWMPs will assess flooding within a catchment/sub-catchment/area and identify methodologies to reduce and/or manage water on the surface and as close to source as possible, in accordance with the principles of the SuDS Management Train.

5.6 Identification of Critical Drainage Areas

5.6.1 Critical Drainage Areas are specific areas in Flood Zone 1 (only) where runoff can cause problems downstream. They are located upstream of the areas identified as highly susceptible to surface water flooding. Rainfall modelling for Redditch Borough using LiDAR data has identified areas where surface flooding is an issue for the 1 in 100 year event (shown in red) on drawing 41518000/01/005, Appendix 5. Flood Zone 1 areas immediately upstream of locations subject to flooding, and potentially contributing to runoff/flows, will be classified as Critical Drainage Areas. Gaps in LiDAR coverage for Bromsgrove District precluded a similar analysis being undertaken.

5.6.2 The DEFRA Surface Water Management Plan Technical Guidance (March 2010) states that 'Critical Drainage Areas are specific areas in Flood Zone 1 only, where runoff can cause problems downstream, and is not necessarily an area where flooding problems may occur'.

5.6.3 Potential 'hotspots' for surface water flooding which are planned to accommodate future development were identified using Environment Agency 'Areas Susceptible to Surface Water Flooding Maps' and using historic flooding information (See Drawing 41518000/001/003, Appendix 4 and Drawing 41518000/001/005, Appendix 5, Results of Modelling to Determine Areas at Risk from Surface Water Flooding). The hotspots can be identified from the areas susceptible to surface water flooding which indicates those areas that are at high risk. SWMP of the borough and district should be carried out to fully understand the complex issues and interactions between the various flooding mechanisms and pathways. A SWMP will also propose suitable mitigation methods for reducing flood risk within the areas and managing surface water flows to direct water when it does exceed channel, pipe or ground capacity to areas to safely manage and control.

5.7 Identification of Areas of High Water Runoff

- 5.7.1 Potential areas of high water runoff could not be identified, due to incomplete LiDAR coverage for the Borough and District, as the modelling applies rainfall to the DSM and any areas within the boundaries will not apply runoff characteristics correctly to those areas where there is inadequate data. Similarly, incomplete data from beyond the boundaries will not accurately simulate overland flow into and out of the borough and district, giving higher or lower values. Simulating runoff using incomplete data would provide an inaccurate assessment of high water runoff. Once LiDAR data is available for the entire area this task should be completed.
- 5.7.2 Localised assessment for site specific development should be carried out using topographical survey data to supplement existing LiDAR data to provide a more detailed DSM. This assessment will be suitable for indicative flood risk assessment issues at a sub catchment scale and will indicate flood risk mitigation and surface water management measures that should be implemented.

5.8 Identification of Areas at Risk of Flooding due to Land Management Practice

- 5.8.1 Potential solutions to reducing the risk of flooding from land management practices will involve close liaison with land owners to identify locations where flooding is an issue, current land management practices and options. Areas of arable land may require potential amendments to current management practices and/or may require areas of land to be dedicated to surface water management, e.g. sacrificial SuDS attenuation and storage areas. However, land owners should be encouraged to set aside land for occasional flood attenuation.
- 5.8.2 Land not used for agricultural purposes may be modified to incorporate SuDS to reduce runoff by introducing ponds, wetlands, swales and/or detention basins as landscape features. Modifications may also be carried out to existing parkland and public open space in a coordinated approach to managing runoff at a district/borough wide scale.
- 5.8.3 There may also be associated benefits to incorporating SuDS into open areas of land, by creating marginal areas of biodiversity and habitat.
- 5.8.4 Land management practices within Bromsgrove District and Redditch Borough should be monitored through working closely with farmers, land managers and others to understand the benefits and challenges to reduce flood risk. The Environment Agency and local councils have set up working groups with users to understand the role that farmers and land managers play in reducing flood risk for the wider community. Land should not be allowed to be compacted, which results in reduced infiltration, rapid runoff and pollution. Where there are known issues with high runoff flooding, mitigation measures should be implemented to control, attenuate, store and infiltrate runoff on local land.

6 Findings of the Sequential Test

6.1 Introduction

6.1.1 A traffic light system was developed, which is similar to that provided in PPS25, describing the flood zone within which each of the sites fall and the restrictions that this places on any future development at that location (Table 6-1). It should be noted that in some instances sites are only partially affected by flooding, or lie within multiple flood zones. In these cases, the 'traffic light' within Table 6-1 reflects the most severe risk of flooding within the site. More detailed assessments of the flood risk within the medium to high risk preferred option sites have also been carried out to determine their development potential adopting a sequential approach to development within the site, complying with the vulnerability of development permitted in each zone and Part C of the Exception Test. This information for each of the sites is contained in Appendix 3.

6.2 Identification of Sites at Risk

6.2.1 An assessment was carried out to identify which development areas, identified by Redditch Borough and Bromsgrove District Councils are located within low, medium and high flood risk areas.

6.2.2 Further modelling was carried out to understand the nature of the flood hazard on the required sites and answer Part C of the Exception Test.

Table 6-1 Sequential Test Findings

Name	Planning Land Use			Area (Ha)	Mixed	Highest Risk Flood Zone	% of Site Within Highest Risk Zone	Vulnerability	The Suggested Permissible Land Use Under PPS25				
	A1 to A5	B1 to B2	C3						Essential Infrastructure	Water Compatible Development	Highly Vulnerable Development	More Vulnerable Development	Less Vulnerable Development
Bromsgrove District Council													
BDC 20 Perryfields Road, Bromsgrove			✓	69.4	✓	3b	<1%	More vulnerable	EXCEPTION TEST REQUIRED				
BDC35B Kidderminster & Stourbridge Road Hagley			✓	9.8	✓*	3b	1.8%	Less/More Vulnerable	EXCEPTION TEST REQUIRED				
BDC 49 Gallows Brook Pig Farm, Kidderminster Road, Hagley			✓	1.7	✓*	3b	1.6%	Less/More Vulnerable	EXCEPTION TEST REQUIRED				
BDC 51 Land at Algoa House, Western Road, Hagley			✓	1.44	✓*	3b	1.1%	Less/More Vulnerable	EXCEPTION TEST REQUIRED				
BDC80 Whitford Road, Bromsgrove			✓	24.2		3b	<0.1%		EXCEPTION TEST REQUIRED				
BDC81 Norton Farm, Birmingham Road, Bromsgrove			✓	17.8		1	100%	More vulnerable					
BDC188 Rose Cottage, Thicknall Cottage and land rear of Western Road, Hagley			✓	1.2	✓*	3b	<0.1%	Less/More Vulnerable	EXCEPTION TEST REQUIRED				
BDC 189 Strathearn, Western Road, Hagley			✓	3.05	✓*	3b	5.3%	Less/More Vulnerable	EXCEPTION TEST REQUIRED				
Site 2 Ravensbank Business Park ³		✓		29.8		3b	2%	Less vulnerable	EXCEPTION TEST REQUIRED				
Redditch Borough Council													
EL63 (IN67) North of Red Ditch, Enfield		✓		10.9		3b	5.3%	Less vulnerable	EXCEPTION TEST REQUIRED				

³ Falls within Bromsgrove District but is allocated to meet the needs of Redditch

* may be developed separately or combined as one site

Name	Planning Land Use			Area (Ha)	Mixed	Highest Risk Flood Zone	% of Site Within Highest Risk Zone	Vulnerability	The Suggested Permissible Land Use Under PPS25				
	A1 to A5	B1 to B2	C3						Essential Infrastructure	Water Compatible Development	Highly Vulnerable Development	More Vulnerable Development	Less Vulnerable Development
2010/09 RO Alexandra Hospital			✓	8.23	✓	1	100%	More vulnerable					
2010/10 A435 ADR			✓	33.4	✓	3a	4.8%	Less/More Vulnerable	EXCEPTION TEST REQUIRED			EXCEPTION TEST REQUIRED	
2010/11 Brockhill ADR			✓	16.4		1	100%	More vulnerable					
2010/12 Webheath ADR			✓	25.5		3b	1.6%	More vulnerable	EXCEPTION TEST REQUIRED				
2010/13 Brockhill Green Belt			✓	27.7		3b	1.15%	More vulnerable	EXCEPTION TEST REQUIRED				
2010/14 Foxlydiat Green Belt			✓	22.2		1	100%	More vulnerable					
St 8 Edward Street		✓		0.48		1	100%	Less vulnerable					
St10 Town Centre, Northwest Quadrant		✓		5.35		1	100%	Less vulnerable					

It should be noted that it was agreed that detailed assessments were not required for all development sites within the study area. This table only lists the sites to be included as part of the SFRA



Development is appropriate



Development is not permitted



Development may be permitted if the requirements of an Exception Test are met

6.2.3 Following discussions with the Environment Agency, it was agreed that if flooding occurs in less than 5% of the site, this is considered minor for the purposes of the Sequential Test and development should not be precluded. This allowed the Sequential Approach to be applied within each of the sites themselves rather than across the catchment, i.e. directing development to lower risk areas within each of the sites. For high risk sites where there was no suitable alternative, an Exception Test would have to be applied.

Table 6-2 Percentage of Site at High Risk from Flooding

Site	Not in the floodplain	Up to 5%	6% and over	Exception test required (if no suitable alternative site available)
BDC 20 Perryfields Road		✓		
BDC35B Kidderminster & Stourbridge Road, Hagley		✓		
BDC 49 Gallows Brook Pig Farm, Kidderminster Road, Hagley		✓		
BDC51 Land at Algoa House, Western Road, Hagley		✓		
BDC80 Whitford Road, Bromsgrove		✓		
BDC81 Norton Farm, Birmingham Road, Bromsgrove	✓			
BDC188 Rose Cottage, Thicknall Cottage & land rear of Western Road, Hagley		✓		
BDC 189 Strathearn, Western Road, Hagley			✓	✓
Site 2 Ravensbank Business Park		✓		
EL 63 (IN67) North of Red Ditch, Enfield		✓		
2010/09 RO Alexandra Hospital	✓			
2010/10 A435 ADR		✓		
2010/11 Brockhill ADR	✓			
2010/12 Webheath ADR		✓		
2010/13 Brockhill ADR		✓		
2010/14 Foxlydiate Green Belt	✓			
St 8 Edward Street	✓			
St 10 Town Centre, Church Street/Northwest Quadrant	✓			

7 Findings of the Exception Test

7.1 Introduction

7.1.1 Whilst the Sequential Test should ensure that more vulnerable property types are not located in areas at high risk of flooding, in exceptional circumstances there may be a valid reason for a development type which is not compatible with the level of flood risk to be considered. The Exception Test has three parts. As discussed in Section 2.8.3, a development must satisfy all of the three criteria outlined in PPS25, to pass the Exception Test and there must be robust evidence in support of every part of the test:

- it must be demonstrated that development provides wider sustainability benefits to the community that outweigh flood risk;
- the development must be on developable previously developed or, if it is not on previously developed land, that there are no reasonable alternative sites on developable previously developed land; and
- a FRA must demonstrate that the development will be safe, without increasing flood risk elsewhere, and, where possible, will reduce flood risk.

7.1.2 After carrying out sequential tests on 18 sites, (9 sites in RBC and 9 sites in BDC) 1 site was identified as requiring an Exception Test. As described in Section 6.2.3, the site identified as requiring an Exception Test was:

- BDC 189 Strathearn, Western Road, Hagley.

7.1.3 However, the predicted flooding at this site is relatively minor and the sequential approach can be applied within the development itself, by locating the built development in areas at lowest risk from flooding. No built development should be located in areas identified as lying within the predicted 1% plus climate change extent. A precautionary approach is still considered necessary and the following recommendations apply to this site, in order to meet the requirements of the Exception Test.

Table 7-1 Findings of the Exception Test

BDC 189 Strathearn, Western Road, Hagley	
Part a) Wider Sustainability Benefits	<p>The site is currently greenfield, with the majority located in Flood Zone 1. A sequential test could be applied within the site itself to ensure no development takes place within areas which are subject to risk of flooding. The flooding mechanism is insufficient capacity in a downstream culvert, therefore care would need to be taken to ensure that runoff entering the watercourse is appropriately controlled. It is recommended that opportunities should be considered to address downstream flooding issues through appropriate design.</p> <p>Appendix K of the Bromsgrove District Council SHLAA included a site appraisal matrix for assessment of all sites, which considers the sustainability of each, environmental issues and constraints. A traffic light assessment was carried out on a number of criteria including biodiversity, access to schools and highway access. All criteria were considered as being 'good' for this site, except access to public transport.</p>
Part b) Previously Developed Land	<p>Greenfield site. However, Sequential Test has demonstrated that there are no reasonable alternative sites on developable previously developed land.</p>

BDC 189 Strathearn, Western Road, Hagley

**Part c)
Safe
Development**

No development will take place in any location which is at high risk from flooding. At the development control site application stage more detailed flood modelling will be required.

Finished floor levels must be 600mm above the predicted 1% plus an allowance for climate change flood level.

Safe access/egress route provided to Western Road, to the south of the site which lies in Flood Zone 1. If considered necessary, signposts should be provided showing safe access routes.

It is recommended that all residents receive an information pack, identifying the areas at risk from flooding, how this flood risk is being managed and explaining actions which should be taken in the event of a flood. All residents should also be encouraged to sign up to Floodline.

Surface water should be managed through the use of SuDS. These should be designed to ensure as a minimum that the runoff from the site is no greater than greenfield runoff rates.

Developers should also be encouraged to apply a management train approach to managing surface water

8 Site Specific Flood Risk Assessments

8.1 Introduction

8.1.1 Development is permitted within areas at risk of flooding if the proposed land use is acceptable for the degree of flood risk to which the land is subjected. The specific requirements for a development proposal will depend on the scale and vulnerability of the development and the level of flood risk at the site. The information provided in this Level 2 SFRA applies a precautionary approach to flood risk, in accordance with the guidance in NPPF, PPS25 and Environment Agency advice, and it is **essential** that more detailed site specific assessments are carried out.

8.1.2 The requirements for site-specific FRAs are detailed in PPS25. In general, it will be necessary for a developer to prepare a site-specific FRA to support a planning application if the:

- development is located in Flood Zone 2, 3a or 3b;
- proposed development site area is greater than 1 hectare (even in Flood Zone 1);
- floor space of proposed non-residential development is greater than 1,000m² or the site area is greater than 1 hectare;
- development site is located in an area known to have experienced flooding problems from any flood source; and
- development is located within 20m of the top-of-bank of a main river watercourse regardless of zone classification.

8.1.3 The level of information and detail in a FRA should be proportionate to the degree of flood risk and the scale, nature and location of the proposed development. Specifically, the three levels of Flood Risk Assessment can be described as:

1. **Screening study** - to identify whether there are any flooding issues related to a development site which may warrant further consideration.
2. **Scoping study** - to be undertaken if the Level 1 study indicates that the site may lie within an area which is at risk of flooding or that the site may increase flood risk due to increased runoff, to confirm the possible sources of flooding which may affect the site. The study should include the following objectives:
 - assessment of the availability and adequacy of existing information;
 - qualitative assessment of the flood risk to the site, and the impact of the site on flood risk elsewhere; and
 - assessment of the possible scope for appropriate development design and to scope additional work required.
3. **Detailed study** - to be undertaken if the Level 2 study concludes that quantitative analysis is required to assess flood risk issues related to the development site. The study should include a:
 - quantitative assessment of the potential flood risk to the development;

- quantitative assessment of the potential impact of development site on flood risk elsewhere; and
- quantitative demonstration of the effectiveness of any proposed mitigation measures (CIRIA, 2004).

8.1.4 Where developers promote development outside of the allocated areas identified within the LDD, that is, windfall sites, and within flood risk areas defined by the SFRA, they are responsible for demonstrating that the Sequential Test has been applied and the Exception Test, where required has been passed. A site-specific FRA will be needed.

8.1.5 A site-specific FRA must demonstrate that the proposed land use is acceptable and that the development can be designed to be safe and reduce flood risk. FRAs must consider flooding from all sources:

- **fluvial** flooding;
- flooding from the **sea**;
- flooding from **land**;
- **surface water** flooding;
- flooding from **groundwater**;
- flooding from **sewers**; and
- flooding from **reservoirs, canals** and **artificial** sources.

8.1.6 The level of detail included in a FRA will depend on the nature and scale of the proposed development. Paragraphs 22 and 23 of PPS25 clarify the responsibilities of developers to consider flood risk issues at a site as early as possible including:

- consulting with the Environment Agency early in the planning process;
- the responsibility of landowners for safeguarding land and other property against hazards;
- the responsibility of property owners and users to manage the drainage of their land, as far as possible to prevent adverse impacts on neighbouring land;
- advise that developers undertake independent checks regarding flood risk before purchasing a site. Where an allocated site has been sequentially tested for the type of development proposed and is supported by a SFRA, the Sequential Test does not have to be applied. However the developer should apply a sequential approach to determine the appropriate land uses across the site with respect to any flood risk within the site;
- the requirement that the scope of any FRA should be agreed with the LPA, and if necessary the Environment Agency, and it should be agreed who the developer needs to consult. For example the developer may need to consult Sewerage undertakers, Highways Authorities, Reservoir Undertakers, British Waterways, etc.;
- the developer must demonstrate that the development is consistent with the policies in PPS25, NPPF and those on flood risk in the LDDs; and

- FRAs should consider all sources of flooding and demonstrate how flood risk will be managed taking into account climate change.

8.1.7 The following sections outline the specific requirements for FRAs for development within each flood zone.

8.2 Flood Zone 1 – Low Probability

8.2.1 In Flood Zone 1, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage techniques. It should be noted that all minor watercourses have not been modelled, therefore there should **not** be a presumption that if flood zones are **not** indicated that a site lies within Flood Zone 1.

Operational Development Less than 1 Hectare

8.2.2 Developers for all sites within Flood Zone 1 should undertake a basic ‘screening’ FRA to identify whether there are any flooding issues related to a development site which may warrant further consideration. It is not necessary to submit a FRA to the LPA for this type of development, however a FRA may be required if it is identified that there is a known drainage problem that may affect the site and the LPA requires assurance that flood risk has been addressed.

8.2.3 The main flood risk issue to consider for these sites will often be managing the surface water runoff.

Development Greater than 1 Hectare

8.2.4 Although the flood risk in Zone 1 is considered to be low, a Flood Risk Assessment is required that is focused on the management of surface water runoff. The assessment should focus on:

- alternative sources of flooding (for example, groundwater or surface water flooding); and
- the potential for the development to increase flood risk elsewhere through the removal of permeable surfaces such as grass and the addition of hard surfaces and the associated runoff. Details of the proposed mitigation measures and potential SuDS must be provided, in conjunction with hydraulic calculations to demonstrate the robustness of the methodology adopted. A reduction in surface water flows should be sought for the lifetime of the development and greenfield rates should be achieved on all sites.

8.2.5 The type of information that should be included in a FRA in Flood Zone 1 is:

- location plan;
- site plan showing existing features and proposed development;
- existing and proposed site levels related to Ordnance Datum;
- information about the surface water disposal method;
- assessment of the volume of runoff and existing proposed runoff rates from the development;
- proposals for surface water management according to sustainable drainage principles with the aim of reducing the rate of runoff from the site;

- allowance in design for climate change effects;
- information on other potential sources of flooding and how they will be managed within the development proposal;
- consideration of the proposal relative to this SFRA; and
- confirmation whether the Environment Agency consent is necessary for any aspect of the work and whether or not this consent has been applied for. Consent would be required for any works in, over, under or within 8m of top of bank of a 'Main River'. From the 6 April 2012 the role and responsibility for determining permission for works to an 'ordinary watercourse', under the Land Drainage Act (1991), will transfer to the Lead Local Flood Authority.

8.3 Flood Zone 2 – Medium Probability

8.3.1 In Flood Zone 2, developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

8.3.2 All development proposals within this zone should be accompanied by a FRA that addresses the following issues:

- details of the existing site levels, proposed site levels and proposed ground floor levels (must be 600mm above the 1% annual exceedance flood level plus an allowance for climate change);
- vulnerability of the development to flooding from other sources (e.g. groundwater, sewer and surface water drainage), as well as river flooding. This would involve discussion with the Environment Agency, Severn Trent Water Limited (STWL), Lead Local Flood Authority, Worcestershire County Council and LPA to confirm whether a risk of flooding exists at the proposed site;
- vulnerability of the development to flooding over the lifetime of the development, including the future impact that climate change may have on flooding;
- volumes of flood storage displaced as a result the development proposals. Details of compensatory flood storage must be provided within the site on a level basis up to and including the 1% annual probability flood level, then on a volume basis up to and including the 1% annual probability flood level plus climate change;
- demonstration that the residual risk is managed appropriately (e.g. raising floor levels or the provision of an evacuation route);
- preservation of flood flow routes;
- safe access/egress to and from the site during the predicted 1% plus climate change event;
- raised floor levels (i.e. raised 600mm above the 1% annual probability flood level);
- potential for the development to increase flood risk elsewhere through the removal of permeable surfaces such as grass and the addition of hard surfaces and the associated runoff. Details of the proposed mitigation measures and potential SuDS must be provided, in conjunction with hydraulic calculations to demonstrate the robustness of the

methodology adopted. A reduction in surface water flows should be sought for the lifetime of the development and greenfield rates should be achieved on all sites; and

- confirmation whether the EA's consent is necessary for any aspect of the work and whether or not this consent has been applied for. Consent would be required for any works in, over, under or within 8m of top of bank of a 'Main River'. From the 6 April 2012 the role and responsibility for determining permission for works to an 'ordinary watercourse', under the Land Drainage Act (1991), will transfer to the Lead Local Flood Authority.

8.4 Flood Zone 3a – High Probability

8.4.1 In this zone, developers and local authorities should seek opportunities to:

1. reduce the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques;
2. relocate existing development to land in zones with a lower probability of flooding; and
3. create space for flooding to occur by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open space for flood storage.

8.4.2 A FRA is required to support all proposed developments within Flood Zone 3a. The FRA should include an assessment of the following areas:

- details of the existing site levels, proposed site levels and proposed ground floor levels (must be 600mm above the 1% annual exceedance flood level plus an allowance for climate change);
- vulnerability of the development to flooding from other sources (e.g. groundwater, sewer and surface water drainage), as well as river flooding. This would involve discussion with the Environment Agency, STWL, Lead Local Flood Authority, Worcestershire County Council and LPA to confirm whether a risk of flooding exists at the proposed site;
- vulnerability of the development to flooding over the lifetime of the development (including the potential impact of climate change), for example, maximum water levels, flow paths and flood extents. The Environment Agency may have carried out detailed flood risk mapping within some localised areas, which may be made available to the developer at cost. Where this kind of detailed modelling is not available, hydraulic modelling by a qualified engineer will be required in order to determine the risk of flooding to the site;
- effect of the new development on the depth and velocity of floodwater. This will require a detailed modelling assessment by a qualified engineer;
- volumes of flood storage displaced as a result the development proposals. Details of compensatory flood storage must be provided within the site on a level basis up to and including the 1% flood level, then on a volume basis up to and including the 1% flood level plus climate change;
- preservation of flood flow routes;
- safe access/egress to and from the site. Consideration should be given to the requirements for a pedestrian and disabled access route but also vehicular access, in consultation with the Council's Emergency Planners. Ideally a flood free route for both

pedestrians and vehicles should be available to/from the development during a 1% plus climate event. However, in assessing 'safe' pedestrian access for those routes affected by flooding, reference could be made to the DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320). Table 13.1 of this document highlights the danger to people for different combinations of depth and velocity. Developers should also be referred to the Environment Agency's guidance 'What to do before, during and after a flood' and to the local Emergency Services, who will advise on proposals.

- raised floor levels (i.e. raised 600mm above the 1% annual probability plus an allowance for climate change flood level);
- potential for the development to increase flood risk elsewhere through the removal of permeable surfaces such as grass and the addition of hard surfaces and the associated runoff. Details of the proposed mitigation measures and potential SuDS must be provided, in conjunction with hydraulic calculations to demonstrate the robustness of the methodology adopted. A reduction in surface water flows should be sought for the lifetime of the development and greenfield rates should be achieved on all sites;
- for areas that are deemed to already be protected by flood defences or alleviation schemes, the risk of failure or exceedance of design criteria should be outlined. This will require a detailed assessment, carried out by a qualified engineer;
- demonstration that residual risks of flooding (following existing and planned mitigation techniques are carried out) are an acceptable risk. Further measures may include, for example, flood resistant and resilient design, evacuation planning and effective flood warning systems; and
- confirmation whether the EA's consent is necessary for any aspect of the work and whether or not this consent has been applied for. Consent would be required for any works in, over, under or within 8m of top of bank of a 'Main River'. From the 6 April 2012 the role and responsibility for determining permission for works to an 'ordinary watercourse', under the Land Drainage Act (1991), will transfer to the Lead Local Flood Authority.

8.5 Flood Zone 3b – The Functional Floodplain

8.5.1 Inappropriate development should be resisted within Flood Zone 3b. Only the water-compatible uses and the essential infrastructure that has to be there should be permitted in this zone. Essential infrastructure in this zone should pass the Exception Test. It should be designed and constructed to:

- remain operational and safe for users in times of flood;
- result in no net loss of floodplain storage;
- not impede water flows; and
- not increase flood risk elsewhere.

8.5.2 In this zone, developers and local authorities should seek opportunities to:

1. **reduce** the overall level of flood risk in the area through the layout and form of the development and the appropriate application of sustainable drainage techniques; and
2. **relocate** existing development to land with a lower probability of flooding.

8.5.3 All development proposals within Flood Zone 3b require the preparation of a FRA supporting the proposed development. The FRA should provide the following information in relation to the development:

- details of the existing site levels, proposed site levels and proposed ground floor levels (must be 600mm above the 1% annual exceedance flood level plus an allowance for climate change);
- vulnerability of the development to flooding from other sources (e.g. groundwater, sewer and surface water drainage), as well as river flooding. This would involve discussion with the Environment Agency, STWL, Lead Local Flood Authority, Worcestershire County Council and LPA to confirm whether a risk of flooding exists at the proposed site;
- vulnerability of the development to flooding over the lifetime of the development (including the potential impact of climate change), for example, maximum water levels, flow paths and flood extents. The Environment Agency may have carried out detailed flood risk mapping within some localised areas, which may be made available to the developer at cost. Where this kind of detailed modelling is not available, hydraulic modelling by a qualified engineer will be required in order to determine the risk of flooding to the site;
- effect of the new development on the depth and velocity of floodwater. This will require a detailed modelling assessment by a qualified engineer;
- volumes of flood storage displaced as a result the development proposals. Details of compensatory flood storage must be provided within the site on a level basis up to and including the 1% flood level, then on a volume basis up to and including the 1% flood level plus climate change;
- preservation of flood flow routes;
- safe access/egress to and from the site. Consideration should be given to the requirements for a pedestrian access route but also vehicular access, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event. However, in assessing 'safe' pedestrian access for those routes affected by flooding, reference could be made to the DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320). Table 13.1 of this document highlights the danger to people for different combinations of depth and velocity .
- raised floor levels (i.e. raised 600mm above the 1% annual probability plus climate change flood level);
- potential for the development to increase flood risk elsewhere through the removal of permeable surfaces such as grass and the addition of hard surfaces and the associated runoff. Details of the proposed mitigation measures and potential SuDS must be provided, in conjunction with hydraulic calculations to demonstrate the robustness of the methodology adopted. A reduction in surface water flows should be sought for the lifetime of the development and greenfield rates should be achieved on all sites, with preference for a reduction where possible;
- for areas that are deemed to already be protected by flood defences or alleviation schemes, the risk of failure or exceedance of design criteria should be outlined. This will require a detailed assessment, carried out by a qualified engineer;

- demonstration that residual risks of flooding (following existing and planned mitigation techniques are carried out) are an acceptable risk. Further measures may include, for example, flood resistant and resilient design, evacuation planning and effective flood warning systems; and
- confirmation whether the EA's consent is necessary for any aspect of the work and whether or not this consent has been applied for. Consent would be required for any works in, over, under or within 8m of top of bank of a 'Main River'. From the 6 April 2012 the role and responsibility for determining permission for works to an 'ordinary watercourse', under the Land Drainage Act (1991), will transfer to the Lead Local Flood Authority.

8.6 Requirements for FRAs in Areas of Non-Fluvial Flood Risks

- 8.6.1 In addition to addressing the fluvial flood risks within Redditch and Bromsgrove, it is also necessary to address non-fluvial flood risk to developments in areas of known flood threats from surface water, and sewer and groundwater flood risk.

8.7 Surface Water Flooding

- 8.7.1 Surface water flooding is a potential risk at all sites due to the spatial variability, duration and intensity of rainfall. Planning policy for greenfield and brownfield development should seek to reduce surface water runoff rates as a result of development. Moreover, the appropriate SuDS measures should be applied to reduce the overall level of risk in the areas. For extreme events, surface flooding of open spaces such as landscaped areas or car parks may be acceptable for short periods, but the layout and landscaping of a site should aim to route water away from any vulnerable property, and avoid creating hazards to access and egress routes. Surface Water Flooding maps are shown in Appendix 5. Localised assessment for site specific development should be carried out using topographical survey data to supplement existing LiDAR data to provide a more detailed DSM. This assessment will be suitable for indicative flood risk assessment issues at a sub catchment scale and will indicate flood risk mitigation and surface water management measures that should be implemented

8.8 Sewer Flooding

- 8.8.1 Sewer flooding is the responsibility of STWL. Records of sewer flooding were derived through hydraulic modelling data provided by STWL as shown in Table 8-1, which describes the areas at risk from sewer flooding. The potential sewer flood risk should be investigated further as part of a FRA, particularly in terms of where the development will connect to the network, the potential outflow to the network, the current capacity of the sewer network and its ability to cope with the proposed additional flows. Sewers are designed to convey up to the 1 in 40 year flow however, where capacity has been exceeded due to increase impermeable area runoff surcharging and surface flooding may occur. Flooding shown in Table 8-1 is indicative only from outline modelling of the local sewerage system, immediately adjacent to the proposed development sites. A FRA and drainage impact assessment must assess the capacity of the sewer system and the available capacity. STWL will advise on the location of suitable connection and allowable discharge volumes.

Table 8-1 Sewer Flooding Adjacent to Development Sites

Site	Drainage Area	Frequency	40 yr Flood Volume Adjacent to Site
BDC35B	Hagley	5 yr.	19 m ³
BDC51		>40 yr.	0 m ³
BDC188		>40 yr.	0 m ³
BDC189		>40 yr.	0 m ³
BDC49		>40 yr.	0 m ³
2010/11 2010/13 EL63 (IN67)	Spernal	1 yr.	101 m ³
Site2	Spernal	None	None
2010/12	Spernal	1 yr.	240 m ³
2010/09	Spernal	30 yr.	1 m ³
2010/14	Spernal	>40 yr.	0 m ³
BDC80	Bromsgrove	>40 yr.	0 m ³
BDC81		20 yr.	4 m ³
BDC20		2 yr.	74 m ³
2010/10	Spernal	1 yr.	1200 m ³
St8	Spernal	20 yr.	19 m ³
St10	Spernal	1 yr.	475 m ³
Red = potential issue requiring further investigation in FRA			

8.8.2 The sites requiring further investigation are: BDC 35B (Kidderminster and Stourbridge Road), 2010/11 Brockhill ADR, 2010/13 Brockhill ADR, EL63/IN67 (North of Red Ditch, Enfield), 2010/12 (Webheath ADR), BDC81 (Norton Farm, Birmingham Road), BDC 20 (Perryfields Road), 2010/10 A435, St8 (Edward Street) and St10 (Town Centre, Church Street / Northwest quadrant).

8.9 Groundwater Flooding

8.9.1 Groundwater flooding can occur due to fluctuations in groundwater levels as a result of periods of prolonged high rainfall. In this situation groundwater can rise to the surface and flood low lying land and sub-surface structures. Groundwater flooding is rarer than river or coastal flooding, but it can be more disruptive and damaging than surface water flooding, as it takes significantly longer for the water to recede. Drawing 41518000/01/004, 'Areas at Risk of Groundwater Flooding by Type and Coverage' is included in Appendix 5.

8.9.2 A FRA should establish the level of risk at the site by identifying local groundwater monitoring (where available) and assessing local groundwater levels.

9 SuDS Guidance

9.1 Introduction

- 9.1.1 The application of Sustainable Drainage (SuDS) techniques should be encouraged through the adoption of appropriate policy for new development and redevelopment within the Borough and District. Surface water management is a material planning consideration and will need to be considered at the earliest possible stage in the planning and design process, in consultation with the LPA, sewerage undertakers, EA and other relevant bodies. There may be opportunities to alleviate surface water flooding in adjacent and downstream areas, as well as in the development site. It is recommended that developments with a size greater than one hectare (>1ha) be required to comply with the following in order to encourage more sustainable development practices:
- allocate suitable land and incorporate SuDS techniques within the drainage design for the development;
 - ensure that discharge rates from the development do not exceed and, if possible improve upon, greenfield rates (see definition below); and
 - provide on-site attenuation for the 1% annual probability or 1 in 100 chance in any year plus an allowance for climate change.
- 9.1.2 It is recommended that for sites less than 1ha, the same criteria are applied, in accordance with best practice. The greenfield discharge rate is the surface water runoff regime from a site prior to development. To maintain the natural equilibrium of a site, the surface water discharge from a developed site should not exceed the natural greenfield run-off rate. The LPA should actively encourage the use of sustainable drainage to improve upon greenfield runoff rates from development.
- 9.1.3 Typically, the application of SuDS should not be limited to one technique per site. A successful SuDS solution will often involve the use a number of methods, known as a management train approach. SuDS can also be employed on a strategic level, for example with a number of sites contributing to large scale jointly coordinated and managed SuDS.
- 9.1.4 As described in Part H of the Building Regulations, the first to consider is the use of infiltration devices, where this is not possible due to ground conditions the use of SuDS should not be precluded.
- 9.1.5 Where development proposals are on brownfield sites, there are real benefits to be gained by making substantial reductions in the amount of surface water runoff generated through the redevelopment of a site. A minimum of 20% reduction in surface water run-off would be required post-development. In areas where there are known surface water flooding issues downstream, further betterment may be required.
- 9.1.6 In highly urbanised areas, it is likely that in some circumstances the most suitable types of SuDS will be source control methods such as permeable paving, green roofs, swales and filter drains. Measures such as permeable paving can be used, as long as they incorporate high level overflows in their design, to discharge excess flows into a suitable receiving watercourse or drainage system.
- 9.1.7 Appropriate land **must** be set aside in a development to accommodate SuDS. If this is not possible, justification must be provided as to why this is the case. Lack of space is not considered appropriate justification.

9.1.8 The use of SuDS should be considered for all development, unless it can be demonstrated that their use is inappropriate. A range of measures are available, although some will be more suited to some site than others. No two sites will be the same and therefore SuDS selection should be specific to a site. Table 9-1 describes the type of devices which should be considered.

Table 9-1 Surface Water Management Measures

Scale	Control type	Comments
Regional controls	Stormwater wetlands	Wetlands which can be used to attenuate runoff and provide biological treatment of runoff. These can also provide multiple benefits and be used to provide integrated urban infrastructure. These are best suited for larger sites and developed on a regional scale.
	Retention ponds	Usually end of pipe measures or the last component in a management train. These are ponds which attenuate runoff and provide biological treatment of runoff.
Source/site controls	Detention basins	Primarily designed to be dry most of the time, but fill up during rainfall events. They can also be designed to provide biological treatment of runoff by incorporating a sediment forebay and a permanent pool of water. These are best suited on a site scale, such as commercial developments, industrial estates road drainage, medium scale residential developments.
	Swales	Grass filled trapezoidal channels designed to convey runoff and filter pollutants. These devices can be underdrained to minimise ponding on the surface. These are best suited on a site scale, such as commercial developments, road drainage and medium scale residential developments.
Source controls	Permeable paving	Permeable surface/blocks sited on a gravel bed which allows water to infiltrate into the base of the structure. This provides storage of runoff and in some cases infiltration. Permeable paving also provides some degree of water quality benefits. It is best placed for use in car parks, car parking areas on streets, low trafficked areas such as cul-de-sacs and schools.
	Filter drains	Underdrained gravel filled trench which provides some degree of attenuation. Best suited for road drainage, but may require another measure downstream in the management train to provide the level of treatment required for some developments.
	Water butts	These devices should be considered for all new development.
	Green roofs	These should be considered where the building design allows, e.g. commercial and office developments.

9.1.9 Infiltration devices are appropriate for some types of development. However, their application should only be considered after detailed site surveys have been carried out. Soil maps may suggest that infiltration may be appropriate in a specific development, but without trial pits being employed it would be inappropriate to suggest the use of such measures. Other considerations include depth to groundwater, bedrock and proximity to groundwater protection zones.

9.1.10 Developers, particularly when undertaking master plans for developments, will need to allow for sufficient land for SuDS features to be designed in at the outset, as it is much more difficult and costly to incorporate these once detailed design is underway (Refer to CIRIA C687: Planning for SuDS – Making it happen).

- 9.1.11 The formation of steering groups for master-planning of larger sites provides the opportunity for close liaison with relevant parties from an early stage. This approach has been successful on numerous sites in England. In accordance with the requirements of the FWMA, SuDS will need to be approved by a SuDS Approving Body (SAB), and subject to agreement and compliance with appropriate standards, will be adopted by the SAB.
- 9.1.12 Particular care should be taken on potentially contaminated land when selecting measures, reference should be made to the CIRIA C697 SuDS Manual guidance for use of SuDS in specific circumstances.
- 9.1.13 SuDS should be designed in accordance with CIRIA C697 SuDS Manual (and the new national design standards which were being prepared when this report was issued). Water quality and amenity benefits should also be maximised wherever possible, in accordance with Annex F of PPS25 and NPPF.
- 9.1.14 Table 9-2 describes the preferred options for each of the development sites which are being assessed as part of this SFRA.

Table 9-2 Recommended Surface Water Management Measures by Site

	Site	Recommended Surface Water Management Measures
Bromsgrove District Council	BDC 20 Perryfields Road, Bromsgrove	Large greenfield site, therefore a management train approach should be adopted, which includes source, site and regional controls.
	BDC35B Kidderminster & Stourbridge Road Hagley	Large greenfield site, therefore a management train approach should be adopted, which includes source, site and regional controls. There will be more opportunities for coordinated site and regional control if this site is combined with BDC49 (Gallows Brook Pig Farm), BDC51 (Land at Algoa House, Western Road), BDC188 (Rose Cottage, Thicknall Cottage & land rear of Western Road) and BDC 189 (Strathearn, Western Road).
	BDC49 Gallows Brook Pig Farm, Kidderminster Road, Hagley	Relatively small greenfield site, therefore there will be opportunities for the use of source and site control. However, the use of regional control should not be discounted. There will be more opportunities for a management train approach if this site is combined with BDC35B (Kidderminster & Stourbridge Road), BDC51 (Land at Algoa House, Western Road), BDC188 (Rose Cottage, Thicknall Cottage and land rear of Western Road) and BDC 189 (Strathearn, Western Road).
	BDC51 Land at Algoa House, Western Road, Hagley	Relatively small greenfield site, therefore there will be opportunities for the use of source and site control. However, the use of regional control should not be discounted. There will be more opportunities for a management train approach if this site is combined with BDC35B (Kidderminster and Stourbridge Road), BDC49 (Gallows Brook Pig Farm), BDC188 (Rose Cottage, Thicknall Cottage and land rear of Western Road) and BDC 189 (Strathearn, Western Road).
	BDC80 Whitford Road, Bromsgrove	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.
	BDC81 Norton Farm, Birmingham Road, Bromsgrove	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.

	Site	Recommended Surface Water Management Measures
	BDC188 Rose Cottage, Thicknall Cottage and land rear of Western Road, Hagley	Relatively small greenfield site, therefore there will be opportunities for the use of source and site control. However, the use of regional control should not be discounted. There will be more opportunities for a management train approach if this site is combined with BDC35B (Kidderminster & Stourbridge Road), BDC49 (Gallows Brook Pig Farm), BDC51 (Land at Algoa House, western Road) and BDC 189 (Strathearn, Western Road).
	BDC 189 Strathearn, Western Road, Hagley	Relatively small greenfield site, therefore there will be opportunities for the use of source and site control. However, the use of regional control should not be discounted. There will be more opportunities for a management train approach if this site is combined with BDC35B (Kidderminster & Stourbridge Road), BDC49 (Gallows Brook Pig Farm), BDC51 (Land at Algoa House, Western Road) and BDC 188 (Rose Cottage, Thicknall Cottage and land rear of Western Road)
	Site 2 Ravensbank Business Park ⁴	Large brownfield site, therefore a management train approach should be adopted, including the use of source, site and regional controls. However, consideration should be given to the potential for contaminated land and whether the use of infiltration devices is appropriate (lined SuDS may be more appropriate).
Redditch Borough Council	EL63/IN67 North of Red Ditch, Enfield	Large greenfield site, therefore a management train approach should be adopted, including the use of source, site and regional controls.
	2010/09 RO Alexandra Hospital	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.
	2010/10 A435 ADR	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls. Consideration should be given to compartmentalising the site drainage, to discharge surface water via a number of outlets to local watercourses/drainage systems.
	2010/11 Brockhill ADR	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.
	2010/12 Webheath ADR	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.
	2010/13 Brockhill Green Belt	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.
	2010/14 Foxlydiate Green Belt	Large greenfield site, therefore a management train approach should be adopted, which includes source site and regional controls.

⁴ Falls within Bromsgrove District but is allocated to meet the needs of Redditch

	Site	Recommended Surface Water Management Measures
	St 8 Edward Street	Medium sized brownfield site, therefore there will be opportunities for the use of source and site control. However, the use of regional control should not be discounted. However, consideration should be given to the potential for contaminated land and whether the use of infiltration devices is appropriate (lined SuDS may be more appropriate).
	St10 Town Centre, Northwest Quadrant	Large brownfield site is a high density area. Source controls may be the preferred option, but site controls may still be considered. . However, consideration should be given to the potential for contaminated land and whether the use of infiltration devices is appropriate (lined SuDS may be more appropriate).

- 9.1.15 SUDS retrofitting should be encouraged wherever possible, further guidance is available in the CIRIA document CIRIA RP922 Retrofitting Surface Water Management Measures Guidance (in prep).

Table 9-3 Recommended Surface Water Management Measures

Step	Strategic Level	Site Level	Both
Opportunities should be sought to retrofit SuDS in known problem areas to help reduce surface water flood risk. Seek developer contributions to fund this retrofitted SuDS scheme.			✓
In those areas identified as having a surface water flood risk problem seek opportunities to undertake a SWMP.	✓		
SuDS must be included in all new development where technically possible. These must be appropriate to the local soil and geology are utilized, adopted and maintained.			✓
The Environment Agency's SuDS hierarchy shall be used to ensure that the most sustainable SuDS solutions are utilised			✓
A Surface Water Flood Risk Assessment must be undertaken for all developments greater than 1ha in size.			✓
Reduce surface water runoff from all new development and redevelopment to provide no greater than greenfield discharge rates and 1 in 100 year (plus an allowance for climate change) attenuation taking into account climate change shall be achieved on all developments greater than 1ha in size.			✓
Introduce a consistent approach towards paving over front gardens in existing and new developments.			✓

9.1.16 Table 9-3 summarises the level at which surface water management measures can be implemented, i.e. strategic or site level. It indicates which measures are appropriate for regulators to implement and those where developers should give cognisance in designs and layouts.

9.2 Flood Plain Compensation

9.2.1 Development in high risk areas should be avoided and this has been reflected in the site specific comments included in the site factsheets (Appendix 3). If development is absolutely necessary in the floodplain, care should be taken to ensure the floodplain which is created, mimics the natural flooding mechanism. Floodplain compensation must be provided on a level for level, volume for volume basis and must be directly connected to the floodplain that it is meant to serve. Any floodplain compensation assessments must be carried out as part of a detailed Flood Risk Assessment for a particular site. However, it is recommended that no compensation should be necessary for any of the sites discussed as part of this Level 2 SFRA, if development is allocated appropriately.

10 Conclusions

10.1 Strategic Flood Risk Assessment

- 10.1.1 Flood risk has been assessed strategically for the proposed developments within Redditch Borough and Bromsgrove District to consider the impacts on existing flooding and development restrictions. The existing and future flood risk of land within the District and Borough is classified to provide the evidence necessary to direct new developments to lower flood risk areas, where possible. In the context of this document, flood risk refers to the likelihood of a particular event occurring and the impact or consequences that will result if the flood occurs. This Level 2 SFRA assesses flooding in conjunction with wider planning requirements.
- 10.1.2 Sites identified for development have been assessed, based on additional hydraulic modelling of local watercourses and understanding of flood risk issues. Individual sites were selected by the councils for further assessment. These sites were considered in more detail and individual site factsheets prepared indicating the local flood risk issues and potential development restrictions.
- 10.1.3 This Level 2 SFRA will enable Redditch Borough and Bromsgrove District Councils to prepare appropriate policies to manage these risks and assist in making spatial planning decisions. It will enable developers to make informed decisions about sites including site layouts, flood risk management and surface water runoff disposal through the use of SuDS.
- 10.1.4 The SFRA is a living document and should be reviewed and updated periodically and/or when:
- NPPF, PPS25 and/or the accompanying Practice Guidance is revised;
 - significant flooding occurs;
 - the hydraulic modelling of relevant watercourses is updated; and
 - climate change scenarios are updated

10.2 Local Recommendations

Flood Risk Assessments

- 10.2.1 A sequential approach is required to determine the suitability of land for development in areas at risk from flooding. A risk-based approach must be applied at all stages of the planning process. Development should be avoided, where possible, in areas identified as high risk of flooding and directed towards areas at least risk.
- 10.2.2 Opportunities should be sought through all stages of the planning process for improving the river environment. This includes exploring opportunities for restoring watercourses, deculverting and ensuring that an appropriate buffer zone is provided between the watercourse and any development. Certain land uses should be avoided in areas at high risk from flooding. However, in exceptional circumstances mitigation measures may be required to allow development. These must be developed in accordance with other flood risk policies and NPPF and PPS25, and should not impact on flood risk elsewhere. The use of more sustainable measures will be encouraged.

10.2.3 Inappropriate development in the functional floodplain should be avoided, to protect flood flow routes and storage areas. Existing flood storage areas should not be removed, unless it can be demonstrated that appropriate mitigation measures can be provided which can replicate the existing flooding mechanism. SuDS should be implemented to reduce, attenuate and store runoff generated by development. Wherever possible, the construction of new defences to enable development should be avoided. In exceptional circumstances, defences may be allowed where it can be demonstrated that there are no other alternatives, but these must be in line with the requirements of NPPF and PPS25.

10.2.4 Paragraph 12 of PPS25 states: Policies in Local Development Documents should set out the requirements for site specific flood risk assessments to be carried out by developers and submitted with planning applications in areas of flood risk. They have suggested that the following wording may be included in the Councils' relevant policy documents:

'A Flood Risk Assessment (FRA) must be submitted with planning applications for proposals in flood risk zones 2 and 3, appropriate to the scale and nature of the development. This must identify and assess the risk from all forms of flooding to and from the development and demonstrate how the flood risks will be managed over the lifetime of the development'.

10.2.5 A surface water flood risk assessment must be submitted with planning applications for all developments over 1 hectare in size.

10.2.6 Detailed site factsheets, for the 18 sites that were sequentially tested for this Level 2 SFRA, are provided in Appendix 3. The factsheets provide information on the location, extent, depth, velocity and period of inundation of flooding

Flood Storage

10.2.7 Planning policy should safeguard existing areas of open space in the floodplain.

Protecting Existing Flood Flow Routes

10.2.8 Planning policy should safeguard existing flood flow routes.

Functional Floodplain

10.2.9 Planning policy should seek betterment in restoring areas of 'functional' floodplain.

Biodiversity

10.2.10 Where development is proposed adjacent to a watercourse, enhancement of the river corridor, including creation of biodiversity areas and consideration of protected species, should be sought as part of the development. Opportunities should also be sought for flood risk betterment and water quality enhancements to assist in meeting the objectives of the Water Framework Directive.

Sustainable Drainage Systems

10.2.11 Sustainable drainage systems (SuDS) should be incorporated into developments to reduce the impact on receiving drainage systems, by attenuating and storing surface water runoff. Opportunities should also be taken to create multifunctional SuDS that create habitat, encourage biodiversity and/or have amenity value.

Site Assessments

- 10.2.12 A Sequential Test was carried out in accordance with the requirements of PPS25. Sites included for sequential testing were provided solely for the purposes of determining flood risk at these locations and no final decisions have been made on the location, land use and size of these developments (other than those with planning permission).

Building Behind Defences

- 10.2.13 All development must be located at least 5m beyond the base of any flood defences to allow access for inspection, maintenance, repair or replacement. The developer will still need to demonstrate through the provision of a site specific FRA that the proposals will be safe for the lifetime of the development.

Buffer Zones

- 10.2.14 Planning policy should state that a minimum of an 8m buffer strip is provided next to Main Rivers. It is recommended that a similar easement is also provided along ordinary watercourses. New development should provide an adequate buffer strip (public open space and not gardens) adjacent to watercourses, along with a suitable maintenance strategy. This is to reduce the risk of channel blockages occurring and ensuring suitable access to undertake works such as bank protection, as both of these could lead to increased flood risk.

Deculverting

- 10.2.15 There are a number of culverted watercourses, such as the Spadesbourne Brook through Bromsgrove. Opportunities should be sought to improve these watercourses through the opening up of culverted sections.

New Development

- 10.2.16 The guidance and site factsheets described in this Level 2 SFRA should be applied to any new development, including any recommendations on the requirements of site specific flood risk assessments.

11 References

- CIRIA. 2000, *Sustainable urban drainage systems - design manual for England and Wales (Report C522)*.
- CIRIA. 2001, *Sustainable urban drainage systems - best practice manual (Report C523)*.
- CIRIA. 2003, *Sustainable drainage systems. Hydraulic, structural and water quality advice (Report C609)*.
- CIRIA RP922 Retrofitting Surface Water Management Measures Guidance (in prep).
- Communities and Local Government. 2010 *Planning Policy Statement 25: development and Flood Risk*).
- Communities and Local Government. 2007, *Improving the Flood Performance of New Buildings, Flood Resilient Construction*.
- Communities and Local Government. 2009 *Planning Policy Statement 25: `Development and Flood Risk Practice Guide*.
- Defra. 2007, *Future Water*.
- Defra. 2005, *Making Space for Water*.
- Environment Agency. 2007, *Thames Catchment Flood Management Plan*.
- Environment Agency. 2007, *Preparing for a flood. Practical advice on what to do to protect you and your property*.
- Environment Agency. 2007, *Living on the Edge*.
- Environment Agency. *Thames Region Land Drainage Byelaws*.
- Environment Agency. 2006, *Sustainable Drainage Systems – Draft Best Practice Guideline*.
- Flood and Water Management Act 2010
- Institute of Hydrology. 1994, *Report No. 124 Flood Estimation for Small Catchments*.
- Town and Country Planning Act 1990.
- Town and Country Planning - Flooding (England) Direction 2007.
- Water Resources Act 1991 (WRA 1991).
- Bromsgrove and Redditch Borough Councils. 2009. *Strategic Flood Risk Assessment Level 1 Report*.
- Bromsgrove and Redditch Borough Councils. 2009. *Strategic Flood Risk Assessment Level 1 Report – Summary of Changes*.
- Bromsgrove District Council. 2009. *Employment Land Review Final Report*.
- Bromsgrove District Council. 2011. *Strategic Housing Land Availability Assessment*.

Bromsgrove District Council. 2011. *Draft Core Strategy 2*.

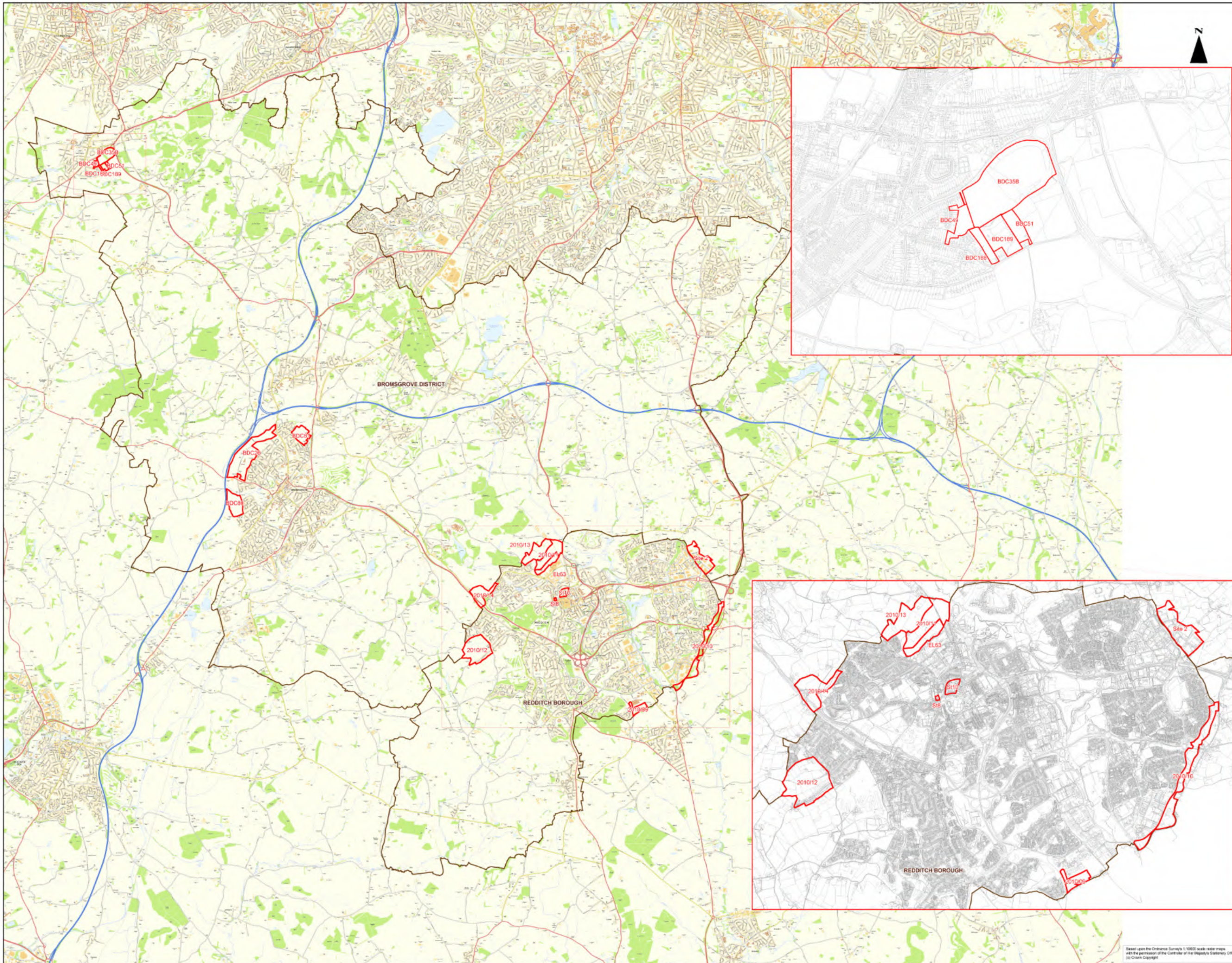
Bromsgrove District. 2006. *Draft Core Strategy Sustainability Appraisal*.

Redditch Borough Council .2011. *Strategic Housing Land Assessment*.

Redditch Borough Council. 2010. *Employment Land Review Update 2010*.

Redditch Borough Council. 2011. *Revised Preferred Draft Core Strategy: Development Plan Document for the Borough of Redditch*.

APPENDIX 1 SITES TO APPLY SEQUENTIAL APPROACH



- Development Sites Investigated For the SFRA
- Council Boundaries



Redditch and Bromsgrove Strategic Flood Risk Assessment

Potential Development Sites Assessed for the Purposes of the Level 2 SFRA

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APPENDIX 2 FLOOD DEFENCE DATA

Photo	Description
1	Batchley Brook looking downstream, Red Ditch is along the tree line to the left
2	Red Ditch after first housing estate, before culvert under main road
3	Red Ditch after first housing estate, before culvert under main road
4	Red Ditch after first housing estate, before culvert under main road
5	Red Ditch after first housing estate, before culvert under main road
6	Entrance of culvert under Salters lane - Red Ditch
7	Red Ditch to the rear of industrial estate immediately after confluence
8	Red Ditch to the rear of industrial estate immediately after confluence
9	Flood defence at Paper Mill, Brooklands Lane, looking downstream, house to left
10	Flood defence at Paper Mill, Brooklands Lane, looking upstream
11	Flood defence at Paper Mill, Brooklands Lane, showing bank erosion
12	Flood defence at Paper Mill, Brooklands Lane, showing bank erosion
13	Flood defence at Paper Mill, Brooklands Lane, showing bank erosion
14	Flood defence at Paper Mill, Brooklands Lane, showing bank erosion
15	Attenuation area at upstream end of 2010/12 catchment, Church Road, Webheath
16	Attenuation area at upstream end of 2010/12 catchment, Church Road, Webheath
17	Attenuation area at upstream end of 2010/12 catchment, Church Road, Webheath
18	Attenuation area control structure , Church Road, Webheath
19	Attenuation area control structure, Church Road, Webheath
20	Sugar Brook upstream of supermarket
21	Raised bank between Sugar Brook and supermarket car park
22	Raised bank between Sugar Brook and supermarket car park
23	Raised bank between Sugar Brook and supermarket car park



Photograph 1 - Batchley Brook looking downstream, Red Ditch is along the tree line to the left



Photograph 2 - Red Ditch after first housing estate, before culvert under main road



Photograph 3 - Red Ditch after first housing estate, before culvert under main road



Photograph 4 - Red Ditch after first housing estate, before culvert under main road

Photograph 6 - Entrance of culvert under Salters lane - Red Ditch



Photograph 5 - Red Ditch after first housing estate, before culvert under main road





Photograph 7 - Red Ditch to the rear of industrial estate immediately after confluence



Photograph 8 - Red Ditch to the rear of industrial estate immediately after confluence



Photograph 9 - Flood defence at Paper Mill, Brooklands Lane, looking downstream, house to left



Photograph 10 - Flood defence at Paper Mill, Brooklands Lane, looking upstream

Photograph 12 - Flood defence at Paper Mill, Brooklands Lane, showing bank erosion



Photograph 11 - Flood defence at Paper Mill, Brooklands Lane, showing bank erosion





Photograph 13 - Flood defence at Paper Mill, Brooklands Lane, showing bank erosion



Photograph 14 - Flood defence at Paper Mill, Brooklands Lane, showing bank erosion



Photograph 15 - Attenuation area at upstream end of 2010/12 catchment, Church Road, Webheath



Photograph 16 - Attenuation area at upstream end of 2010/12 catchment, Church Road, Webheath



Photograph 17 - Attenuation area at upstream end of 2010/12 catchment, Church Road, Webheath



Photograph 18 - Attenuation area control structure, Church Road, Webheath



Photograph 19 - Attenuation area control structure, Church Road, Webheath



Photograph 20 - Sugar Brook upstream of supermarket



Photograph 21 - Raised bank between Sugar Brook and supermarket car park



Photograph 22 - Raised bank between Sugar Brook and supermarket car park

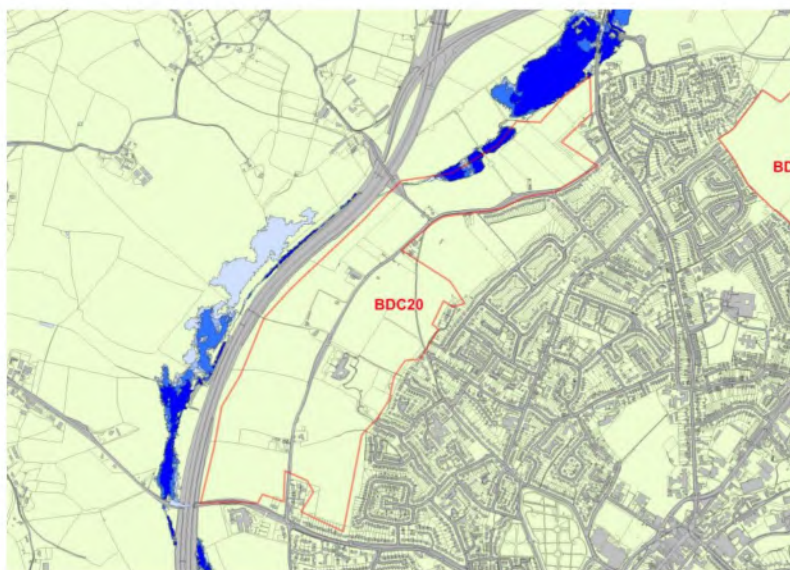


Photograph 23 - Raised bank between Sugar Brook and supermarket car park

APPENDIX 3 SITE FACTSHEETS

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC20 (Perryfields Road, Bromsgrove)



General Site Information:

Development Type:	Residential			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	69.74ha (64.74ha residential and 5ha employment)			
Floodplain:	Battlefield Brook			
Watercourse within site:	Yes			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer	✓	Groundwater	✓
<p>Insufficient capacity in culvert beneath minor road crossing northern end of site causing localised flooding.</p> <p>Groundwater fluctuations due to weather patterns. Prolonged precipitation may increase risk of surface outcropping. The majority of the site is shown as less than 25% coverage per km². The northern section of the site, towards Stourbridge Road, is shown as 50 – 75% coverage per km² and a small proportion of the site (10-15%), adjacent to the existing residential properties on Crabtree Lane, is shown as greater or equal to 75% coverage per km².</p>				
Flood Zones*:	Flood Zone 1 – 98.6%; Flood Zone 2 – 1.4%; Flood Zone 3a – 1.1%; Flood Zone 3b – <1%			
Flood Defence:	No defences affecting the site.			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

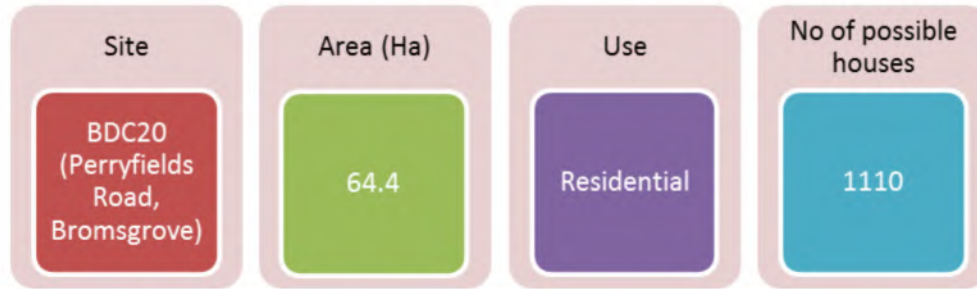
Flood Depth	Not Applicable
Flow Velocity	Not Applicable
Period of Inundation	Not Applicable
Localised flooding	Potential localised surcharging of sewerage system in the vicinity of the site

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests **<1% of this site lies within Flood Zone 3b, 1.1% within Flood Zone 3a and 1.4% within Flood Zone 2.**

A review of the sites identified in the SHLAA indicated that there were no appropriate and suitably sized alternative sites, with sufficient capacity to accommodate the housing needs of the District, that were completely outside Flood Zone 3.

As a small proportion of the site is located within Flood Zone 3, as agreed with the Environment Agency, the Sequential Test should be applied to the site layout to direct residential development to areas at less risk from flooding. The site development proposals should ensure that there is sufficient stand-off from the watercourse and functional floodplain, in accordance with Environment Agency guidance.



Exception Test findings

No increase to flood risk	Opportunities should be sought to reduce existing flood risk .
Safety	1% of the site lies within a high risk area and development in this area should be avoided.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out. Infiltration measures should be carefully designed and their use monitored in the areas where groundwater flooding is predicted to be above 75% coverage per km ² , to avoid overloading of groundwaters (See Appendix F).

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>No other sites are available to accommodate this development; however a sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2. Ideally any built development should be located outside of the 1% plus climate change flood extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Modelling carried out for this SFRA was to determine the flood risk at strategic level; more detailed assessment will be required at the site specific planning application stage.</p> <p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to</p>

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	attenuate and store surface water runoff from the proposed site.
<i>Development Control</i>	<p>All proposed development within the site will require a site-specific FRA and drainage impact assessment.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, a management train approach to SuDS should be implemented which includes source, site and regional controls.</p> <p>Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas. SuDS should be monitored in areas where groundwater flooding coverage exceeds 75% per km².</p> <p>Opportunities for deculverting and river restoration should also be sought. No development should take place within 8m of the watercourse.</p>

Summary

The site lies predominantly within Flood Zone 1, low probability, with some minor sections adjacent to the unnamed watercourse in Flood Zones 2 and 3. It is therefore assessed as appropriate for residential and employment developments in designated areas outside of the 1% plus climate change flood extent. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates to minimise the impact on Battlefield Brook. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk.

It is essential that the development is designed to be safe with finished floor levels set at least 600mm above the predicted 1% plus climate change flood level.

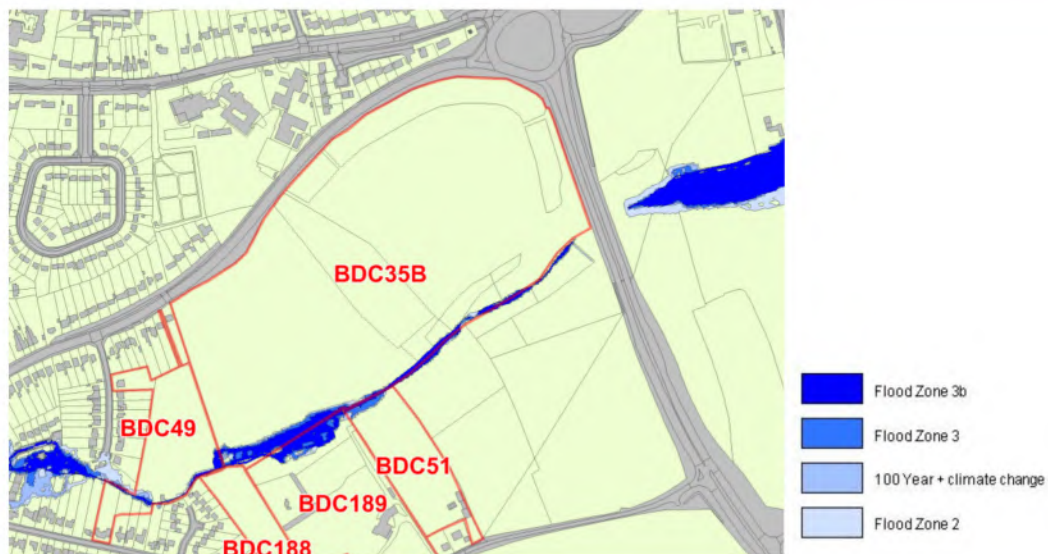
Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

Where groundwater flooding coverage is predicted to exceed 75% per km² the use of SuDS should be monitored to ensure that groundwaters are not overloaded

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC35B (Kidderminster & Stourbridge Road, Hagley)



General Site Information:

Development Type:	Residential (Potential mixed use when combined with BDC49, BDC51, BDC188 and BDC189)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	9.8ha			
Floodplain:	Gallows Brook			
Watercourse within site:	Yes			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer	✓	Groundwater	
<p>Insufficient capacity in the channel and downstream culvert. Culvert is significant restriction to flow.</p> <p>Some minor sewer flooding is possible adjacent to the site due to potential hydraulic overloading of the sewerage system during periods of prolonged rainfall.</p>				
Flood Zones*:	Flood Zone 1 –97.%; Flood Zone 2 – 3%; Flood Zone 3a – 2.6%; Flood Zone 3b – 1.8%			
Flood Defence:	No defences affecting the site.			
Flood Depth	1 in 20 year = 0.16 m 1 in 100 year = 0.48 m 1 in 100 year + CC = 0.68 m			

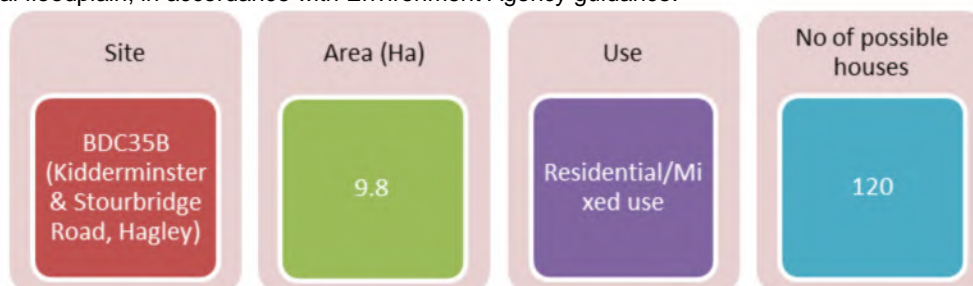
BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	1 in 1000 year = 0.88 m
Flow Velocity	1 in 20 year = 2.97 m/s 1 in 100 year = 3.12 m/s 1 in 100 year + CC = 3.19 m/s 1 in 1000 year = 3.26 m/s
Period of Inundation	10 hours 40 minutes for a 1 in 100 year storm
Localised flooding	No localised flooding reported in the vicinity of the site

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests **1.8% of this site lies within Flood Zone 3b, 2.6% within Flood Zone 3a and 3% within Flood Zone 2.**

As a small proportion of the site is located within Flood Zone 3b, the Sequential Test should be applied to the site layout, to direct residential development to areas at less risk from flooding. The site development proposals should ensure that there is sufficient stand-off from the watercourse and functional floodplain, in accordance with Environment Agency guidance.



A review of the sites identified in the Bromsgrove District Council SHLAA, suggested that there are other similar sites available. However, as this site (combined with BDC49, BDC51, BDC188 and BDC189) can be used for mixed use employment, recreational uses and housing, with only minor intrusion by Flood Zone 3, development could proceed. This would be subject to application of the Sequential Test to the site layout.

Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out

Recommendations:

Exception Test Applicable?	No
Spatial Planning	A sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2 (i.e. 97.3% of the site). Ideally, any built development should be located outside of the predicted 1% plus climate change extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Modelling carried out for the purposes of this SFRA was used to determine flood risk at a strategic level; more detailed assessment is required for site specific planning applications.

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	<p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p>
<i>Development Control</i>	<p>All proposed development within the site will require a site-specific FRA and drainage impact assessment.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, a management train approach to SUDS should be implemented which includes source, site and regional controls (regional control if BDC35B, BDC49, BDC51 and BDC188 and BDC189 are all to be developed). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p> <p>A minimum of an 8m buffer strip should be provided next to Main Rivers and it is recommended that a similar easement is also provided along ordinary watercourses.</p>

Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for built development in designated areas outside of the 1% plus climate change flood extent. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. There will be opportunities for the use of source and site control. However, there will be more opportunities for coordinated site and regional control if this site is combined with BDC49, BDC51, BDC188 and BDC189, such as detention basins, stormwater wetlands and retention ponds.

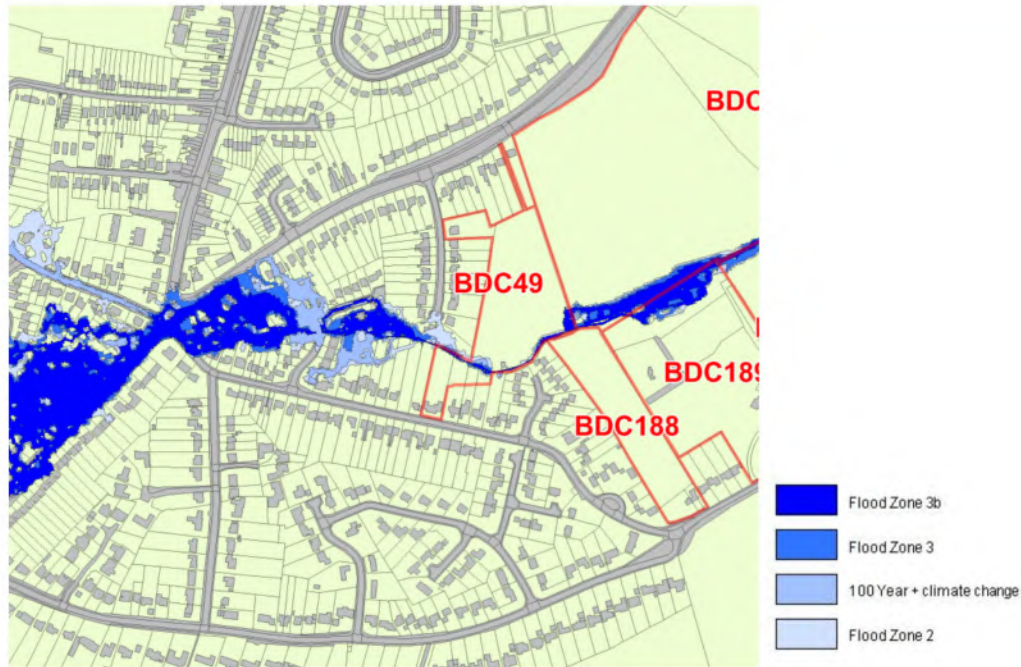
A site specific FRA and drainage impact assessment should be prepared. Ensuring safe development is essential, with finished floor levels being above the predicted 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)
The hydraulic modelling of the watercourse has been undertaken using FEH estimated inflows not recorded data. MWH has carried out no model calibration, or comparison against reported flooding incidents.

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC49 (Gallows Brook Pig Farm, Hagley)



General Site Information:

Development Type:	Residential (Potential mixed use when combined with BDC35B, BDC51, BDC188 and BDC189)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	1.7ha			
Floodplain:	Gallows Brook			
Watercourse within site:	Yes			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	
	Insufficient capacity in the channel and downstream culvert (Brookland Road). The culvert and modified channel are significant restrictions to flow.			
Flood Zones*:	Flood Zone 1 –97.4%; Flood Zone 2 – 2.6%; Flood Zone 3a – 2.1%; Flood Zone 3b – 1.6%			
Flood Defence:	No defences affecting the site.			
Flood Depth	1 in 20 year = 0.36 m 1 in 100 year = 0.59 m			

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	1 in 100 year + CC = 0.67 m 1 in 1000 year = 0.75 m
Flow Velocity	1 in 20 year = 3.7 m/s 1 in 100 year = 3.9 m/s 1 in 100 year + CC = 3.9 m/s 1 in 1000 year = 4 m/s
Period of Inundation	5 hours
Localised flooding	No localised flooding reported in the vicinity of the site

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests **1.6% of this site lies within Flood Zone 3b, 2.1% within Flood Zone 3a and 2.6% within Flood Zone 2.**

A review of the sites identified in the Bromsgrove District Council SHLAA, suggested that there are other similar sites available. However, as this site (combined with BDC35B, BDC51, BDC188 and BDC189) can be used for mixed use employment, recreational uses and housing, with only minor intrusion by Flood Zone 3, development could proceed.

As a small proportion of the site is located in the floodplain, as agreed with the Environment Agency the sequential test should be applied to the site layout, to direct residential development to areas at less risk from flooding. The site development proposals should ensure that there is sufficient stand-off from the watercourse and functional floodplain, in accordance with Environment Agency guidance.



Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out

Recommendations:

Exception Test Applicable?	No
Spatial Planning	A sequential approach should be adopted to the layout within the site itself. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2. Ideally, any proposed built development should be located outside of the predicted 1% plus climate change extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Hydraulic modelling carried out for the purposes of this SFRA was to determine flood risk on a strategic scale. Further detailed assessments will be required for site specific planning applications. Runoff from the site should not exceed existing greenfield rates and

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	<p>should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p>
<i>Development Control</i>	<p>All proposed development within the site will require a site-specific FRA and drainage impact assessment.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p> <p>Opportunities for river restoration should also be sought. No development should take place within 8m of the watercourse.</p>

Summary

The site lies predominantly within Flood Zone 1, low probability, with some minor sections adjacent to the unnamed watercourse in Flood Zones 2 and 3. It is therefore assessed as appropriate for residential or mixed use developments in only designated areas of the site. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates to minimise the impact on Gallows Brook. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. There will be opportunities for the use of source and site control measures. However, there will be more opportunities for coordinated site and regional control if this site is combined with BDC35B, BDC51, BDC188 and BDC189, such as detention basins, stormwater wetlands and retention ponds.

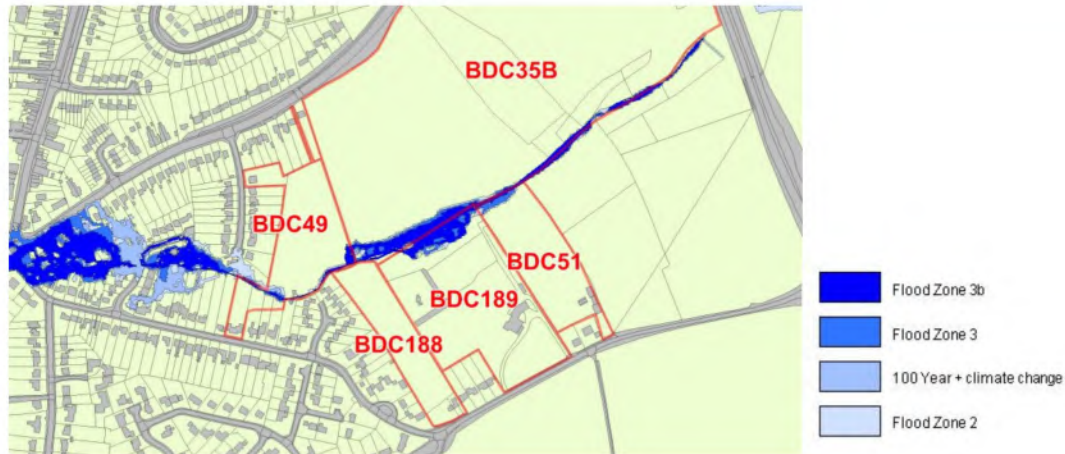
Safe development is essential with finished floor level being set at least 600mm above the predicted 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)
The hydraulic modelling of the watercourse has been undertaken using FEH estimated inflows not recorded data. MWH has carried out no model calibration, or comparison against reported flooding incidents.

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC51 (Land at Algoa House, Western Road, Hagley)




General Site Information:

Development Type:	Residential (Potential mixed use when combined with BDC35B, BDC49, BDC188 and BDC189)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	1.44ha			
Floodplain:	Gallows Brook			
Watercourse within site:	Yes			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	✓
	Insufficient capacity in culvert. Culvert is significant restriction to flow. Possible minor flooding issue on south eastern corner of site due to groundwater rising and outcropping at surface			
Flood Zones*:	Flood Zone 1 –93.6%; Flood Zone 2 – 4.5%; Flood Zone 3a – 3.3%; Flood Zone 3b – 1.1%			
Flood Defence:	None			
Flood Depth	1 in 20 year = 1.05 m 1 in 100 year = 1.23 m 1 in 100 year + CC = 1.28 m 1 in 1000 year = 1.33 m			
Flow Velocity	1 in 20 year = 1.58 m/s 1 in 100 year = 1.8 m/s 1 in 100 year + CC = 1.9 m/s 1 in 1000 year = 2.04 m/s			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

Period of Inundation	2 hours 50 minutes for a 1 in 100year storm
Localised flooding	Localised sewer flooding the vicinity of the site
Sequential Test Findings	
<p>The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests 1.1% of this site lies within Flood Zone 3b, 3.3% within Flood Zone 3a and 4.5% within Flood Zone 2.</p> <p>A review of the sites identified in the Bromsgrove District Council SHLAA, suggested that there are other similar sites available. However, as this site (combined with BDC35B, BDC49, BDC188 and BDC189) can be used for mixed use employment, recreational uses and housing, with only minor intrusion by Flood Zone 3, development could proceed. This would be subject to application of the Sequential Test to the site layout.</p>	
	
Exception Test	
No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out
Recommendations:	
Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>No other sites are available to accommodate this mixed use development; however a sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2). Ideally, any proposed built development should be located outside of the 1% plus climate change extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Modelling to determine the flood extent was carried out on a strategic level, for the purposes of the SFRA. More detailed assessments will be required for site specific planning applications. Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p>
<i>Development Control</i>	<p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of</p>

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	<p>the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p> <p>A minimum of an 8m buffer strip should be provided next to Main Rivers and it is recommended that a similar easement is also provided along ordinary watercourses</p>
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Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential and mixed use developments in designated areas only. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. There will be opportunities for the use of source and site control measures. However, there will be more opportunities for coordinated site and regional control if this site is combined with BDC35B, BDC49, BDC188 and BDC189, such as detention basins, stormwater wetlands and retention ponds.

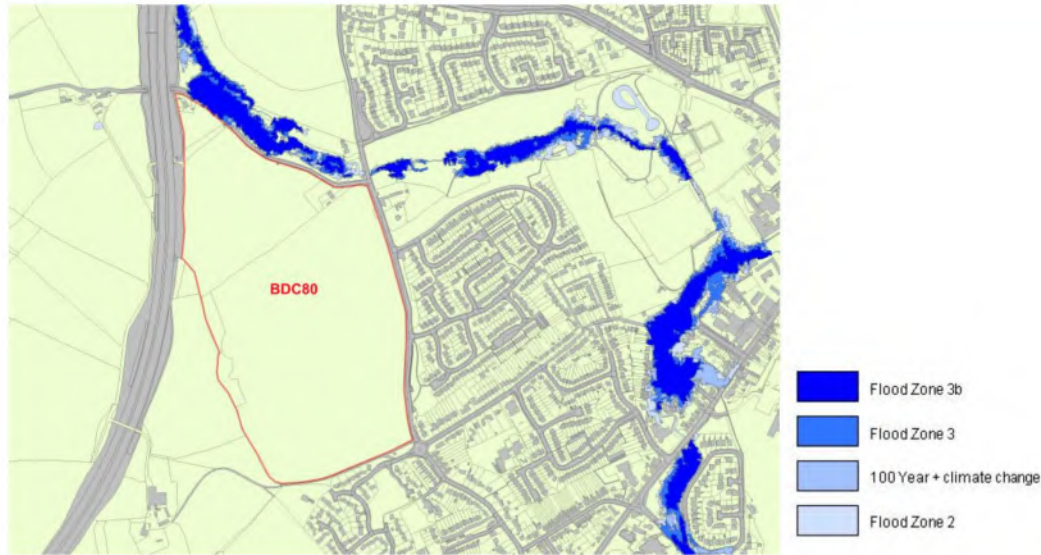
A site specific FRA and drainage impact assessment should be prepared. Finished floor levels should be at least 600mm above the predicted 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)
The hydraulic modelling of the watercourse has been undertaken using FEH estimated inflows not recorded data. MWH has carried out no model calibration, or comparison against reported flooding incidents.

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BDC 80 (Whitford Road)



General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)	More Vulnerable (Residential)	✓
	Highly Vulnerable	Water Compatible	
Planning Permission Granted (as July 2010)	No		
Size:	24ha		
Floodplain:	Battlefield Brook flows to north of site. Flooding shown on Timberhonger Lane		
Watercourse within site:	No		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	✓
	Sewer		Groundwater	
	Fluvial flooding identified to immediate north of site. Groundwater flooding coverage identified as 25 – 50% per km ² from superficial deposits (from raised water level in local watercourse).			
Flood Zones*:	Flood Zone 1 – 99.9%; Flood Zone 2 – <0.1%; Flood Zone 3a – <0.1%; Flood Zone 3b – < 0.1%			
Flood Defence:	No defences affecting the site.			
Flood Depth	Not Applicable			
Flow Velocity	Not Applicable			
Period of Inundation	Not Applicable			
Localised flooding	Localised flooding indicated on Environment Agency Flood Maps on			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	Timberhonger Lane to immediate north of the site.		
Sequential Test Findings			
<p>The site lies almost entirely within Flood Zone 1 which is considered appropriate for all development types as long as an appropriate buffer zone is left between the development and the watercourse.</p>			
<div style="border: 1px solid #ccc; padding: 10px; margin: 5px;"> <p style="text-align: center; font-weight: bold;">Site</p> <div style="background-color: #c00000; color: white; padding: 10px; text-align: center; border-radius: 10px;"> <p style="font-weight: bold; margin: 0;">BDC 80 (Whitford Road)</p> </div> </div>	<div style="border: 1px solid #ccc; padding: 10px; margin: 5px;"> <p style="text-align: center; font-weight: bold;">Area (Ha)</p> <div style="background-color: #008000; color: white; padding: 10px; text-align: center; border-radius: 10px;"> <p style="font-weight: bold; margin: 0;">24</p> </div> </div>	<div style="border: 1px solid #ccc; padding: 10px; margin: 5px;"> <p style="text-align: center; font-weight: bold;">Use</p> <div style="background-color: #660066; color: white; padding: 10px; text-align: center; border-radius: 10px;"> <p style="font-weight: bold; margin: 0;">Residential</p> </div> </div>	<div style="border: 1px solid #ccc; padding: 10px; margin: 5px;"> <p style="text-align: center; font-weight: bold;">No of possible houses</p> <div style="background-color: #008080; color: white; padding: 10px; text-align: center; border-radius: 10px;"> <p style="font-weight: bold; margin: 0;">470</p> </div> </div>
Exception Test findings			
No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.		
Safety	There are no flooding issues identified with this site.		
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out		
Recommendations:			
Exception Test Applicable?	No		
<i>Spatial Planning</i>	<p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site. SuDS should be monitored in areas where groundwater flooding coverage is between 25 - 50% per km².</p> <p>All proposed development within the site will require a site-specific FRA and drainage impact assessment.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p>		
<i>Development Control</i>	<p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, a management train approach to SUDS should be implemented which includes source, site and regional controls. Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p>		
Summary			
<p>The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential development. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on Battlefield Brook/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. A site specific FRA and drainage impact assessment should be prepared.</p>			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC81 (Norton Farm)



	Flood Zone 3b
	Flood Zone 3
	100 Year + climate change
	Flood Zone 2

General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)		More Vulnerable (Residential) ✓
	Highly Vulnerable		Water Compatible
Planning Permission Granted (as July 2010)	No		
Size:	12ha		
Floodplain:	Spadesbourne Brook flows to east of site. Flooding shown on Birmingham Road		
Watercourse within site:	No		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial		Surface water	
	Sewer		Groundwater	✓
	No fluvial or surface water flooding issues. Groundwater flooding coverage is identified at the site as 25-50% per km ² (see Appendix F).			
Flood Zones*:	Flood Zone 1 – 100%; Flood Zone 2 – 0%; Flood Zone 3a – 0%; Flood Zone 3b – 0%			
Flood Defence:	No defences affecting the site.			
Flood Depth	Not Applicable			
Flow Velocity	Not Applicable			
Period of Inundation	Not Applicable			
Localised flooding	Localised flooding identified on Environment Agency Flood Maps along Birmingham Road, Beechcroft Drive, Roman Way and Townsend Avenue.			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

Sequential Test Findings

The site lies entirely within Flood Zone 1, which is considered appropriate for all development types.

Site	Area (Ha)	Use	No of possible houses
BDC81 (Norton Farm)	12	Residential	270

Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	There are no flooding issues identified with this site.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out. The SuDS should be monitored to ensure that groundwaters are not overloaded.

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.
<i>Development Control</i>	All proposed development within the site will require a site-specific FRA and drainage impact assessment. Opportunities should also be sought through the design and layout for reducing the flood risk in the area. The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas. The use of SuDS should be monitored to ensure that groundwaters are not overloaded.

Summary

The site lies entirely within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential development. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on Spadesbourne Brook/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on any existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. A site specific FRA and drainage impact assessment should be prepared.

*(Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC188 (Western Road, Hagley)



General Site Information:

Development Type:	Residential (Potential mixed use when combined with BDC35B, BDC49, BDC51 and BDC189)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	1.2ha			
Floodplain:	Gallows Brook			
Watercourse within site:	Yes			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	
	Insufficient capacity in the channel and downstream culvert. Culvert is restriction to flow			
Flood Zones*:	Flood Zone 1 – 99.9%; Flood Zone 2 – <0.1%; Flood Zone 3a – <0.1%; Flood Zone 3b – <0.1%			
Flood Defence:	None			
Flood Depth	1 in 20 year = 0.16 m 1 in 100 year = 0.28 m 1 in 100 year + CC = 0.36m 1 in 1000 year = 0.43 m			
Flow Velocity	1 in 20 year = 1.76 m/s 1 in 100 year = 1.94 m/s 1 in 100 year + CC = 1.99 m/s			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	1 in 1000 year = 2.04 m/s
Period of Inundation	4 hours 45 minutes for a 1 in 100 year storm
Localised flooding	No localised flooding reported in the vicinity of the site

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests **<0.1% of this site lies within Flood Zone 3b, <0.1% within Flood Zone 3a and <0.1% within Flood Zone 2.**

A review of the sites identified in the Bromsgrove District Council SHLAA, suggested that there are other similar sites available. However, as this site (combined with BDC35B, BDC49, BDC51 and BDC189) can be used for mixed use employment, recreational uses and housing, with only minor intrusion by Flood Zone 3, development could proceed.

As only a small proportion of the site is located within the floodplain, as agreed with the Environment Agency the sequential test should be applied to the site layout to direct residential development to areas at less risk from flooding. The site development proposals should ensure that there is sufficient stand-off from the watercourse and functional floodplain, in accordance with Environment Agency guidance



Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out.

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>A sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2. Ideally, any built development should be located outside of the 1% plus climate change flood extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Further detailed hydraulic modelling will be required.</p> <p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p>
<i>Development Control</i>	<p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak</p>

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

	<p>runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p>
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Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential and mixed use developments in designated areas only. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. There will be more opportunities for coordinated site and regional control if this site is combined with BDC35B, BDC51 and BDC189, such as detention basins, stormwater wetlands and retention ponds.

A site specific FRA and drainage impact assessment should be prepared. Safe development is essential with finished floor levels set at least 600mm above the 1% plus climate change flood level. Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

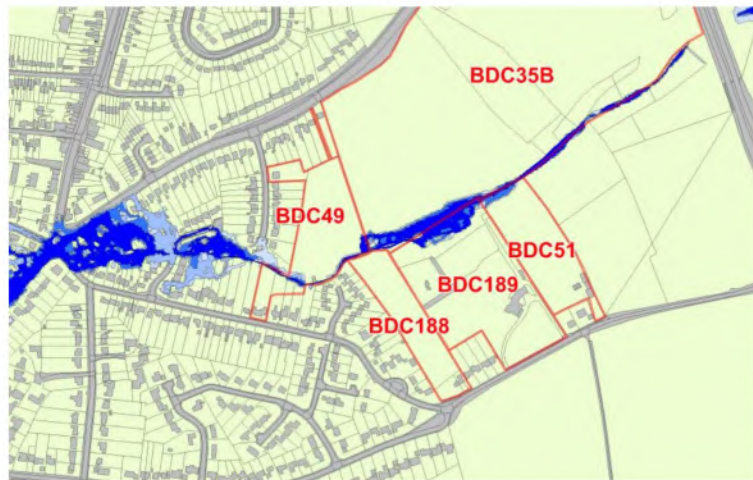
A minimum of an 8m buffer strip should be provided next to Main Rivers and it is recommended that a similar easement is also provided along ordinary watercourses

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

The hydraulic modelling of the watercourse has been undertaken using FEH estimated inflows not recorded data. MWH has carried out no model calibration, or comparison against reported flooding incidents.

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

BDC189 (Strathearn, Western Road, Hagley)



General Site Information:

Development Type:	Residential (Potential mixed use when combined with BDC35B, BDC49, BDC51 and BDC188)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	3.05ha			
Floodplain:	Gallows Brook			
Watercourse within site:	Yes			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	
	Insufficient capacity in the channel and downstream culvert. Culvert is significant restriction to flow.			
Flood Zones*:	Flood Zone 1 – 92.2 %; Flood Zone 2 – 7.8 %; Flood Zone 3a – 6.8 %; Flood Zone 3b – 5.3 %			
Flood Defence:	None			
Flood Depth	1 in 20 year = 0.53 m 1 in 100 year = 0.58 m 1 in 100 year + CC = 0.62 m 1 in 1000 year = 0.65 m			
Flow Velocity	1 in 20 year = 2.97 m/s 1 in 100 year = 3.12 m/s 1 in 100 year + CC = 3.19 m/s 1 in 1000 year = 3.26 m/s			

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

Period of Inundation	4 hours 40 minutes for a 1 in 100 year storm
Localised flooding	No localised flooding reported in the vicinity of the site

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests **5.3% of this site lies within Flood Zone 3b, 6.8% within Flood Zone 3a and 7.8% within Flood Zone 2.**

A review of the sites identified in the Bromsgrove District Council SHLAA, suggested that there are other similar sites available. However, as this site (combined with BDC35B, BDC49, BDC51 and BDC188) can be used for mixed use employment, recreational uses and housing, with only minor intrusion by Flood Zone 3, development could proceed. This would be subject to the Exception Test being passed.

As a small proportion of the site is located within Flood Zone 3, the Sequential Test should be applied to the site layout, to direct residential development to areas at less risk from flooding. The site development proposals should ensure that there is sufficient stand-off from the watercourse and functional floodplain, in accordance with Environment Agency guidance.



Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out.

Recommendations:

Exception Test Applicable?	Yes
<p><i>Spatial Planning</i></p> <p><i>Development Control</i></p>	<p>A sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2. Ideally, any built development should be located outside of the 1% plus climate change extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Detailed modelling will be required to inform the FRA.</p> <p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of</p>

BROMSGROVE DISTRICT COUNCIL DEVELOPMENT SITES

the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.

A minimum of an 8m buffer strip should be provided next to Main Rivers and it is recommended that a similar easement is also provided along ordinary watercourses.

Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential or mixed use developments in designated areas. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. There will be opportunities for the use of source and site control. However, there will be more opportunities for coordinated site and regional control if this site is combined with BDC35B, BDC49, BDC51 and BDC188, such as detention basins, stormwater wetlands and retention ponds.

Safe development is essential with finished floor level being set at least 600mm above the predicted 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development. Reference should also be made to Table 7-1 Findings of the Exception Test SFRA Level 2.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)
The hydraulic modelling of the watercourse has been undertaken using FEH estimated inflows not recorded data. MWH has carried out no model calibration, or comparison against reported flooding incidents.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Site 2 Ravensbank⁺



General Site Information:

Development Type:	Employment		
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)
	Highly Vulnerable		Water Compatible
Planning Permission Granted (as July 2010)	No		
Size:	29.8ha		
Floodplain:	Unnamed tributary of Blacksoils Brook		
Watercourse within site:	Yes		
Brownfield/Greenfield:	Brownfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water
	Sewer		Groundwater
	Insufficient capacity in culverted section beneath Ravensbank Drive. Channel through site has insufficient capacity to contain high flows.		
Flood Zones*:	Flood Zone 1 – 96%; Flood Zone 2 – 4%; Flood Zone 3a – 3%; 1 in 100 year + CC – 3% Flood Zone 3b – 2%		
Flood Defence:	No defences affecting the site.		
Flood Depth	Approximate Maximum Depths (m) Flood Zone 2 – 0.77		

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

	Flood Zone 3a – 0.82; Flood Zone 3b – 0.93 Note – These flood depths are within the river channel, located approximately in the centre of the site.
Flow Velocity	Flood Zone 2 – 2.44 Flood Zone 3a – 1.39 Flood Zone 3b – 0.92 Note – Velocities are within the river channel taken approximately through the centre of the site.
Period of Inundation	11 hours 45 minutes for a 1 in 100yr storm
Localised flooding	Flooding shown through site and downstream

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Detailed hydraulic modelling suggests **2% of this site lies within Flood Zone 3b, 3% within Flood Zone 3a and 4% within Flood Zone 2.**

As the site is partly within Flood Zone 3, as agreed with the Environment Agency the sequential test, should be applied to the site layout to direct development to areas at less risk from flooding. No built development should be permitted within the predicted 1% plus climate change extent.



Exception Test findings

No increase to flood risk	This is a brownfield site and therefore opportunities should be explored for reducing the previous site runoff to greenfield or better.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the runoff rates are restricted to greenfield from the site to reduce existing flood risk. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out.

Recommendations:

Exception Test Applicable?	No
Spatial Planning	<p>No other sites are available to accommodate this development; however a sequential approach should be adopted to the layout within the site. In accordance with PPS25, less vulnerable uses are appropriate within Flood Zones 1, 2 and 3a. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Further detailed hydraulic modelling will be required.</p> <p>Runoff from the site should not exceed and should ideally improve on greenfield rates. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p>

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Development Control

Opportunities should also be sought through the design and layout for reducing the flood risk in the area.

The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.

Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for employment use outside of Flood Zone 3b. The existing site is brownfield however, any runoff from the proposed development should be limited to the greenfield rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site.

A site specific FRA and drainage impact assessment should be prepared. Safe development is essential with finished floor levels set at least 600mm above the 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

* Falls within Bromsgrove District, but allocated to meet the needs of Redditch

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

2010/09 (Rear of Alexandra Hospital)



General Site Information:

Development Type:	Mixed use (employment and residential)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	8.23ha			
Floodplain:	Not Applicable			
Watercourse within site:	No			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial		Surface water	
	Sewer		Groundwater	✓
Groundwater flooding coverage identified as 25 – 50% per km ² from superficial deposits (from raised water level in local watercourse).				
Flood Zones*:	Flood Zone 1 – 100%; Flood Zone 2 – 0%; Flood Zone 3a – 0%; Flood Zone 3b - 0%			
Flood Defence:	No defences affecting the site.			
Flood Depth	Not Applicable			
Flow Velocity	Not Applicable			
Period of Inundation	Not Applicable			
Localised flooding	No localised flooding reported in the vicinity of the site			

Sequential Test Findings

The site lies entirely within Flood Zone 1, which is considered low probability and is therefore deemed suitable for the proposed use.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Site	Area (Ha)	Use	No of possible houses
2010/09 (Rear of Alexandra Hospital)	8.23	Mixed use (employment and residential)	145

Exception Test Findings

No increase to flood risk	This is a greenfield site therefore there should be no increase in runoff following development. The unnamed watercourse which flows next to the site is a tributary of the River Arrow, which is known to flood, measures should be incorporated to attenuate and store runoff through the use of sustainable drainage techniques.
Safety	The site is entirely located in Flood Zone 1. However, an unnamed tributary of the River Arrow flows adjacent to the site so consideration should be given to ensuring properties do not encroach into the floodplain.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse

Recommendations

Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site. SuDS should be monitored in areas where groundwater flooding coverage is between 25 - 50% per km².</p> <p>It should be noted that flood extents shown in this SFRA have been prepared to provide a strategic overview of flooding in the area. All proposed development within the site will require a site-specific FRA and drainage impact assessment. Development of the site should be designed sequentially in order to direct development to areas of the site at lowest flood risk in the first instance and to preserve floodplain storage in the highest risk areas.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p>
<i>Development Control</i>	<p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas. Pollution control measures should also be incorporated to prevent contamination of unnamed watercourse and River Arrow. This may be achieved through the incorporation of SuDS measures required for attenuation.</p>

Summary

The site lies entirely within Flood Zone 1, low probability and is therefore assessed as appropriate for mixed use development. The existing site is greenfield and therefore any runoff from the proposed



REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

development should be limited to the existing rate, as a minimum requirement and preferably a reduction of existing runoff volume and rate to minimise the impact on the local unnamed watercourse and the downstream River Arrow. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. Pollution prevention controls should also be incorporated into the site drainage system to protect receiving watercourses. A site specific FRA and drainage impact assessment should be prepared.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

2010/10 (A435 ADR)




General Site Information:

Development Type:	Mixed use (residential and employment)			
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)	✓
	Highly Vulnerable		Water Compatible	
Planning Permission Granted (as July 2010)	No			
Size:	33ha			
Floodplain:	River Arrow, an unnamed tributary and minor tributaries of Ipsley Brook			
Watercourse within site:	Yes, minor watercourses			
Brownfield/Greenfield:	Greenfield			

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer	✓	Groundwater	
	Limited capacity of A435, Birmingham Road Bridge over River Arrow, causing localised flooding along southern portion of site. Minor localised flooding from ordinary watercourses within site boundary. Localised sewer surcharging is predicted within the immediate vicinity of the site. The risk and likelihood is high.			
Flood Zones*:	Flood Zone 1 – 95.1%; Flood Zone 2 – 4.9%; Flood Zone 3a – 4.8%; Flood Zone 3b – 0%			
Flood Defence:	Informal defences identified on Environment Agency Flood Maps			
Flood Depth	Not Applicable			
Flow Velocity	Not Applicable			
Period of Inundation	Not Applicable			

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Localised flooding	Localised sewer surcharging is predicted within the immediate vicinity of the site. The risk and likelihood is high
Sequential Test Findings	
<p>The site lies partially within Flood Zone 2, medium probability. Detailed hydraulic modelling suggests 4.8% of this site lies within Flood Zone 3a and 4.9% within Flood Zone 2.</p> <p>As the site is partly within Flood Zone 3b, the Sequential Test, should be applied to the site layout to direct development to areas at less risk from flooding. No development should be permitted in Flood Zone 3b.</p>	
	
<p>A review of the sites identified in the SHLAA indicated that there were no appropriate alternatives with sufficient capacity to accommodate the housing needs of the Borough.</p>	
Exception Test findings	
No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out.
Recommendations:	
Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>No other sites are available to accommodate this residential development; however a sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2 (i.e. 95.1% of the site). Ideally, any proposed built development should be located outside of the 1% plus climate change flood extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Further detailed hydraulic modelling will be required.</p>
<i>Development Control</i>	<p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>All proposed development within the site will require a site-specific FRA and drainage impact assessment. Development of the site should be designed sequentially in order to direct development to areas of the site at lowest flood risk in the first instance and to preserve floodplain storage in the highest risk areas.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p>

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

	<p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p>
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Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential and mixed use developments. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site.

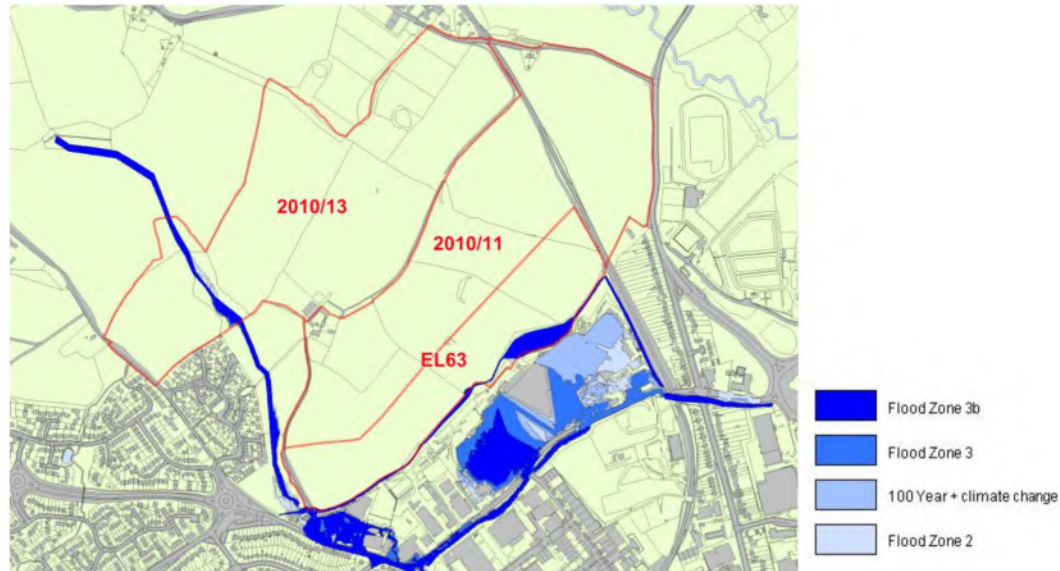
A site specific FRA and drainage impact assessment should be prepared. Safe development is essential with finished floor levels set at least 600mm above the 1% plus climate change flood level and safe access and egress available for the same storm event.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

** (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)*

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

2010/11 (Brockhill ADR)



General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)	More Vulnerable (Residential)	✓
	Highly Vulnerable	Water Compatible	
Planning Permission Granted (as July 2010)	No		
Size:	16.4 ha		
Floodplain:	Red Ditch		
Watercourse within site:	No		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	Surface water	
	Sewer	Groundwater	
	No Flooding occurs within the site boundary.		
Flood Zones*:	Flood Zone 1 – 100%; Flood Zone 2 – 0%; Flood Zone 3a – 0%; Flood Zone 3b - 0%		
Flood Defence:	No defences affecting the site.		
Flood Depth	1 in 20 year = No Flooding 1 in 100 year = No Flooding 1 in 1000 year = No Flooding		
Flow Velocity	No Flooding		
Period of Inundation	1 in 20 year = No Flooding		

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

	1 in 100 year = No Flooding 1 in 1000 year = No Flooding		
Localised flooding	No localised flooding reported in the vicinity of the site		
Sequential Test Findings			
The site is not affected by flooding.			
<div style="border: 1px solid #ccc; border-radius: 10px; padding: 10px; background-color: #f0e6e6; margin-bottom: 5px;"> <p style="text-align: center; margin: 0;">Site</p> <div style="background-color: #c00000; color: white; padding: 10px; border-radius: 10px; text-align: center; margin: 0;"> <p style="margin: 0;">2010/11 (Brockhill ADR)</p> </div> </div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 10px; background-color: #f0e6e6; margin-bottom: 5px;"> <p style="text-align: center; margin: 0;">Area (Ha)</p> <div style="background-color: #6aa84f; color: white; padding: 10px; border-radius: 10px; text-align: center; margin: 0;"> <p style="margin: 0;">16.4</p> </div> </div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 10px; background-color: #f0e6e6; margin-bottom: 5px;"> <p style="text-align: center; margin: 0;">Use</p> <div style="background-color: #663399; color: white; padding: 10px; border-radius: 10px; text-align: center; margin: 0;"> <p style="margin: 0;">Residential</p> </div> </div>	<div style="border: 1px solid #ccc; border-radius: 10px; padding: 10px; background-color: #f0e6e6; margin-bottom: 5px;"> <p style="text-align: center; margin: 0;">No of possible houses</p> <div style="background-color: #0099cc; color: white; padding: 10px; border-radius: 10px; text-align: center; margin: 0;"> <p style="margin: 0;">450</p> </div> </div>
Exception Test findings			
No increase to flood risk	Not applicable.		
Safety	Not applicable.		
Reducing flood risk	Not applicable		
Recommendations:			
Exception Test Applicable?	No		
<i>Spatial Planning</i>	No other sites are available to accommodate this residential development; however it is not predicted to be at risk from fluvial flooding. In accordance with PPS25, more vulnerable land uses proposed within this site are. A drainage impact assessment will need to demonstrate that the development will not increase flood risk elsewhere.		
<i>Development Control</i>	Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.		
Summary			
The site lies entirely within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential development. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates to minimise the impact on Red Ditch. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on any existing flood risk.			

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

2010/12 (Webheath ADR)



General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)		More Vulnerable (Residential) ✓
	Highly Vulnerable		Water Compatible
Planning Permission Granted (as July 2010)	No		
Size:	25.5ha		
Floodplain:	Un-named tributary of Swan's Brook		
Watercourse within site:	Yes		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	
Insufficient localised capacity in the watercourse channel, causing minimal out of bank flows through site (as shown on figure above)				
Flood Zones*:	Flood Zone 1 –97.4%; Flood Zone 2 – 2.6%; Flood Zone 3a – 2.1%; Flood Zone 3b – 1.6%			
Flood Defence:	None			
Flood Depth	1 in 20 year = 0.36 m 1 in 100 year = 0.59 m 1 in 100 year + CC = 0.67 m 1 in 1000 year = 0.75 m			
Flow Velocity	1 in 20 year = 3.7 m/s 1 in 100 year = 3.9 m/s 1 in 100 year + CC = 3.9 m/s 1 in 1000 year = 4 m/s			

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Period of Inundation	Under 8 hours 25 minutes for a 1 in 20yr storm 8 hours 25 minutes for a 1 in 100yr storm 8 hours 25 minutes for a 1 in 100yr + CC storm Over 8 hours 25 minutes for a 1 in 1000yr storm
Localised flooding	No localised flooding reported in the vicinity of the site. Development may result in increased sewer flooding and pollution of the Batchley Brook and River Arrow

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Hydraulic modelling suggests **1.6% of this site lies within Flood Zone 3b, 2.1% within Flood Zone 3a and 2.6% within Flood Zone 2.**

As a small proportion of the site is located within Flood Zone 3b, the Sequential Test should be applied to the site layout, to direct residential development to areas at less risk from flooding. The site development proposals should ensure that there is sufficient stand-off from the watercourse and functional floodplain, in accordance with Environment Agency guidance.



A review of the sites identified in the SHLAA indicated that there were no appropriate alternatives with sufficient capacity to accommodate the housing needs of the Borough.

Exception Test findings

No increase to flood risk	Opportunities should be sought to reduce existing flood risk.
Safety	3.7% of the site lies within a high risk area (Flood Zone 3a and b) and built development in this area should be avoided.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out

Recommendations:

Exception Test Applicable?	No
<p><i>Spatial Planning</i></p> <p><i>Development Control</i></p>	<p>No other sites are available to accommodate this development; however a sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2. Ideally, any built development should be located outside of 1% plus climate change flood extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere.</p> <p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>All proposed development within the site will require a site-specific FRA and drainage impact assessment. All modelling carried out for this SFRA was developed to assess flood risk on a strategic scale and more detailed modelling would be required for site specific</p>

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

applications. Development of the site should be designed sequentially in order to direct development to areas of the site at lowest flood risk in the first instance and to preserve floodplain storage in the highest risk areas.

Opportunities should also be sought through the design and layout for reducing the flood risk in the area.

The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.

Opportunities for deculverting and river restoration should also be sought. No development should take place within 8m of the watercourse.

Summary

The site lies predominantly within Flood Zone 1, low probability, with some minor sections adjacent to the unnamed watercourse in Flood Zones 2 and 3. It is therefore assessed as appropriate for development in designated areas (outside of the 1% plus climate change flood extent). The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates to minimise the impact on the local unnamed watercourse and the downstream Swan's Brook. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk.

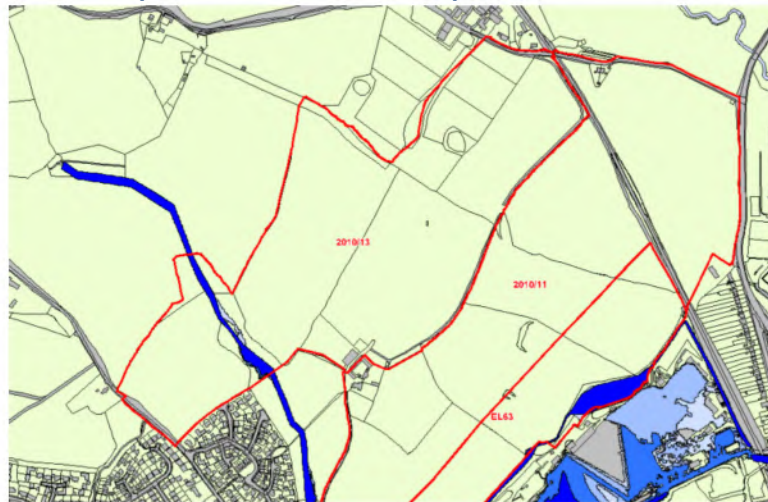
Safe development is essential with appropriate finished floor levels provided, 600mm above the predicted 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)
The hydraulic modelling of the watercourse has been undertaken using FEH estimated inflows not recorded data. MWH has carried out no model calibration, or comparison against reported flooding incidents.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

2010/13 (Brockhill Green Belt)




General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)	More Vulnerable (Residential)	✓
	Highly Vulnerable	Water Compatible	
Planning Permission Granted (as July 2010)	No		
Size:	27.73 ha		
Floodplain:	Red Ditch		
Watercourse within site:	No		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	
	The watercourse runs splits the site into two parts (approximately 25%/75%). The flood extent is limited to a short distance either side of the channel.			
Flood Zones*:	Flood Zone 1 – 98.49%; Flood Zone 2 – 0.31%; Flood Zone 3a – 0.05%; Flood Zone 3b – 1.15%			
Flood Defence:	No defences affecting the site.			
Flood Depth	1 in 20 year = Max Depth 0.25m 1 in 100 year = Max Depth 0.34m 1 in 100 year + CC = Max Depth 0.38m 1 in 1000 year = Max Depth 0.45m			
Flow Velocity	1 in 20 year = Max Velocity 0.32m 1 in 100 year = Max Velocity 0.39m 1 in 100 year + CC = Max Velocity 0.40m			

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

	1 in 1000 year = Max Velocity 0.42m
Period of Inundation	1 in 20 year = 10 hour maximum 1 in 100 year = 10 hour maximum 1 in 100 year + CC = 10 hour maximum 1 in 1000 year = 10 hour maximum
Localised flooding	No localised flooding reported in the vicinity of the site
Sequential Test Findings	
<p>The site lies partially within Flood Zone 3b, which is considered functional floodplain. Detailed hydraulic modelling suggests 1.15% of this site lies within Flood Zone 3b, 0.05% within Flood Zone 3a and 0.31% within Flood Zone 2.</p> <p>As the site is partly within Flood Zone 3b, following the Sequential Test, residential development should ideally be directed to a site which is at less risk from flooding.</p>	
	
<p>However, as the area which is susceptible to flooding is very small, it is considered appropriate to carry out the sequential test within the site itself and avoid built development in areas of high risk.</p>	
Exception Test findings	
No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans. 1.2% of the site lies within a high risk area and development in this area should be avoided
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out
Recommendations:	
Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>No other sites are available to accommodate this residential development; however a sequential approach should be adopted to the layout within the site. In accordance with PPS25, more vulnerable land uses proposed within this site are appropriate within Flood Zone 1 and 2. Ideally, any built development should be located outside of the 1% plus climate change extent. A FRA and drainage impact assessment will need to demonstrate that the development will be safe and will not increase flood risk elsewhere. Detailed modelling will be required to inform the FRA.</p>
<i>Development Control</i>	<p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site. All proposed development within the site will require a site-specific</p>

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

	<p>FRA and drainage impact assessment. All modelling carried out for this SFRA was developed to assess flood risk on a strategic scale and more detailed modelling would be required for site specific applications. Development of the site should be designed sequentially in order to direct development to areas of the site at lowest flood risk in the first instance and to preserve floodplain storage in the highest risk areas.</p> <p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas.</p> <p>No development should take place within 8m of the watercourse.</p>
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Summary

The site lies predominantly within Flood Zone 1, low probability, however a minor part of the site is in Flood Zones 2 and 3 (Red Ditch). It is therefore assessed as appropriate for residential development. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates to minimise the impact on Red Ditch. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk.

Safe development is essential with finished floor levels set at least 600mm above the predicted 1% plus climate change flood level.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

2010/14 (FoxlydiateGreen Belt)



General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)	More Vulnerable (Residential)	✓
	Highly Vulnerable	Water Compatible	
Planning Permission Granted (as July 2010)	No		
Size:	22.16ha		
Floodplain:	No		
Watercourse within site:	No		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	Surface water	
	Sewer	Groundwater	
	Not Applicable		
Flood Zones*:	Flood Zone 1 – 100%; Flood Zone 2 – 0%; Flood Zone 3a – 0%; Flood Zone 3b – 0%		
Flood Defence:	No defences affecting the site.		
Flood Depth	Not Applicable		
Flow Velocity	Not Applicable		
Period of Inundation	Not Applicable		
Localised flooding	No localised flooding reported in the vicinity of the site Development may result in increased sewer flooding/pollution of the Batchley Brook and River arrow for a considerable distance downstream.		

Sequential Test Findings

The site lies entirely within Flood Zone 1, which is considered appropriate for all development types.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Site	Area (Ha)	Use	No of possible houses
2010/14 (FoxlydiatGreen Belt)	22.16	Residential	350

Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	There are no flooding issues identified with this site.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site. All proposed development within the site will require a site-specific FRA and drainage impact assessment. . Opportunities should also be sought through the design and layout for reducing the flood risk in the area.
<i>Development Control</i>	The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas. Pollution control measures should also be incorporated to prevent contamination of Batchley Brook and River Arrow. This may be achieved through the incorporation of SuDS measures required for attenuation

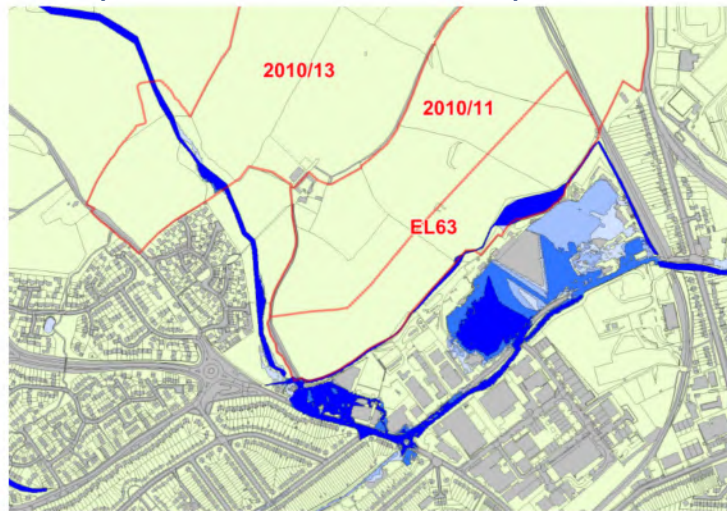
Summary

The site lies entirely within Flood Zone 1, low probability. It is therefore assessed as appropriate for residential development. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. Pollution prevention controls should also be incorporated into the site drainage system to protect receiving watercourses. A site specific FRA and drainage impact assessment should be prepared.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

EL63 (North of Red Ditch, Enfield)



General Site Information:

Development Type:	Residential		
Vulnerability Classification:	Less Vulnerable (Industrial)	More Vulnerable (Residential)	✓
	Highly Vulnerable	Water Compatible	
Planning Permission Granted (as July 2010)	No		
Size:	10.97 Ha		
Floodplain:	Red Ditch		
Watercourse within site:	Yes		
Brownfield/Greenfield:	Greenfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial	✓	Surface water	
	Sewer		Groundwater	
	The watercourse runs along the western and southern edge of the site. As the flow comes out of bank, the water spills away to the south (away from the site)			
Flood Zones*:	Flood Zone 1 – 94.64%; Flood Zone 2 – 0.04%; Flood Zone 3a – 0.01%; Flood Zone 3b – 5.31%			
Flood Defence:	No defences affecting the site.			
Flood Depth	1 in 20 year = 0.45m 1 in 100 year = 0.53m 1 in 100 year + CC = 0.58m 1 in 1000 year = 0.64m			
Flow Velocity	1 in 20 year = 0.32m 1 in 100 year = 0.39m 1 in 100 year + CC = 0.39m 1 in 1000 year = 0.42m			

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Period of Inundation	Up to 10 hours for a 1 in 20 year storm 10 hours for a 1 in 100 year storm 10 hours for a 1 in 100 + CC year storm 10 hours for a 1 in 1000 year storm
Localised flooding	No localised flooding reported in the vicinity of the site

Sequential Test Findings

The site lies partially within Flood Zone 3b, which is considered functional floodplain. Detailed hydraulic modelling suggests **5.31% of this site lies within Flood Zone 3b, 0.01% within Flood Zone 3a and 0.04% within Flood Zone 2.**

As the site is partly within Flood Zone 3b, following the Sequential Test, residential development should be directed to a site which is at less risk from flooding.



No alternative sites have been identified, therefore as agreed with the Environment Agency a sequential test should be applied within the site itself, directing development to areas at lowest risk.

Exception Test findings

No increase to flood risk	This is a greenfield site and therefore opportunities should be explored for reducing the existing downstream flood risk through appropriate design and layout of any development.
Safety	Although the majority of the site is located in Flood Zone 1, consideration should be given to the preparation of flood management and evacuation plans.
Reducing flood risk	It is essential that the existing, greenfield runoff rates from the site are maintained. This could be adequately achieved through the use of SuDS and enhancements to the watercourse, such as creating flood attenuation and storage. A site specific flood risk assessment and drainage impact assessment should be carried out

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>All proposed development within the site will require a site-specific FRA and drainage impact assessment (including hydraulic modelling). Development of the site should be designed sequentially in order to direct development to areas of the site at lowest flood risk in the first instance and to preserve floodplain storage in the highest risk areas.</p>
<i>Development Control</i>	<p>Opportunities should also be sought through the design and layout for reducing the flood risk in the area.</p> <p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or ideally betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented (examples of measures</p>

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

that may be appropriate for this site include rainwater harvesting, bioretention, swales, rain gardens and permeable pavements). Appropriate landscaping should also be utilised to improve drainage efficiency within the site and to direct flow paths away from development to flood storage areas. Pollution control measures should also be incorporated to prevent contamination of Red Ditch. This may be achieved through the incorporation of SuDS measures required for attenuation

Summary

The site lies predominantly within Flood Zone 1, low probability. It is therefore assessed as appropriate for built development in areas outside of the predicted 1% plus climate change flood extent. The existing site is greenfield and therefore any runoff from the proposed development should be limited to the existing rate, as a minimum requirement and preferably betterment of existing runoff volumes and rates, in order to minimise the impact on receiving watercourses/public sewerage system. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. SuDS should be incorporated into the proposed development to attenuate and store runoff from the site. Pollution prevention controls should also be incorporated into the site drainage system to protect receiving watercourses. A site specific FRA and drainage impact assessment should be prepared.

Consideration should be given to the requirements for a safe access/egress, in consultation with the Council's Emergency Planners. Ideally a flood free route for both pedestrians and vehicles should be available to/from the development during a 1% plus climate event (See DEFRA/Environment Agency document 'Flood Risk Assessment Guidance for New Development' (FD2320)). An emergency evacuation plan should be prepared as part of the FRA/drainage impact assessment for the proposed development. Finished floor levels should be at least 600mm above the 1% plus climate change flood level.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

St8 (Edward Street)



General Site Information:

Development Type:	Employment		
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)
	Highly Vulnerable		Water Compatible
Planning Permission Granted (as July 2010)	No		
Size:	0.48ha (this site forms part of the wider Town Centre Strategic Site)		
Floodplain:	No watercourse		
Watercourse within site:	No		
Brownfield/Greenfield:	Brownfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial		Surface water
	Sewer		Groundwater
	No flooding issues.		
Flood Zones*:	Flood Zone 1 – 100%; Flood Zone 2 – 0%; Flood Zone 3a – 0%; Flood Zone 3b – 0%		
Flood Defence:	No defences affecting the site.		
Flood Depth	Not applicable		
Flow Velocity	Not applicable		
Period of Inundation	Not applicable		
Localised flooding	No localised flooding reported in the vicinity of the site		

Sequential Test Findings

The site lies entirely within Flood Zone 1, which is considered appropriate for all development types.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Site	Area (Ha)	Use	No of possible houses
St8 (Edward Street)	0.48	Employment	N/A

Exception Test findings

No increase to flood risk	This is a strategic redevelopment site and therefore opportunities should be explored for reducing the flood risk through appropriate design and layout of any development.
Safety	There are no flooding issues identified with this site.
Reducing flood risk	The site is currently highly urbanised (i.e. 100% impervious surfaces). Therefore, the development of the site would not increase the runoff or the rate of runoff to downstream areas. However, PPS25 requires improvement to the existing situation and it will be necessary to ensure that greenfield discharge rates are achieved.

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>This is a strategic site identified for employment and as this is appropriate use in Flood Zone 1 no alternative sites have been identified. Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>All proposed development within the site will require a site-specific FRA/drainage impact assessment.</p>
<i>Development Control</i>	<p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented. Examples of measures that may be appropriate for this site include green roofs and permeable pavements. Pollution control measures should also be incorporated to prevent contamination of Batchley Brook and River Arrow. This may be achieved through the incorporation of SuDS measures required for attenuation</p>

Summary

This strategic redevelopment site lies entirely within Flood Zone 1, low probability and is therefore assessed as appropriate for employment uses. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. The existing site is brownfield and therefore any runoff from the proposed development should be limited to the greenfield rate, as a minimum requirement, and preferably a reduction of existing runoff volume and rate to minimise the impact on the drainage system. Pollution prevention controls should also be incorporated into the site drainage system to protect receiving watercourses.

* (Note: the percentage of the site allocated to each Flood Zone has been calculated from mapping produced by hydraulic modelling of the watercourse. The percentages for Flood Zones 2, 3a and 3b are calculated by subtracting the area from the overall site area. Flood Zone 1 is the site area less Flood Zone 2)

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

St10 (Church Road/North West Quadrant)



	Flood Zone 3b
	Flood Zone 3
	100 Year + climate change
	Flood Zone 2

General Site Information:

Development Type:	Employment		
Vulnerability Classification:	Less Vulnerable (Industrial)	✓	More Vulnerable (Residential)
	Highly Vulnerable		Water Compatible
Planning Permission Granted (as July 2010)	No		
Size:	5.35ha (this site forms part of the wider Town Centre Strategic Site)		
Floodplain:	No watercourse		
Watercourse within site:	No		
Brownfield/Greenfield:	Brownfield		

Potential Flood Risk:

Flooding Mechanism:	Fluvial		Surface water	
	Sewer		Groundwater	
	No flooding issues.			
Flood Zones:	Flood Zone 1 – 100%; Flood Zone 2 – 0%; Flood Zone 3a – 0%; Flood Zone 3b – 0%			
Flood Defence:	No defences affecting the site.			
Flood Depth	Not Applicable			
Flow Velocity	Not applicable			
Period of Inundation	Not applicable			
Localised flooding	Minor localised sewer surcharging in the vicinity of the site. High probability of occurrence.			

Sequential Test Findings

The site lies entirely within Flood Zone 1, which is considered appropriate for all types of development.

REDDITCH BOROUGH COUNCIL DEVELOPMENT SITES

Site	Area (Ha)	Use	No of possible houses
St10 (Church Road/North West Quadrant)	5.35	Employment/ Retail	N/A

Exception Test findings

No increase to flood risk	This is a strategic redevelopment site and therefore opportunities should be explored for reducing the flood risk through appropriate design and layout of any development.
Safety	There are no flooding issues identified with this site.
Reducing flood risk	The site is currently highly urbanised (i.e. 100% impervious surfaces). Therefore, the development of the site would not increase the runoff or the rate of runoff to downstream areas. However, PPS25 requires improvement to the existing situation and it will be necessary to ensure that greenfield discharge rates are achieved.

Recommendations:

Exception Test Applicable?	No
<i>Spatial Planning</i>	<p>This is a strategic site identified for employment and as this is appropriate use in Flood Zone 1 no alternative sites have been identified. Runoff from the site should not exceed existing greenfield rates and should ideally improve on current volume and rates of runoff. Sustainable drainage systems (SuDS) should be promoted to attenuate and store surface water runoff from the proposed site.</p> <p>All proposed development within the site will require a site-specific FRA/drainage impact assessment.</p>
<i>Development Control</i>	<p>The local planning authority should promote the attenuation of peak runoff from the development area, in order to achieve greenfield runoff rates, or betterment, and ensure that the capacity of the drainage system downstream of the site is not compromised. To achieve this, SuDS should be implemented. Examples of measures that may be appropriate for this site include green roofs and permeable pavements. Pollution control measures should also be incorporated to prevent contamination of Batchley Brook and River Arrow. This may be achieved through the incorporation of SuDS measures required for attenuation.</p>

Summary

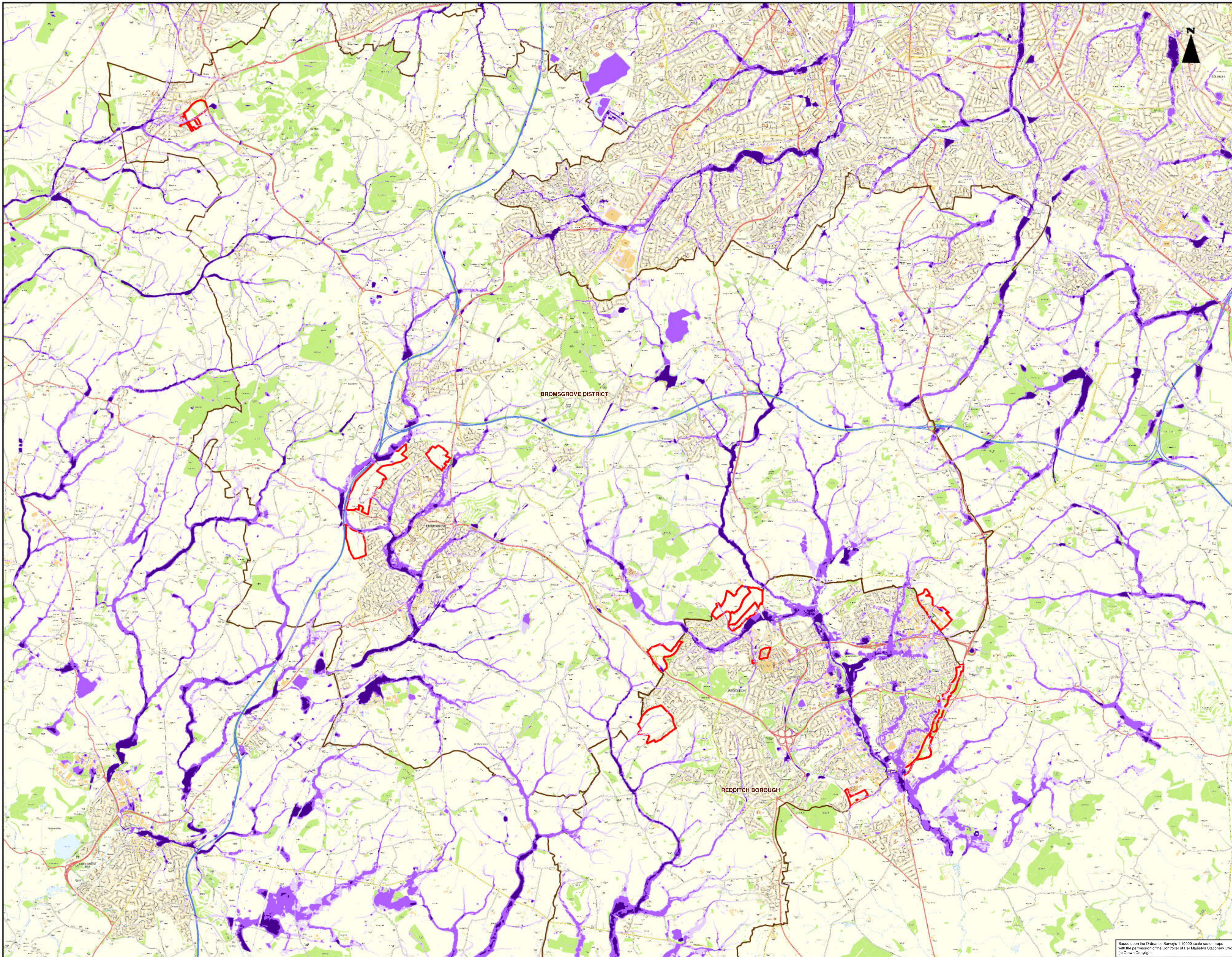
This strategic redevelopment site lies entirely within Flood Zone 1, low probability and is therefore assessed as appropriate for employment uses. A precautionary approach should be adopted to flood risk to ensure that development does not adversely impact on existing flood risk. The existing site is brownfield and therefore any runoff from the proposed development should be limited to the greenfield rate, as a minimum requirement, and preferably a reduction of existing runoff volume and rate to minimise the impact on the drainage system. Pollution prevention controls should also be incorporated into the site drainage system to protect receiving watercourses.






BUILDING A BETTER WORLD

APPENDIX 4

AREAS SUSCEPTIBLE TO SURFACE WATER FLOODING



 Development Sites Investigated For the SFRA
 Council Boundaries

Areas Susceptible to Surface Water Flooding
 Low
 Medium
 High

No Window



Redditch and Bromsgrove Strategic Flood Risk Assessment

Areas Susceptible to Surface Water Flooding

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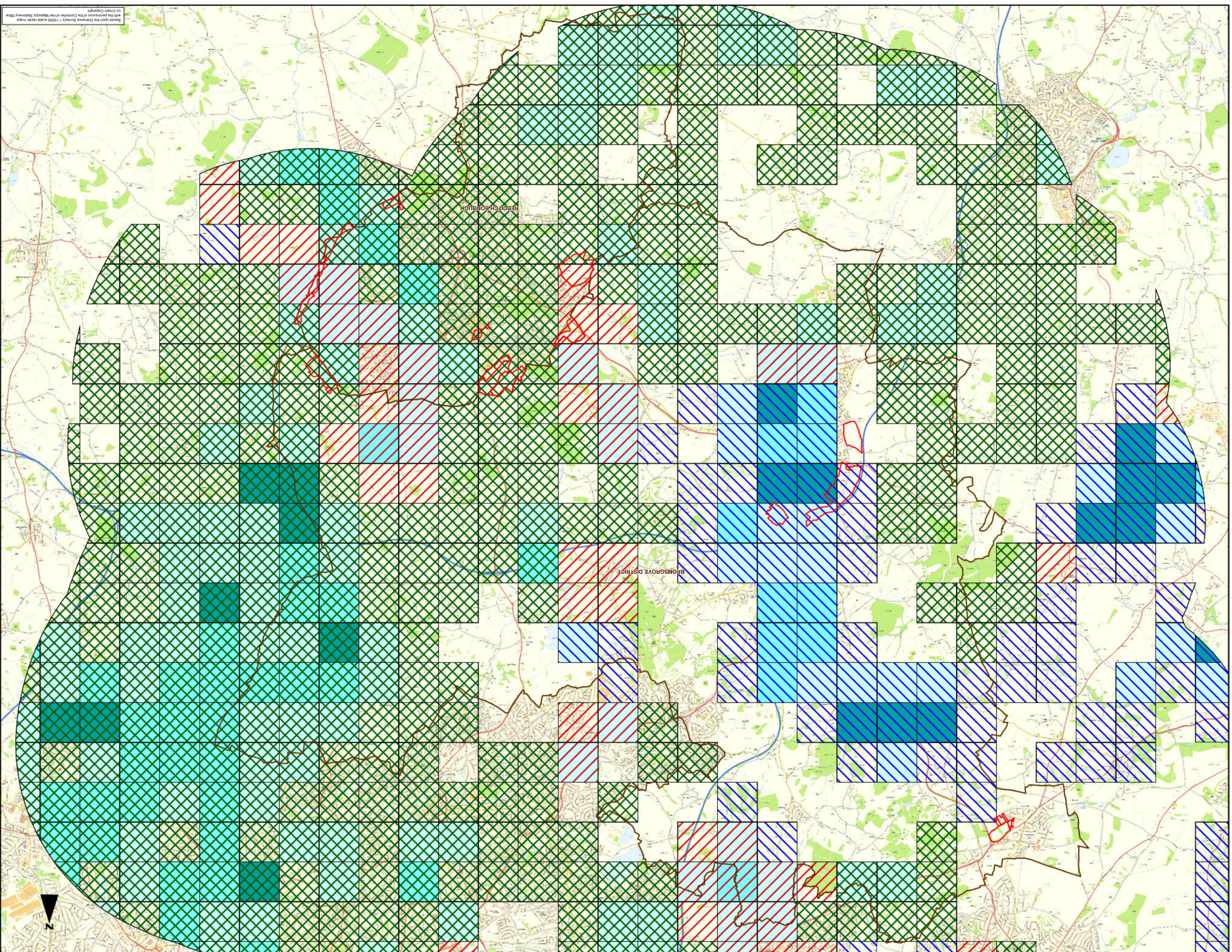


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APPENDIX 5

**GROUNDWATER FLOODING AND AREAS AT RISK FROM SURFACE
WATER FLOODING**



Development Sites for the SFRA

Council Boundaries

Ground Water Flooding by Flood Type

Clearwater Flooding*

Clearwater and Superficial Deposits Flooding

Superficial Deposits Flooding**

Ground Water Flooding Coverage
Coverage per km square

- $\ge 75\%$
- $50\% < 75\%$
- $25\% < 50\%$
- $\le 25\%$

**Superficial deposits flooding occurs when water moves through the permeable deposits from the river and floods the low-lying land either side of the river

No Window

Redditch and Bromsgrove Strategic Flood Risk Assessment

Areas at Risk of Groundwater Flooding By Type and Coverage

Bromsgrove District Council

MWH

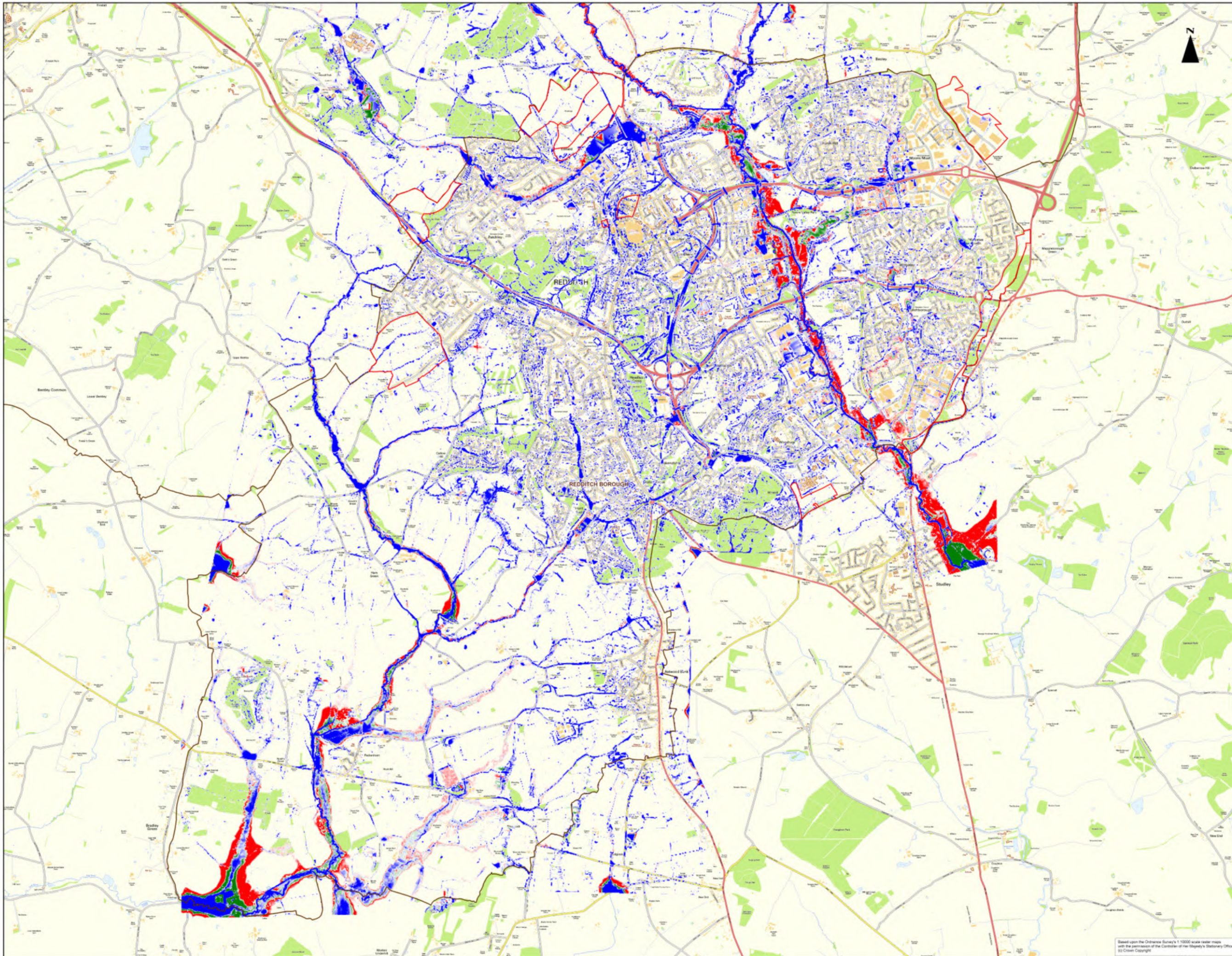
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- Development Sites Investigated for the SFRA
- Council Boundaries
- Areas at risk during the 1:20 year event
- Areas at risk during the 1:100 year event
- Areas at risk during the 1:1000 year event



Redditch and Bromsgrove Strategic Flood Risk Assessment

Results of Modelling to Determine Areas at Risk from Surface Water Flooding

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