CAPITA SYMONDS

GLOUCESTER CITY COUNCIL

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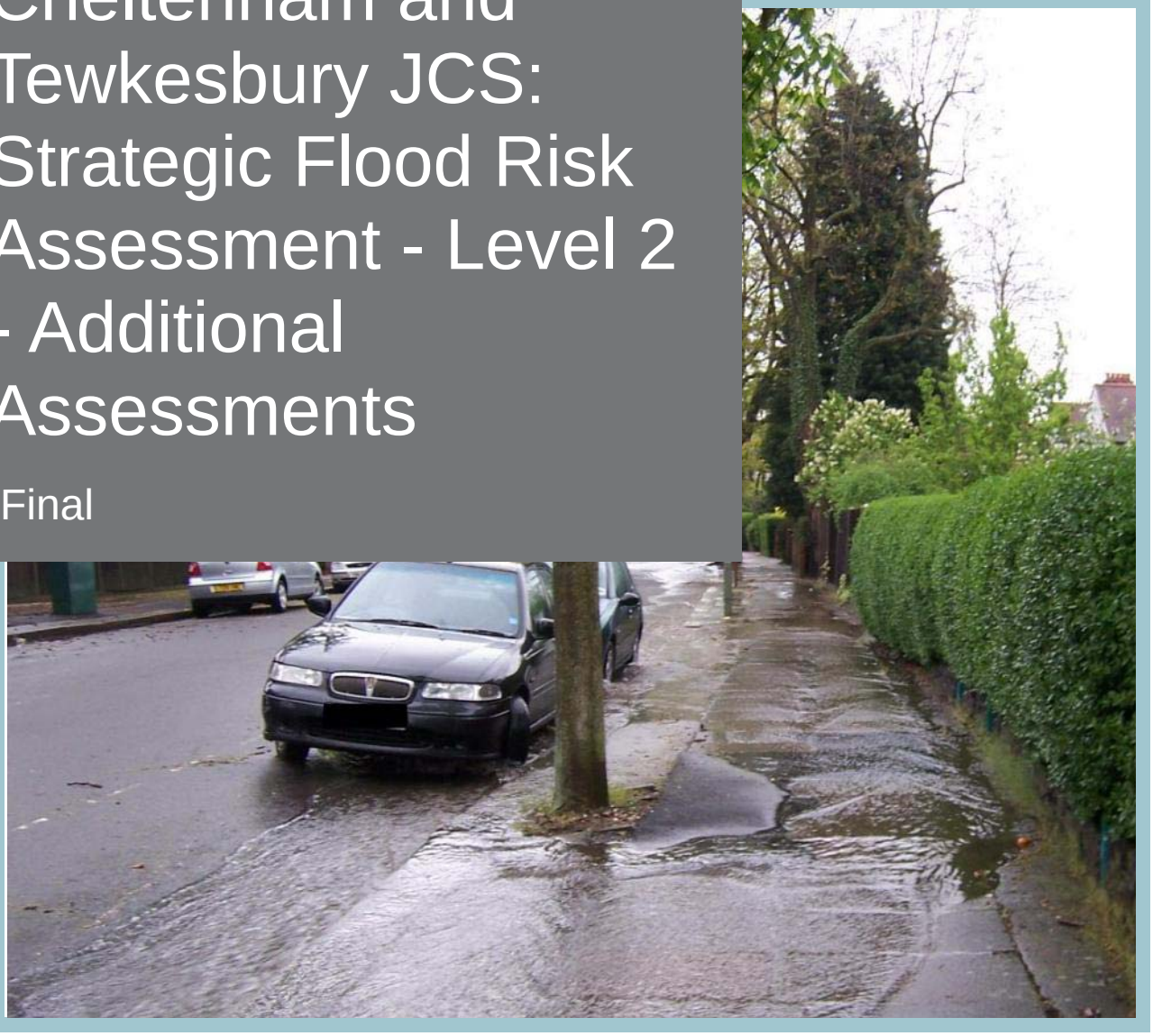
Flood Risk & Water Management

Gloucester, Cheltenham and Tewkesbury JCS: Strategic Flood Risk Assessment - Level 2 - Additional Assessments

Final



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RELATED DOCUMENTS

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Gloucester, Cheltenham & Tewkesbury Joint Core Strategy – Strategic Flood Risk Assessment – Level 2	Halcrow Group Ltd	October 2011	Issue 3
Cheltenham Borough Council - Strategic Flood Risk Assessment – Level 1	Halcrow Group Ltd	September 2008	Issue 2A
Gloucester City Council - Strategic Flood Risk Assessment – Level 1	Halcrow Group Ltd	September 2008	Issue 2A
Tewkesbury Borough Council - Strategic Flood Risk Assessment – Level 1	Halcrow Group Ltd	September 2008	Issue 2A
Gloucestershire County Council - Strategic Flood Risk Assessment – Level 1	Halcrow Group Ltd	September 2008	Issue 2
Gloucestershire County Council – Preliminary Flood Risk Assessment	Gloucester County Council	June 2011	Rev 3
Gloucestershire First Edition Surface Water Management Plan Pilot	Gloucester County Council	February 2010	Issue 2

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1. Introduction

1.1 Project Overview

Following receipt of the Regional Spatial Strategy Panel Report in December 2007 discussion was entered into between the local authorities of Gloucester, Cheltenham and Tewkesbury; and Government Office for the South West to consider the benefits of preparing a Joint Core Strategy for the three local authority areas.

These discussions led to an agreement 'in principle' to work towards producing a Joint Core Strategy in March 2008 by the three Councils. This agreement was finalised in July 2008 and a provisional timetable for the Joint Core Strategy was developed following a resolution from each Council to formally enter into joint working arrangements.

Since this agreement was made the Joint Core Strategy (JCS) team has brought together the Local Development Framework Evidence Bases of each individual authority to produce a comprehensive joint evidence base. This has since been supplemented by a number of joint studies commissioned by the Joint Core Strategy team.

In the context of flood risk management, the JCS team has delivered a Level 2 Strategic Flood Risk Assessment (2011). However, following the Coalition coming to power in May 2010, a number of steps were made to revoke Regional Strategies. The Localism Act which came into force in November 2011 effectively removed Regional Strategies from being, save for strategic environmental assessment of the revocation of the strategies and the subsequent Statutory Instruments being laid before Parliament and individually revoked. At the time of publication, the Regional Strategy for the South West has yet to be formally revoked.

Following the Localism Act coming into being, local authorities are now afforded the responsibility to produce their own housing and employment targets and decide on their own sites to accommodate development. Consequently, a number of other sites have now been considered by the JCS authorities to meet future needs. These sites have not been assessed as part of the original SFRA Level 2 work. Therefore, the JCS authorities now require an assessment of additional sites in order to be able to determine if these are suitable for allocation. The purpose of this Level 2 SFRA is to assess these additional sites for development potential and recommend suitable development control policies.

1.2 Objectives

The primary objectives of this Level 2 SFRA for additional sites in the JCS study area are to:

- Improve the Flood Zone maps for watercourses/canals which are currently coarsely modelled or not included in the Environment Agency Flood Map due to their small catchment size;
- Improve the resolution of Flood Zones which may impinge proposed development sites, so that better informed Sequential Testing decisions can be made;
- Produce flood hazard maps to understand the varying flood hazard that can occur within the flood zone, allowing application of the Exception Test where required;
- Understand the influence of flood defences and modelling the residual risk posed by those defences;
- Understand the residual risk posed by potential culvert blockages;
- Assess the suitability of the sites in light of the above data;
- Put forward suitable and site-specific flood risk management and development control policies in light of the above data.

The SFRA will deliver these objectives by utilising existing EA hydraulic models, building new hydraulic models where relevant and using them in combination with other sources of flood information to assess the nominated sites and develop flood risk mitigation policies to control future development.

There are also several secondary objectives of this SFRA:

- To assess the cumulative impacts of the proposed developments;
- To provide advice on the role of the new National Planning Policy Framework (NPPF); and
- To provide advice on the sequential approach in regard application to brownfield regeneration sites.

The cumulative impact assessment will be delivered by this SFRA by undertaking a strategic review of the proposed development sites, assessing their cumulative impacts and incorporating relevant mitigation measures into the site specific assessments.

1.3 Previous Strategic Flood Risk Assessments

The table below summarises the SFRAs previously completed within the JCS study area. These SFRA documents contain valuable and relevant information on flood risk. This SFRA does not reproduce all of the information in these historic documents, but provides cross references to relevant sections of each document where relevant to avoid repetition and possible conflict.

Table 1: Previous Strategic Flood Risk Assessments

Study	Date Completed	Link to Document
Cheltenham Borough Council SFRA – Level 1	September 2008	www.cheltenham.gov.uk/info/1004/planning_policy/378/local_development_framework-evidence_base/14
Gloucester City Council SFRA – Level 1	September 2008	www.gloucester.gov.uk/LGNL/Housing/Planning/Localdevelopmentframework/LDFEvidenceBase/StrategicFloodRiskAssessmentLevel1.aspx
Tewkesbury Borough Council SFRA – Level 1	September 2008	www.tewkesbury.gov.uk/index.cfm?articleid=3272
Gloucestershire County Council SFRA	September 2008	www.gloucestershire.gov.uk/SFRA
Gloucestershire County Council SFRA for Minerals and Waste	September 2008	www.gloucestershire.gov.uk/SFRA
Gloucester, Cheltenham & Tewkesbury Joint Core Strategy SFRA – Level 2	October 2011	www.gct-jcs.org/EvidenceBase/StrategicFloodRiskAssessment.aspx

2. Planning Context

2.1 Planning Policy Statement 25: Development and Flood Risk (PPS25)

The guidance incorporated within PPS25 has existed in English law in various forms since 2001. The most recent edition was in March 2010 and outlined the national policy on development and flood risk assessment at that time. The policy stated that flood risk should be considered at all stages throughout the planning and that the development process should ensure that new development is not exposed to unnecessary flood risk and where possible floodplains are maintained as natural flood storage areas.

PPS25 was supported by the Development and Flood Risk Practice Guide (December 2009). The Practice Guide provided advice on the practical implementation of PPS 25, and provided additional guidance on what is required at regional and local level. The document provided supporting information on:

- Preparing regional spatial strategies, sustainability appraisals and local development documents and the roles and responsibilities for those managing individual planning applications and the planning process;
- Additional guidance on the contents of RFRAs, SFRAs, and FRAs;
- The application of the sequential approach and Sequential and Exception Tests;
- Surface water management and implementing sustainable drainage;
- Measures to reduce flood risk to acceptable levels; and
- How to manage residual risks

The previous SFRA studies completed within the study area are based on these planning policy documents. PPS25 has since been cancelled and replaced by the National Planning Policy Framework (March 2012). The associated Practice Guide remains in place. The flood risk policy components of the NPPF are similar to PPS25, but have some subtle differences. The NPPF is summarised in Section 2.2 and the key differences between NPPF and PPS25 for flood risk are discussed in Section 2.3.

2.2 National Planning Policy Framework (NPPF)

The NPPF replaced the suite of Planning Policy Statements (PPS), including PPS25, on 27 March 2012. It should be noted however that the PPS25 Practice Guide is still current and a useful reference tool for technical guidance. The NPPF sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

In the context of flood risk, the NPPF is supported by a Technical Guidance to the National Planning Policy Framework (the 'Technical Guidance'). The Technical Guidance provides further background to policies relating to flood risk and minerals. The Guidance retains the majority of requirements of PPS25 for Strategic Flood Risk Assessment (SFRA), site specific flood risk assessment and the overall processes for sequential and exception tests.

The NPPF and Technical Guidance maintain the requirement to apply a risk-based, sequential approach to the location of development in order to avoid flood risk to people and property. The key difference for flood risk policy compared to PPS25 is that the NPPF gives local authorities a wider remit to interpret and implement local policies. This makes the SFRA process all the more important in establishing suitable, reasonable and practical local development policies to manage local flood risk. The key differences between NPPF and PPS25 for flood risk are discussed in Section 2.3.

2.3 TRANSITION FROM PPS25 TO NPPF

2.3.1 DIFFERENCES BETWEEN PPS25 AND THE NPPF

The table below summarises key differences between the PPS25 and NPPF. The table includes impacts on existing local policy. Recommendations on how the transition from PPS25 to NPPF can be managed and when to apply changes into local policy are summarised in Section 2.3.2.

Table 2: Differences between PPS25 and NPPF

PPS25	NPPF and Technical Guidance	Difference	Impact on Local Policy
Risk based approach using the source-pathway-receptor model for planning of development (PPS25 – Main Text / Practice Guide – Section 3)	Local Plans should apply a **sequential, risk-based approach** to the location of development to avoid where possible flood risk to people and property and manage any residual risk, taking account of the impacts of climate change (Paragraph 99)	The NPPF simplifies the PPS25 approach by omitting clear definitions for the 'risk based approach' and not providing a specified 'model' for risk assessment.	The JCS Councils will need to make their own decisions on how to apply the 'risk based approach' to assessment of flood risk. *It is recommended that the JCS Councils apply the definitions used in the Flood and Water Management Act 2010. The definitions in the Practice Guide should also still be referred to alongside the slightly less detailed ones in the NPPF.*
Exception Test – Requires the site to be brownfield The Exception Test is only appropriate for use when there are large areas in Flood Zones 2 and 3, where the Sequential Test alone cannot deliver acceptable sites, but where some *continuing development* is necessary for wider sustainable development reasons, taking into account the need to avoid social or economic blight and the need for essential civil infrastructure to remain operational during floods (PPS25 – Paragraph 19)	**Exception Test** – No longer requires the site to be brownfield to pass the test For the Exception Test to be passed it must be *demonstrated that the development provides wider sustainability benefits to the community* that outweigh flood risk, informed by a Strategic Flood Risk Assessment where one has been prepared; and a site-specific flood risk assessment must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall. Both elements of the test will have to be passed for development to be allocated or permitted (Main Text Paragraph 102)	A site does not need to be brownfield to pass the Exception Test.	A wider range of sites may pass the exception test. *It is recommended that the JCS Councils carefully apply the knowledge gained through the various local /JCS wide SFRA documents and ongoing SWMP investigations to ensure flood risk on individual sites is fully understood and that only fundamentally safe developments are approved.*

PPS25	NPPF and Technical Guidance	Difference	Impact on Local Policy
Flood Resilient Construction– PPS25 treats this as one of many mitigation solutions available for managing residual flood risk (PPS25 - Annex G)	**Resilient** (compared to resistant) construction is favoured because it can be achieved more consistently and is less likely to encourage occupiers to remain in buildings that could be inundated by rapidly rising water levels (Technical Guidance – Paragraph 17)	The NPPF main text does not specifically describe what flood mitigation should be used. The Technical Guidance highlights use of resilience and does not specifically describe any other measures.	This change emphasises the use of effective measures as a practical solution for management of residual risk. *Policy guidance and recommendations on use of flood resilience measures are already included in SFRA documents. Flood resistance and resilience measures should not be used to justify development in inappropriate locations.*

PPS25	NPPF and Technical Guidance	Difference	Impact on Local Policy
Assessment of Flood Defence Breach and Overtopping / Safe Access (Residual Risk) - The Flood Zones refer to the probability of flooding from rivers, the sea and tidal sources and ignore the presence of existing defences, because these can be breached, overtopped and may not be in existence for the lifetime of the development (PPS25 – Paragraph 17) Section S3.2 of *FD2320 Flood Risk Assessment Guidance for New Development Phase 2, Defra/Environment Agency R & D Project 2004*, provides guidance on the assessment of the risk to people behind flood defences. Assessment of flood defence breaching should generally be undertaken on the basis of a design event of the appropriate design standard (1 per cent for river flooding, 0.5 per cent for flooding from the sea), including an allowance for climate change (Practice Guide – Paragraph 3.36) LPAs should in determining planning applications … ensure that all new development in flood risk areas is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed (Practice Guide Annex G)	When determining planning applications, local planning authorities should ensure flood risk is not increased elsewhere and only consider development appropriate in areas at risk of flooding where, informed by a site-specific flood risk assessment following the Sequential Test, and if required the Exception Test, it can be demonstrated that: within the site, the most vulnerable development is located in areas of lowest flood risk unless there are overriding reasons to prefer a different location; and development is appropriately flood resilient and resistant, including safe access and escape routes where required, and that any residual risk can be safely managed, including by emergency planning; and it gives priority to the use of sustainable drainage systems (Main Text – Paragraph 103) Residual risks are those remaining after applying the sequential approach and taking mitigating actions. It is the responsibility of those planning development to fully assess flood risk, propose measures to mitigate it and demonstrate that any residual risks can be safely managed. Flood resistance and resilience measures should not be used to justify development in inappropriate locations (Technical Guidance – Paragraph 16)	No explicit reference is made to the best practice Defra Guidance document (*FD2320 Flood Risk Assessment Guidance for New Development Phase 2, Defra/Environment Agency R & D Project 2004)* for assessment and management of residual risk	The JCS Councils will need to develop their own policy on the standards required for assessment and management of residual risk. *It is recommended that the JCS Councils review residual risk guidance in previous SFRA documents and ensure that this is combined with the best practice guidance available from Defra to form a high standard evidence base for assessing development applications.*

PPS25	NPPF and Technical Guidance	Difference	Impact on Local Policy
Sustainable flood plain development – PPS25 and the Practice Guide refer to PPS1 (Delivering Sustainable Development – now superseded by NPPF) for general sustainability principles of development. Sustainable urban drainage systems (SUDS) are the main focus of both PPS25 and the Practice Guide	The NPPF specifically states that Local Plans should use opportunities offered by new development to reduce the causes and impacts of flooding (Main Text – Paragraph 100)	PPS25 focuses on sustainability within individual developments in isolation, while the NPPF encourages local authorities to look at combinations of development sites holistically to identify opportunities.	This change encourages the 'cumulative impact assessment' requested as part of the scope for this SFRA. Refer Sections 3, 4 and 6 for further guidance.
Sustainable Urban Drainage Systems – The Practice Guide has detailed guidance on how SUDS should be implemented within development	NPPF specifies SUDS must be prioritised (Main Text – Paragraph 103), but refers to the Flood and Water Management Act for further detail	Less detail on SUDS is provided in planning guidance – but this will be balanced by new responsibilities of Lead Local Flood Authorities (Gloucestershire County Council) to become SUDS Approval Bodies (SABs) under the Flood and Water Management Act	Following commencement of Section 32 of the Flood and Water Management Act, Gloucestershire County Council will have the responsibility for review, approval and adoption of SUDS systems serving more than one property. *It is recommended that the JCS Councils consult with Gloucestershire County Council to determine if SAB duties will be delegated to them.*

PPS25	NPPF and Technical Guidance	Difference	Impact on Local Policy
Roles and Responsibilities of Parties – Comprehensive definition of the responsibilities and roles of various entities involved with flood risk managements (PPS25 – Paragraphs 21 to 34 and Annex H)	No equivalent content	Definitions of roles and responsibilities are not covered.	Roles and responsibilities of flood 'risk management authorities' are now defined in the Flood and Water Management Act 2010. Responsibilities of owners / developers with regard to flood risk are now only defined in the SFRA documents. *It is recommended that the JCS Councils review the definitions of roles / responsibilities as noted above and integrate any required clarifications within the transition process described in Section 2.3.2.*
Regional Flood Risk Appraisals (RFRAs) - Regional Planning Bodies should prepare RFRAs in consultation with the Environment Agency to inform their Regional Spatial Strategies (RSSs) on flood risk issues.	No equivalent content	RFRAs and RSSs are no longer required	The JCS Councils will need to rely on SFRA documents for flood risk information evidence base.

2.3.2 TRANSITION PROCESS

The NPPF allows for a twelve month transition period for local authorities to adjust local plans to conform. The period started on 27 March 2012 when the NPPF was published. During the transition period, the NPPF allows for the following (as per paragraphs 214, 215 and 516 of the NPPF):

Paragraph 214: *For 12 months from the day of publication, decision-takers may continue to give full weight to relevant policies adopted since 2004*[1] *even if there is a limited degree of conflict with this Framework.*

Paragraph 215: *In other cases and following this 12-month period, due weight should be given to relevant policies in existing plans according to their degree of consistency with this framework (the closer the policies in the plan to the policies in the Framework, the greater the weight that may be given).*

Paragraph 216: *From the day of publication, decision-takers may also give weight*[2] *to relevant policies in emerging plans according to:*

- *the stage of preparation of the emerging plan (the more advanced the preparation, the greater the weight that may be given);*
- *the extent to which there are unresolved objections to relevant policies (the less significant the unresolved objections, the greater the weight that may be given); and*
- *the degree of consistency of the relevant policies in the emerging plan to the policies in this Framework (the closer the policies in the emerging plan to the policies in the Framework, the greater the weight that may be given).*

It is recommended that the JCS Local Planning Authorities use the time available to review current policy in light of the NPPF and prioritise changes based on their level of conflict with the NPPF. It should be noted that the NPPF is not a spatial document – it is essentially a series of prescriptions on how local authorities produce their frameworks. It leaves substantial room for local debate and decisions to be made on a local basis.

2.4 LOCAL PLANNING

2.4.1 REGIONAL SPATIAL STRATEGY

In May 2010 the new Government announced the abolition of the Regional Strategies. These Regional Strategies are being revoked individually and at the time of publication the Regional Strategy for the South West has yet to be formally revoked. Local planning authorities are now responsible for establishing the right level of local housing provision in their area, and identifying a long term supply of housing land without the burden of regional housing targets.

2.4.2 SURFACE WATER MANAGEMENT PLANS

Gloucestershire County Council was one of the pilot areas for developing Surface Water Management Plans (SWMPs) in 2010. The 2010 SWMP completed a strategic level risk assessment of a north-south corridor of Gloucestershire centred on Tewkesbury and including Cheltenham and Gloucester City. Detailed level SWMPs are now currently in progress for the urban areas of Cheltenham, Tewkesbury and Gloucester. SWMPs are also being prepared to cover Bishop's Cleeve, Woodmancote and Southam though the results of this work were not available to input into this report. A SWMP is a framework through which key local partners with a responsibility for surface water and drainage in their area work together to understand the causes of surface water flooding and agree the most cost effective way of managing that risk. The purpose is to make sustainable surface water management decisions that are evidence based, risk based, future

[1] In development plan documents adopted in accordance with the Planning and Compulsory Purchase Act 2004 or published in the London Plan

[2] Unless other material considerations indicate otherwise

proofed and inclusive of stakeholder views. A SWMP establishes a long-term action plan to manage surface water in an area and should influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

The 'Risk Assessment' phases of the SWMPs will produce detailed surface water flood risk and hazard information for the areas assessed as part of this SFRA. The strategic level assessment delivered by the Gloucestershire SWMP has been incorporated within this assessment. Unfortunately, the results from the more detailed SWMPs were available to this study although interim results were provided for the Cheltenham area. Future users of this SFRA should review results from the SWMP as they become available and ensure that no substantial differences in predicted flood extent / hazard exist when compared with the 'locally agreed surface water information' from the Preliminary Flood Risk Assessment (refer next section) as used for the site assessments within this SFRA document.

2.4.3 PRELIMINARY FLOOD RISK ASSESSMENT

The Gloucestershire County Council Preliminary Flood Risk Assessment (PFRA) was prepared in June 2011 to fulfil the requirements of the Flood Risk Regulations 2009. The PFRA is a high level assessment of flood risk and includes assessment of past floods, possible future floods and identifies 'Flood Risk Areas'. The report provides a comprehensive source of historic flood information and defines the 'locally agreed surface water information' as summarised in the table below. This SFRA uses this locally agreed information for assessment of surface water flood risk where possible. As noted in the previous section, outputs from the detailed SWMPs are not currently available. Where the table below refers to 'SWMP Mapping', this is the SWMP mapping delivered by the Gloucestershire SWMP study.

Table 3: Locally Agreed Surface Water Information

Local Authority Boundary	Locally Agreed Surface Water Information
Cheltenham Borough	Within Cheltenham urban area use the SWMP mapping Outside of Cheltenham urban area use the Flood Map for Surface Water
Gloucester City	SWMP mapping to be used throughout Gloucester City
Tewkesbury Borough	SWMP mapping to be used where available (covers Carrant Brook, River Swilgate and Tirle Brook catchments), except in Tewkesbury town where the Areas Susceptible to Surface Water Flooding map should be used For the remainder of the Borough use the Flood Map for Surface Water.

3. Site Assessment Methodology

3.1 Overview

The purpose of the SFRA is to assess all sources of flood risk for the nine 'additional' areas specified by the JCS Local Planning Authorities. The assessment methodology adopted aligns with the method used in the October 2011 Level 2 SFRA and the format of the outputs are generally comparable to aid comparative assessment of all identified development areas assessed.

The method uses a desktop based assessment of currently available flood risk information from 'all sources'. 'All sources' of flood risk is defined by the NPPF Technical Guidance and includes *rivers and the sea, directly from rainfall on the ground surface and rising groundwater, overwhelmed sewers and drainage systems, and from reservoirs, canals and lakes and other artificial sources*.

This report has incorporated the housing trajectories which were set out in the JCS Housing Background Paper (November 2011 which supported the 'Developing the Preferred Options' version of the Joint Core Strategy.

3.2 Fluvial Flood Risk Modelling

Hydraulic modelling of rivers and streams running through or near to the development areas was undertaken in several parts of the study area to define the functional flood plain, generate flood hazard data and estimate residual risk of failure of significant flood risk management structures. Existing models were used and enhanced where needed and additional or new data was available. New hydraulic models were developed for areas where no suitable existing models were available. The following sections summarise the fluvial modelling completed for this study. Further detail on each of the models can be found in Appendix D. The sites are grouped (Tewkesbury, Gloucester, Cheltenham) according to geographical location rather than administrative boundaries.

3.2.1 Sites adjacent to Gloucester G3 and G9 - Horsbere Brook and Innsworth Drain

G3 and G9 are located to the north east of Gloucester city, outside the city ring road. The Innsworth Ditch watercourse flows through both the proposed development sites from its source upstream of the railway embankment. A second, unnamed, watercourse forms the northerly boundary of site G9 before entering the Innsworth Ditch. Based on its size this unnamed watercourse is not thought to pose a significant risk to the site and therefore has not been modelled, but a buffer strip to cater for any overland or localised flooding will be required for development.

The Horsbere Brook flows from south to north along the west of the development sites. Due to the construction of the Horsbere Brook Flood Alleviation Scheme in 2011 (a large flood storage area located to the south of the railway) the development areas are defended from flooding from the Horsbere Brook for events up and including the 1% AEP with climate change allowance. Although the probability of a failure in the flood storage area is low, the effects have been considered as part of the assessment using existing model outputs from the FRA completed for the Flood Alleviation Scheme's.

Permission was obtained from a third party to use the existing Horsbere Brook Estry Tuflow model (2010) for this assessment. To improve the modelling of Innsworth Drain through the development sites the model was extended upstream approximately 500m to the railway embankment (1D) using the existing section data and LiDAR to define the channel.

3.2.2 *Sites adjacent to Tewkesbury T2 and T3 – Tirle Brook and Carrant Brook*

The Ashchurch site (T2) is located to the north east of Tewkesbury, to the east of the M5. The site spans an area made up of approximately 50% farm land and 50% industrial/military installation. The main West Coast railway line also cuts through the site forming the western boundary. Site T3, considered also within the area of Ashchurch but south of the A46, has a land use which is predominantly Greenfield farmland with very little development.

The Tirle Brook flows east to west a short distance to the south of site T2 and along the southern boundary of site T3 before passing under the M5 motorway. A tributary of the Tirle Brook flows in culvert under the barracks. Only a small proportion of the downstream part of the tributary is in open channel south of Ashchurch Industrial Estate. It then flows across the T3 development site and joins the Tirle Brook. It was not covered in detail within this assessment; however it will require detailed assessment at a future master planning stage. A new TUFLOW 2D hydraulic model of the Tirle Brook was created for this assessment. Hydraulically important structures were represented in 1D using ESTRY. The existing Tewkesbury ISIS-TUFLOW model extends a short distance into the SFRA model extent (including the M5 culvert). Through this overlapping reach the existing model data has been used to inform the new model. Data for the majority of the model was developed from LIDAR data and site observations.

The Carrant Brook flows east to west along the northern boundary of site T2 passing under the railway before passing under the M5 motorway at the western extent of the development site. A tributary of the Carrant Brook runs parallel to the brook from the B4704 before the confluence immediately upstream of the motorway culvert. Both the Carrant Brook and the tributary have been considered in this assessment. A new 2D model of the Carrant Brook was created for this assessment using TUFLOW and an approach similar to that described for the Tirle Brook.

3.2.3 *Sites adjacent to Cheltenham C5 and C6*

Development site C5 is located to the west of Cheltenham; the site is predominantly farmland and occupies an area of 1km^2. The River Chelt is located approximately 350m north of the site, the Hatherley Brook flows in a northerly direction west of Pheasant Lane in the south of the site. A number of small drains are present on the site which ultimately discharge to the Hatherley Brook and the River Chelt. The outputs from the Hatherley Brook SFRM (2007) ISIS TUFLOW model were used to inform flood risk at the site. The site is not at risk of flooding from the River Chelt (verified against results from the EA Middle Chelt model).

Two blockage scenarios were carried out at Meadow Close Road and at Fiddlers Farm access bridge. The blockage scenarios were completed for the 0.1% AEP event because the channel is reasonably deep and the 1% plus climate change AEP event flood levels were well contained, therefore this provided a conservative approach to the assessment of residual risk due to blockage.

C6 is located to the south of Cheltenham in the area of Up Hatherley and occupies an area of approximately 1km^2. The site is predominantly greenfield, however there are two small hamlets located within the boundary. No new hydraulic modelling was carried out at the site. The site is at low risk of fluvial flooding, and although there remains a low risk of flooding from the minor watercourse and drains on site, the risk of flooding from them is likely to be similar for that shown on the surface water flooding maps. Therefore they have not been modelled.

3.2.4 *Sites adjacent to Gloucester G8a and G8b*

G8a development site is located west of Gloucester and surrounds the small village of Highnam. The site is predominately farmland, with a small area of woodland, and a number of farms and their associated support buildings. The River Leadon flows from north to south along the eastern boundary prior to its confluence with the River Severn at Over. No new modelling was completed for the site. There is no detailed modelling information available for the River Leadon, therefore JFlow outputs from a recent EA flood zone improvement project were used to assess the flood risk from the River Leadon.

G8b is located to the west of Gloucester, south of the Highnam Estate. The land use is predominantly farmland, but also contains areas of woodland and farm buildings. Three drainage channels run through this site. To the west lies Long Brook, which has a catchment of approximately 0.63km^2, two drainage channels run through the eastern side of the proposed development area. Highnam Stream, which has a catchment of 2.49km^2 and to the east of the Highnam stream, running in parallel, is a drainage channel referred to as Linton Farm drainage channel. This watercourse has an approximate catchment area of 0.56km^2 and merges with the Highnam stream downstream of the railway. A new 2D hydraulic model of all three drainage channels was created for this study using TUFLOW. Hydraulically important structures were represented in 1D using ESTRY. Data for the model was taken from LiDAR data and site observations. The model used 3 inflow points located at the upstream model extent of the drainage channels, and 2 downstream boundaries south of the railway. A blockage scenario was carried out at the Highnam Stream railway culvert for the 1% plus climate change AEP event. Results from the Environment Agency's Tidal Severn model were used to assess the risk from this river which affects land south of the site.

3.2.5 SITE ADJACENT TO GLOUCESTER G2

Development site G2 is located North East of Churchdown, a village which lies between Cheltenham and Gloucester. The site encompasses Gloucestershire Airport, as well as a number of support buildings. Normans Brook runs through the site from south to north emerging from the A40 culvert. The watercourse is culverted for approximately 30m to facilitate the recent development of the runway. These works appear to have been completed since the LiDAR was flown. Normans Brook meets the Hatherley Brook north of the site. The site is not at risk of flooding from the Hatherley Brook.

A new 2D model of Normans Brook was created for the assessment using TUFLOW. Hydraulically important structures were represented in 1D using ESTRY. The flow hydrographs used in the Hatherley Brook SFRM model were utilised in the new Normans Brook model. A model scenario of a 50% blockage of the B4063 culvert for the 1% AEP plus climate change flood event was carried out to assess the impact of culvert blockage.

3.3 ASSESSMENT METHOD

The risk assessment method generally follows the same procedure as applied for the 2011 Level 2 SFRA. A SUDS assessment has also been completed as part of the overall site assessment. SUDS suitability has been informed by the 2011 Level 2 SFRA mapping. Table 4 below summarises which flood risk information sources were used for each individual site assessment.

Table 9 in Section 7.2 summarises the flood risk information used to inform the site assessments. Table 10 in Section 7.5 summarises the update frequencies of key datasets informing this SFRA. It should be noted that the most current information should inform the site assessments. Where Table 10 shows a regular update frequency, then the end user should refer to the most current information to inform their decision.

Table 4: Site Assessment Flood Risk Information Sources

Site	Fluvial	Surface Water / Sewer	Groundwater	Impounded Water / Artificial Sources	Comments
G9 – south of Churchdown	Horsbere model (Refer Section 3.2)	Locally agreed SW information (PFRA dataset) (mapped). Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	Detailed SWMP mapping not expected to be available for 6+ months. Some detailed mapping is included in the locally agreed dataset.
G3 – Land between A40 and railway	Horsbere model (Refer Section 3.2)	Locally agreed SW information (PFRA dataset) (mapped). Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	Detailed SWMP mapping not expected to be available for 6+ months. Some detailed mapping is included in the locally agreed dataset.
T2 – Land at Ashchurch	Carrant & Tirle Brook models (Refer Section 3.2)	Locally agreed SW information (PFRA dataset). Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	Tewkesbury SWMP covers the site therefore detailed SW mapping will be available in the future.
T3 – Land south of A46 at Ashchurch	Tirle Brook model (Refer Section 3.2)	Locally agreed SW information (PFRA dataset). Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	Tewkesbury SWMP covers the site therefore detailed SW mapping will be available in the future.
C5-Land west of Cheltenham	Hatherley Brook SFRM (2007) ISIS TUFLOW model	Locally agreed SW information (PFRA dataset). Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	

Site	Fluvial	Surface Water / Sewer	Groundwater	Impounded Water / Artificial Sources	Comments
C6- Land south of Cheltenham	No modelling undertaken	Locally agreed SW information (PFRA dataset). Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	
G8a-Land to North and East of Highnam	JFlow outputs from a recent EA flood zone improvement project	Locally agreed SW information (PFRA dataset) combined with draft results from detailed SWMP assessment which partially cover the site. Supplemented with historic incident data from L1 SFRA.	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	
G8b-Land south of Highnam	New 2D hydraulic TUFLOW model of all three drainage channels combined with outputs from EA tidal Severn model.	Locally agreed SW information (PFRA dataset).	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	
G2-Land at Gloucestershire Airport	New 2D TUFLOW hydraulic model of Normans Brook	Locally agreed SW information (PFRA dataset).	Areas susceptible to groundwater flooding dataset (not mapped but assessment cross referenced with BGS geology)	Information from L1 SFRA (not mapped) Online EA mapping for reservoir inundation.	

The assessment method also incorporates the Flood Risk Suitability Assessment Criteria used in the 2011 Level 2 SFRA. This suitability criterion was created to assist the JCS Local Planning Authorities in assessing flood risk issues in conjunction with other planning considerations. The scoring codes used for the assessment criteria are reproduced below from the 2011 Level 2 SFRA.

Figure 1: Flood Risk Suitability Assessment Criteria

Scoring Code	Criteria Definition
1	Site is mainly in Flood Zone 3b
2	Site is mainly in Flood Zone 3a
3	Site is mainly in Flood Zone 2
4	Site is mainly in Flood Zone 1 but affected by Flood Zones 2, 3a and 3b
5	Site is fully in Flood Zone 1

3.4 CUMULATIVE IMPACT ASSESSMENT

A Level 2 SFRA generally focuses on individual development areas. It is also important to assess the cumulative impact of all the potential development areas on each other and the existing urban areas. This cumulative assessment is most appropriate at the sub-catchment scale where development areas have the potential to influence downstream flows that could impact existing urban areas or other proposed developments. The general methodology for this assessment is summarised below:

- Review scale of proposed development
- Identify potential strategic positive benefits and negative impacts on drainage, overland flow and river flows (i.e. relative position in catchment in relation to known drainage issues)
- Identify strategic level measures / policies that could be applied to individual / related sites in combination

The review of proposed development referred to the housing trajectories which have been set out in the Housing Background Paper (November 2011). It is recognised that these represent a point in time and set out housing numbers which were associated with the 'Developing the Preferred Options' version of the Joint Core Strategy. A revised paper regarding housing numbers will be published alongside the Preferred Option version of the JCS.

We have grouped together the proposed development sites based on hydrological sub-catchments as follows:

- T2 & T3 (Carrant Brook & Tirle Brook – converge at Tewkesbury)
- G2, C5 and C6 (Normans Brook and Hatherley Brook – Converge to north of Churchdown)
- G3 and G9 (Horsebere Brook)
- G8 (River Leadon / River Severn)

4. Site Assessment Summary

4.1 OVERVIEW

This section summarises the outcomes of the site assessments for the following locations:

Sites adjacent to Gloucester

- Site G9 (land to south of Churchdown)
- Site G3 (land between A40 and Mainline Railway south of site G9)
- Site G8a (land to North and East of Highnam)
- Site G8b (land at Highnam)
- Site G2 (land at Gloucestershire Airport)

Sites adjacent to Cheltenham

- Site C5 (land to west of Cheltenham)
- Site C6 (land to south of Cheltenham)

Sites adjacent to Tewkesbury

- Site T2 (land at Ashchurch – includes MOD site)
- Site T3 (land south of A46 at Ashchurch)

Details of each site assessment are included in Appendices A (Gloucester), B (Tewkesbury) and C (Cheltenham). A summary is provided in Table 5 below for each of the site assessments.

Table 5: Site Assessment Summary

		Percentage of site in flood zones (%)				Summary of Assessment			Flood Risk Suitability Score
Site Reference	Size of site (ha)	Flood Zone 1	Flood Zone 2	Flood Zone 3a (including climate change)	Flood Zone 3b	Surface Water	Groundwater	Reservoir Inundation	
T2	212	100	0	0	0	Small pockets of flooding predominantly low risk	Medium to High Risk--	No	**5**
T3	21	70	11.4	10	7.6	Medium to high risk of surface water flooding	Low to medium risk	No	**3**
G9	37	38	36	16	10	Medium to high risk of surface water flooding	Low to medium risk	Yes	**3**
G3	70	86	9	4	1	Small pockets of flooding predominantly low risk	Low to medium risk	Yes	**5**
C5	100	99.35	0.65	0	0	Low risk of surface water flooding	Low to medium risk	No	**5**

		Percentage of site in flood zones (%)				Summary of Assessment			Flood Risk Suitability Score
Site Reference	Size of site (ha)	Flood Zone 1	Flood Zone 2	Flood Zone 3a (including climate change)	Flood Zone 3b	Surface Water	Groundwater	Reservoir Inundation	
C6	97.5	100	0	0	0	Small pockets of flooding predominantly low risk	Low risk	No	**5**
G8a	195	95	0.5	3.4	Not available	Small pockets of flooding predominantly low risk	Low to medium risk	No	**5**
G8b	128.1	80	9	6.71	3.8	Small pockets of flooding around existing watercourses predominantly low risk	Low to medium risk	No	**4**
G2	170	82	6.6	6.3	5.2	Medium to high risk of surface water flooding	Low to medium risk	Yes	**4**

It is worth noting that a large proportion of land between the A40 and Cheltenham Road is at risk of flooding, more than half within Flood Zone 2, this may make passing the Sequential Test more difficult for site G9 when compared to other sites.

4.2 CUMULATIVE IMPACT ASSESSMENT

As described in Section 3.4, the cumulative impact assessment has been completed on a hydrological sub-catchment basis. Each of the general groups defined are assessed in the sub-sections below. Tables 6 and 7 (at end of section) describe the potential strategic opportunities and negative strategic impacts of the developments.

4.2.1 T2 ANDT3 (CARRANT BROOK, TIRLE BROOK– BOTH CONVERGE AT TEWKESBURY)

Site T2 is approximately 2km^2 in area. It currently consists of approximately 50% farmland and 50% industrial / military installations. The site sits on a ridgeline immediately to the east of Tewkesbury and will contribute flows to the Carrant and Tirle Brooks. These two watercourses flow east to west through Tewkesbury and join the River Swilgate. Site T3 is approximately 0.2km^2 in area and sits directly to the north of the Tirle Brook. The site is currently predominantly greenfield farmland. Both of these sites are in the upper reaches of their respective hydrological sub-catchments and have the potential to influence flood risk in downstream areas – Tewkesbury town in particular. As the type of development proposed for each of these sites has not yet been confirmed, the assessment below is based on an overall increase in impervious area.

There is also a potential cumulative impact of smaller urban developments as described in the Tewkesbury Borough Council Housing Trajectory. This shows a net increase within Tewkesbury of 157 dwellings between 2012 and 2014. Similarly, the development across the remainder of the borough is expected to contribute approximately 1200 new dwellings over the next 10 years on land which generally falls within the hydrological sub-catchments that converge on Tewkesbury town. This development is not yet defined but is expected to be reasonably dispersed across the borough.

Overall, there is a high potential for positive strategic impact on flood risk for the proposed development sites at T2 and T3. The housing trajectory outside these specific areas presents a more challenging strategic issue, but can be managed by consistent enforcement of sustainable drainage policies detailed in previous SFRA work.

4.2.2 G2, G3, C5, C6 AND G9 (NORMANS BROOK, INNSWORTH DITCH AND HORSBERE BROOK)

These sites predominantly fall within the hydrological catchment of the Hatherley Brook and the nearby Horsbere Brook (G3 / G9), both of which flow into the River Severn west of Gloucester. All sites are located towards the lower part of the Hatherley Brook / Horsbere Brook catchments where there may be opportunity to reduce flood risk by attenuating the flows from the tributaries which run through the sites. This could potentially help with the flooding observed downstream in the Longford area where the Hatherley and the Horsbere Brook meet the River Severn.

The sites are largely undeveloped and the cumulative effect of development at these sites is likely to be a significant increase in urban area and impermeable surfaces. If runoff is not properly controlled this could lead to an increase in flood risk to downstream areas such as Innsworth / Longford. In the case of G2 where the site is occupied by Gloucestershire airport, there may be an opportunity to reduce the existing runoff and open up Normans Brook which may reduce flood risk downstream.

Indicative housing trajectory figures for areas adjacent to Gloucester show approximately 5,500 additional potential houses to be built over the next 20 years. A further 2,000 houses are included in the Tewkesbury Borough housing trajectory on sites located within hydrological sub-catchments draining towards Gloucester. Indicative housing trajectory figures for the Cheltenham area show approximately 3,000 additional houses over the next 10 years, delivered through a number of small to medium sized developments.

Overall it is considered there is limited opportunity for a significant reduction in flood risk through development of these sites and potential for a negative impact if the effects of development on runoff are not properly managed. The housing trajectory outside these specific areas presents a similarly challenging strategic issue, but can be managed by consistent enforcement of sustainable drainage policies detailed in previous SFRA work.

There is the possibility that upstream development could have negative impacts on flood risk downstream, due to increased runoff. Throughout the development of all sites awareness and consideration should be made to the potential cumulative impacts and how this can be mitigated throughout the development of the masterplan. This is particularly relevant for the sites upstream of Gloucester where the cumulative impact of development could have negative impacts on flood risk downstream due to the significant increase in surface runoff. Proposals for development at these sites must give consideration to this important cumulative impact. It is recommended that surface water drainage strategies for these sites consider a higher level of exceedance i.e. the 0.1% AEP event (1 in 1000 year return period event). This strategy is likely to include the storage and attenuation of surface water on site to assist in the potential downstream impact.

4.2.3 G8A AND G8B

G8a and G8b development sites are located west of Gloucester and surround the small village of Highnam. The sites are predominantly farmland, with small areas of woodland and farm buildings. Site G8a is located in the lower part of the River Leadon catchment, which discharges to the River Severn. A number of small drains run through site G8b, discharging directly to the River Severn.

The position of these sites in the lower part of the River Leadon and River Severn catchment presents limited opportunity for strategic approaches to reduce flood risk downstream. Enforcement of sustainable drainage policies detailed in previous SFRA work will help to manage any localised impacts to existing or proposed development at the sites.

Table 6: Positive Opportunities and Benefits Cumulative Impact Assessment

Sites	Opportunities	Recommended Measures / Policies
T2, T3	T2 and T3 are both directly upstream of Tewkesbury town – there is an opportunity to control overall runoff volumes from these sites to benefit downstream properties.	Developments within T2 and T3 are reviewed in the strategic context of their potential to reduce flood risk in Tewkesbury Town. A strategic surface water management / drainage strategy for the two sites is recommended to maximise the benefits of a strategic approach.
	Runoff control measures or storage on all three sites could reduce flood extents in Tewkesbury town and increase the quantity of low flood risk development land closer to the town.	Any developments within T2 and T3 are encouraged to achieve a reduction in existing runoff rates / volumes.
	T2 and T3 could be developed in parallel and share flood risk management measures. T2 has substantially more development area available and could facilitate a high density of development in T3 if a higher proportion of T2 was used for flood mitigation measures.	Any development of T2 and T3 should occur in parallel to maximise the benefits of shared flood risk management measures.
	There may be a similar opportunity to control runoff volumes from larger scale developments across the remainder of the borough to reduce flooding in downstream areas.	Any large-scale developments at this location are encouraged to achieve a reduction in existing runoff rates / volumes. An overall drainage strategy should be prepared for larger sites that may be developed sequentially to maximise the benefits of a strategic approach.

Sites	Opportunities	Recommended Measures / Policies
G3, G9	G3 and G9 are located within the catchment of the Horsbere Brook and have tributaries of the brook flowing through or adjacent to the sites (Innsworth Ditch). There may be an opportunity to reduce flooding to downstream areas such as Innsworth by increasing the storage capacity of the existing watercourses through the sites.	Any developments within G3 & G9 should be reviewed in the strategic context of their potential to reduce flood risk downstream.
	G3 has more development area available than G9 and could facilitate a higher density development if G9 was used for flood mitigation measures.	Any development of G9 and G3 should occur in parallel to maximise the benefits of shared flood risk management measures.
	There may be an opportunity to control runoff volumes from larger scale developments in other areas to reduce flooding in downstream areas, particularly where these are on brownfield sites.	Any medium to large-scale developments are encouraged to achieve a reduction in existing runoff rates / volumes. An overall drainage strategy should be prepared for larger sites that may be developed sequentially to maximise the benefits of a strategic approach.

Sites	Opportunities	Recommended Measures / Policies
G2, C5,C6	All three of these areas are in the upper catchment of the Hatherley Brook and contribute flood volume to downstream areas including the River Severn. There may be opportunities to reduce flood risk to downstream areas through increasing the storage capacity of watercourses on the sites & deculverting Normans Brook through site G2. There may also be some opportunities to reduce runoff rates at the sites. There may be an opportunity to control runoff volumes from larger scale developments in other areas to reduce flooding in downstream areas, particularly where these are on brownfield sites.	Although Normans Brook at G2 has only recently been culverted, if as part of a future development this could be opened up this would help in adopting a green corridor and enhancing the riparian corridor, which could be linked to recreation and green space. Any developments within all three sites are encouraged to achieve a reduction in existing runoff rates / volumes where possible. Any medium to large-scale developments are encouraged to achieve a reduction in existing runoff rates / volumes. An overall drainage strategy should be prepared for larger sites that may be developed sequentially to maximise the benefits of a strategic approach.
G8a and G8b	Both sites are located within the downstream catchment area of River Leadon and the River Severn. They present limited opportunity for flood risk reduction due to their small size and downstream location in comparison to the substantial flood plain immediately to the south and west.	

Table 7: Potential Negative Cumulative Impact Assessment

Site	Cause of Impact	Recommended Measures / Policies
All sites	Development of the strategic sites is likely to lead to an overall increase in impermeable area. Application of SUDS policies as described in 2011 SFRA will help to manage this, however the cumulative impacts will need to be considered, particularly for extreme events when SUDS systems may be exceeded. This is a particular consideration for sites T2, T3 and G2, G3 & G9 where development of the sites is likely to lead to a	Consistently apply SUDS policies as described in 2011 Level 2 SFRA All developments are controlled to ensure no net increase in existing runoff rates / volumes and where possible a reduction. FRAs for proposed

	significant extension to the existing urban area and where existing development downstream could be affected. Existing Housing Trajectory figures would indicate an overall increase in total impervious area. This is challenging to control on a site-by-site basis and the specific impacts of individual dwellings are slow to emerge and difficult to quantify. If developments increase the overall volume and rate of surface water runoff, then flood extents may increase in downstream areas.	developments should include assessment of the impacts of exceedance of site drainage / SUDS systems (> 100 year event). Consistently apply SUDS policies as described in 2011 Level 2 SFRA All developments are controlled to ensure no net increase in existing runoff rates / volumes and where possible a reduction.

5. Guidance and Principles

5.1 Overview

As the purpose of this SFRA is to focus on specific development areas and generally address the new NPPF, it is recommended that the previous SFRA studies are referred to for general guidance and principles. Therefore this section aims to highlight key changes to general guidance and principles in relation to flood risk management that have emerged in relation to the NPPF.

5.2 Flood Risk Management Principles

The NPPF does not include the detailed supporting information that was contained within PPS25 for principles of flood risk management. It is the intention of the NPPF that these principles are now adapted to fit local circumstances.

Although PPS25 is technically superseded, both PPS25 and the related Practice Guide contain detailed background information on principles of flood risk management and the Practice Guide should still be referred to for technical guidance. These can be readily adapted to local principles through combination with recommendations made in 2011 Level 2 SFRA document for each source of flood risk.

5.2.1 Application of the Sequential Approach to Brownfield Regeneration Sites

The NPPF promotes the principle of sustainable development, which involves seeking improvements in the quality of the built, natural and historic environment and people's quality of life. Those responsible for preparing local development plans and making development control decisions need to take local circumstances into account to respond to the opportunities and challenges in their area. Development of Brownfield sites in higher flood risk areas may be the preferred option in line with the overriding principles of sustainable development, particularly where:

- It is not possible to accommodate the required level of development solely on Greenfield or other Brownfield sites outside the flood risk zones.
- Regeneration of a Brownfield site or previously developed area, through development, is needed to avoid other sustainability issues associated with 'blight'.
- Development of the Brownfield sites can make a positive contribution towards flood risk reduction, for example through a reduction of surface runoff rates and / or the inclusion of strategic flood mitigation measures that may reduce flooding to existing developments.
- Development of Greenfield sites in favour of Brownfield sites may have other negative impacts that outweigh flood risk.

Need for the Sequential Test

The aim of the Sequential Test is to steer new development to areas with the lowest probability of flooding. The NPPF advises that development should not be allocated or permitted if there are reasonably available sites appropriate for the proposed development in areas with a lower probability of flooding.

Sites categorised as "Brownfield sites which are currently developed" will typically cover individual sites where replacement development is proposed. Typically these will be smaller plots and are owner occupied with limited (if any) opportunity for relocating development to an area of lesser flood risk, either on-site or elsewhere. The NPPF (paragraph 104) states that applications for minor development and changes of use

should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments. Exceptions to this are changes of use to caravan, camp and chalet sites, including mobile & park home sites, where the tests should be applied as appropriate.

Sites categorised as "Brownfield sites which have been previously developed" will typically cover sites larger than a single plot and may have been in use for a variety of uses, often employment based. Parts of the site will function as functional floodplain and parts will not. It is anticipated that many "Brownfield regeneration sites" will fall into this category. If the sites are located in Flood Zone 2 or 3 the Sequential Test would need to be applied.

Application of the Sequential Test

The Environment Agency has produced guidance on the application of the Sequential Test for local planning authorities[3]. This breaks the Test down into a series of questions to guide decision makers through the process. The following section provides guidance on factors relating to Brownfield regeneration sites that local planning authorities should consider when applying the Sequential Test.

Has the Sequential Test already been carried out for this development at development plan level?

Is the flood risk vulnerability classification of the proposal appropriate to the Flood Zone in which the site is located?

If the answer to both the above questions is yes there is no further need to apply the Sequential Test. This will not apply to the site allocation process when preparing the local development plan.

State the geographical area over which the test is to be applied. If greater or less than the district boundary justify why the geographical area for applying the test has been chosen.

The JCS Local Planning Authorities should give particular consideration to the appropriate geographical area when applying the Sequential Test to Brownfield regeneration sites. For example, if one of the objectives for development of a Brownfield site is regeneration of that site or area (to avoid further degeneration or blight) it may be appropriate to refine the geographical 'area of search'. In some circumstances it may be appropriate to restrict the area of search to a single site. This principal could also be applied where there are several Brownfield sites across the administrative area, restricting the area of search to Brownfield sites only.

Similarly if the proposed development serves a specific purpose (such as a school or doctor's surgery serving a local community) it will have certain requirements that will naturally restrict the geographic area of search.

Identify the source of reasonable available sites.

These will usually be drawn from the evidence base / background documents which inform the LDF. Windfall sites are those which have not been specifically identified as available in the Development Planning process. They comprise previously-developed sites that have unexpectedly become available. The Environment Agency guidance recommends that the acceptability of windfall applications in flood risk areas should be considered at the strategic level through a policy setting out broad locations and quantities of windfall development that would be acceptable or not in Sequential Test terms.

For sites to be reasonably available they should meet the functional requirements of the proposed development. The JCS Local Planning Authorities should consider carefully the purpose and requirement of

[3] http://www.environment-agency.gov.uk/research/planning/82584.aspx

the development. If an objective of the development is the regeneration of existing Brownfield sites this will naturally restrict the sites taken forward to the Sequential Test.

Sites taken forward for assessment should have a reasonable prospect of being 'available' within the timescales of the proposed development. This could restrict both Brownfield and Greenfield sites from being taken forward due to other constraints (e.g. land ownership, lack of site infrastructure, contamination or environmental constraints).

Compare the reasonably available sites identified under stage 2 with the application site.

The Environment Agency Guidance states that sites should be compared in relation to flood risk; development plan status; capacity; and constraints to delivery including availability, policy restrictions, physical problems or limitations, potential impacts of the development, and future environmental conditions that would be experienced by the inhabitants of the development. It is possible that through this process further sites will be eliminated on the basis that they are not 'reasonably available'.

Application of the Sequential Approach at Site Level

In addition to the formal Sequential Test the NPPF requires that a Sequential Approach is adopted in areas known to be at risk from any form of flooding. This may be particularly relevant to development of Brownfield regeneration sites in flood risk areas where a development need is identified, but there may be flexibility on the type and layout of development.

Where development of sites in flood risk areas is proposed the following should be considered:

- Can risk be avoided or reduced by substituting less vulnerable uses or amending the site layout?
- Can density be varied to reduce the number or vulnerability of units located in higher risk parts of the site?

Appropriate Development

The successful application of the Sequential Test does not remove the requirement for development to be appropriate in accordance with Table 3 of the NPPF Technical Guidance (Flood risk vulnerability and flood zone 'compatibility') and, where necessary, for application of the Exception Test.

If the site (or part of the site) is in Flood Zone 3b, functional floodplain, new water compatible development is appropriate or a like-for-like replacement of an existing use.

If the site (or part of the site) is in Flood Zone 3a, new development for water compatible uses or less vulnerable uses is appropriate or a like-for-like replacement of an existing use.

The objective when looking at development proposals on this category of land is to ensure that development does not increase flood risk to the site or the building or elsewhere above the existing level and this is the test that must be met.

Overall reduction in flood risk at Brownfield Sites

All development, particularly where it is subject to the Exception Test, should seek to provide an overall reduction in flood risk. The following options for reducing flood risk at Brownfield sites are recommended for consideration:

- New Brownfield development should seek to reduce peak runoff rates as agreed on a site by site basis. In specific areas where there is a known surface water flooding problems a greater reduction will be required. This should be achieved through discharging to soakaways as well as through the

provision of storage and flow restriction devices that discharge at low rates. Where this level of runoff reduction is not practicable, the developer must provide appropriate evidence to that effect and must show that the maximum reduction that can be achieved from the site is being proposed. At the very least development must not increase runoff rates above existing.

- It is entirely probable that at all development sites a form of SUDS could be implemented. Therefore all new developments should include at least one 'at source' SUDS measure e.g. permeable paving.

- On the occasion that the watercourse has been culverted to aid the development there may be opportunities to open up the previously culverted rivers. De-culverting and re-naturalisation would help to increase the capacity of the channel along sections of the river and may help to meet the requirements of the Water Framework Directive (WFD), however, deculverting should be applied with caution if there is a risk of increased flood risk within the development site or to downstream areas. All development adjacent or near to a watercourse should consider opportunities for delivering water quality improvements as required through the Water Framework Directive.

- All new development should consider whether there are opportunities to reduce flood risks at the site without affecting 3rd party land. This may include reconfiguring ground levels or site access points, culvert improvements, and channel restoration as described above.

5.2.2 Approach to the Exception Test

The Exception Test process remains essentially the same from PPS25 to the NPPF. The only change to the Exception Test introduced by the NPPF is the requirement for the site to be on brownfield land has been removed. This has been done to give local authorities more flexibility in allocating development sites. The remaining aspects of the Exception Test remain unchanged and can be applied as per guidance detailed in previous SFRA documents.

5.3 How to Use the SFRA in Development Control

Following the introduction of the NPPF, the SFRA (this document and related SFRAs) process remains the fundamental driver and source of information for flood risk management in development control. The NPPF maintains the need for SFRA documents and highlights their purpose in managing local flood risk. The development control policies contained within previous SFRA documents should be referred to and applied accordingly within the JCS Local Planning Authorities.

5.4 Flood Warning and Emergency Planning

The NPPF gives increased weighting to flood resilience measures rather than flood resistance (which had an approximately equal weighting in PPS25). In line with the transfer of decision making to a local level, the explicit reference to Defra's 'Flood Risk to People' guidance has been removed. It is recommended that emergency planning policies detailed in previous SFRA work continue to be applied and consultation with emergency planning teams within each JCS Local Planning Authority is undertaken to allow policies to be strengthened where relevant with guidance from Defra's 'Flood Risk to People' study (as this can now be done and enforced at a local level).

6. Policy Guidance and Recommendations

6.1 Overview

This section details the policy guidance and recommendations resulting from the specific assessments completed for the additional sites specified by the JCS Local Planning Authority and in response to the NPPF. Refer to the previous SFRA documents summarised in Table 1 for further details on policy guidance and development control recommendations.

The list of recommendations is not exhaustive and it is therefore recommended that the JCS Local Planning Authority additionally refer to key flood risk management documents and spatial planning documents to inform the development of its policies. These include:

- The National Planning Policy Framework and supporting Technical Guidance
- Making Space for Water
- Gloucestershire First Edition Surface Water Management Plan Pilot (2010)
- Surface Water Management Plans for Gloucester, Cheltenham and Tewkesbury (in progress)

6.2 Strategic Policy

Overview

The strategic policy recommendations in The Gloucester, Cheltenham and Tewkesbury Strategic Flood Risk Assessment (October 2011) are still relevant and current and should be referred to. However as part of this document, additional guidance has been provided to enhance the information contained within the Level 2 SFRA (2011) and to provide additional guidance where appropriate.

Strategic policy recommendations for the JCS area have been provided along with specific site assessment policy which is intended to be used at the specific modelled study areas

SuDS Approval Body (SAB)

The introduction of the SuDS Approval Body (SAB) for the lead local flood authority (Gloucestershire County Council) means there is the opportunity to develop a much stronger strategic overview to the management of surface water flooding across the JCS local planning authorities. The SAB will ensure that all developments commit to a range of SuDS techniques which if applied appropriately could result in reduction of flood risk and the improvement of water quality across the JCS Local Authority areas.

Furthermore the use of SAB is encouraged by developers at an early stage in the development proposals to obtain guidance and to ensure the proposed SuDS meets national standards for design. The finer details of the SAB are still being finalised by Defra, and when available should be fed into the planning process.

However, it is anticipated that following the establishment of the body new developments will be required to demonstrate the following:-

- Commitment to the improvement of water quality
- Reduction in existing flow rate on previous developed sites or on greenfield sites, attenuate flows no higher than greenfield runoff rate
- Reduction in overall flow volumes
- Enhancement of biodiversity and amenity

For further guidance on SuDS recommendations refer to section 12.2.17 of the Level 2 SFRA (2011).

Brownfield sites

The guidance contained with Section 5 of this report should be referred to for specific guidance on Brownfield developments. In summary:-

- New Brownfield development should seek to reduce peak runoff rates from existing levels. In specific areas where there is a known surface water flooding problem a greater reduction will be required.
- Due to the range of the SuDS techniques available at least one "at source" technique should be utilised on all pre-developed sites. The SuDS treatment train should be developed in consultation with the SAB.
- The option for de-culverting and re-naturalisation of watercourses should be considered and where possible improvements to water quality should be made.

Summary of Strategic Cumulative effects

A summary is provided of the assessment of the cumulative effects of development, including opportunities for flood risk management that could be implemented at a strategic level. Recommendations include:-.

- Where the site is located within the upper part of hydrological catchment, opportunities at the site level should be investigated to reduce flood risk downstream.
- Where development can occur in parallel to maximise the benefits of shared flood risk management measures this should be encouraged.
- Development sites are encouraged to achieve a reduction in existing runoff rates / volumes and to look to develop a strategic approach across neighbouring sites to the development of SuDS across the JCS area.
- An overall drainage strategy should be prepared for larger sites that may be developed sequentially to maximise the benefits of a strategic approach.
- Proposals for larger developments should consider the effects of any increase in impermeable area on overall catchment runoff during events which would exceed the site drainage / SuDS systems.
- It is recommended that for sites upstream of Gloucester and other areas with potential for a similar impact of increased runoff that surface water drainage strategies consider a higher level of exceedance i.e. the 0.1% AEP event (1 in 1000 year return period event). This strategy is likely to include the storage and attenuation of surface water on site to assist in the potential downstream impact.

6.3 SITE SPECIFIC POLICY

Below is a summary of the key site specific flood risk management issues recommended in each of the site assessments.

Master planning design considerations

- Many of the sites in this report are developable without the need to carry out any extensive flood risk management work. The avoidance of development in the flood risk areas does not substantially change the developable area of the site. Avoidance of development within a flood zone should be encouraged in the first instance.
- Finished floor levels should be 600mm above the 1% AEP event plus climate change fluvial flood level. Ground floor levels should be above surrounding ground levels to prevent ingress of surface water runoff.
- The SuDS treatment train should be considered early on in the master planning process to allow for the full consideration of surface water management options available.
- If development that resulted in modification of ground levels was to take place within the 1% AEP flood extent then compensatory (level for level) flood storage must be provided. Compensatory flood

storage and adequate flood risk management must show that there is no increase in flood risk elsewhere

- The Environment Agency are entitled to request the full statutory byelaw distance (16 metres) from the top of watercourses bank to be left undeveloped or that sufficient access is provided so that maintenance and emergency response activities can be carried out. This distance should be confirmed with the Environment Agency prior to development of a masterplan. Furthermore, any structure that could affect flood risk within the site may be registered as a flood risk management structure, in which case consent would be required to work on the structure. Appropriate byelaw distances should be agreed with the relevant authority for ordinary watercourses.
- A suitable "buffer zone" (to be determined in site specific assessments) should be defined for all watercourses running across to or bordering development sites where development is avoided to manage localised flood risk, regardless of whether a byelaw distance has been imposed by the relevant authority.
- Any works that lie in, over, under or next to a main river or affect existing flood defences on main rivers will require flood defence consent from the Environment Agency under the Water Resources Act 1991 and the current level of flood protection must be maintained throughout those works. Works affecting ordinary watercourses now require the consent of the Local Authority. Additional consents under the Land Drainage Act may be required if a culvert or structure, such as a weir, is proposed to control flow on any ordinary watercourse.

Emergency Planning

- Site access and egress from the site needs to be considered at site master planning level this is particularly relevant if the existing access crosses an area of high risk flood plain.

- A site-specific flood evacuation plan should be developed for proposed developments within areas identified as being at risk of flooding from surface water, fluvial and reservoir sources (actual and residual risks). This should be reviewed and approved by the councils' emergency planners. The Environment Agency and the emergency planners should be consulted to determine the impacts of the development of the site and if it can be made 'safe'. These can be prepared as part of an FRA for the site or conditioned as part of the planning consent to provide information to site users and occupiers on the risks from flooding to the site and the measures in place to manage those risks.

7. SFRA Maintenance and Management

7.1 Overview

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

7.2 Data Collection

The data sets used in the SFRA were supplied by:

- The Environment Agency
- Gloucestershire County Council
- Gloucester City Council
- Cheltenham Borough Council
- Tewkesbury Borough Council

The table below details the key data sets received from various organisations in order to develop the SFRA. The SFRA is a living document and as such the contents of this table should be updated when the SFRA is revised and new data is incorporated. A record should be kept so that is possible to attribute the data used to inform flood risk at any moment in time throughout the plan period.

Table 8: Data Register

Data	Description	Source
OS Mapping, Mastermap	GIS layer identifying open space, water, roads and urban areas	JCS Local Authorities
LiDAR	Digital topographical data for the catchment with a horizontal resolution of 1m and a vertical accuracy of +/- 0.15m	Environment Agency
Flood Zones, ABDs and Storage Areas	Fluvial flood zones (v201205)	Environment Agency
Flood Defence Asset data	GIS layer showing locations of Flood Defences (Gloucester, Cheltenham only) July 2012.	Environment Agency
Historic Flood data	Historic Flood Map (v201205)	Environment Agency
Level 1 and 2 SFRAs (including GIS data)	As described in Table 1	JCS Local Authorities
Hydraulic Models (various – refer Appendix D)	Hydraulic Models developed primarily for flood mapping purposes.	Environment Agency / Robert Hitchins Ltd
Flood Map for Surface Water (FMfSW)	GIS Layer of Broad Scale modelling of areas potentially at risk of surface water flooding	Environment Agency
Preliminary Flood Risk Assessment (including GIS data)	An overview of all local sources of flood risk. Lead Local Flood Authorities must review these PFRAs every 6 years.	Gloucestershire County Council
Reservoir Inundation Mapping	Potential reservoir breach extents (viewed online)	Environment Agency

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

7.3 Data Ownership

The datasets obtained for use in the SFRA have come from a number of sources, under licence agreement. These datasets cannot be passed to external parties without permission from the owner and those require the data should ensure that they possess the appropriate copyrights and access. The JCS Local Planning Authorities should be aware of the IPR they possess so that they only issue data that is contractually appropriate. Datasets produced during the SFRA are owned by the JCS Local Authorities and can be passed to external parties at their discretion. The key datasets are summarised the table below.

Table 9: Key Datasets

Data	Ownership	Licence Required	Contact
LiDAR	Environment Agency (Robert Hitchins Ltd – Horsbere Model)	Yes	Environment Agency (Geomatics Group)
Flood Zones and ABDs			Environment Agency
Flood Defences			
Hydraulic Models and Outputs			
Reservoir Inundation Mapping			
Flood Map for Surface Water (FMfSW)			
Historic Flood Map			
NFCDD			
Historic flood data	JCS Local Planning Authorities	No, may be confidential	JCS Local Planning Authorities
OS Mapping	Ordnance Survey	Yes	
SFRA reports and Maps	JCS Local Planning Authorities	No	

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

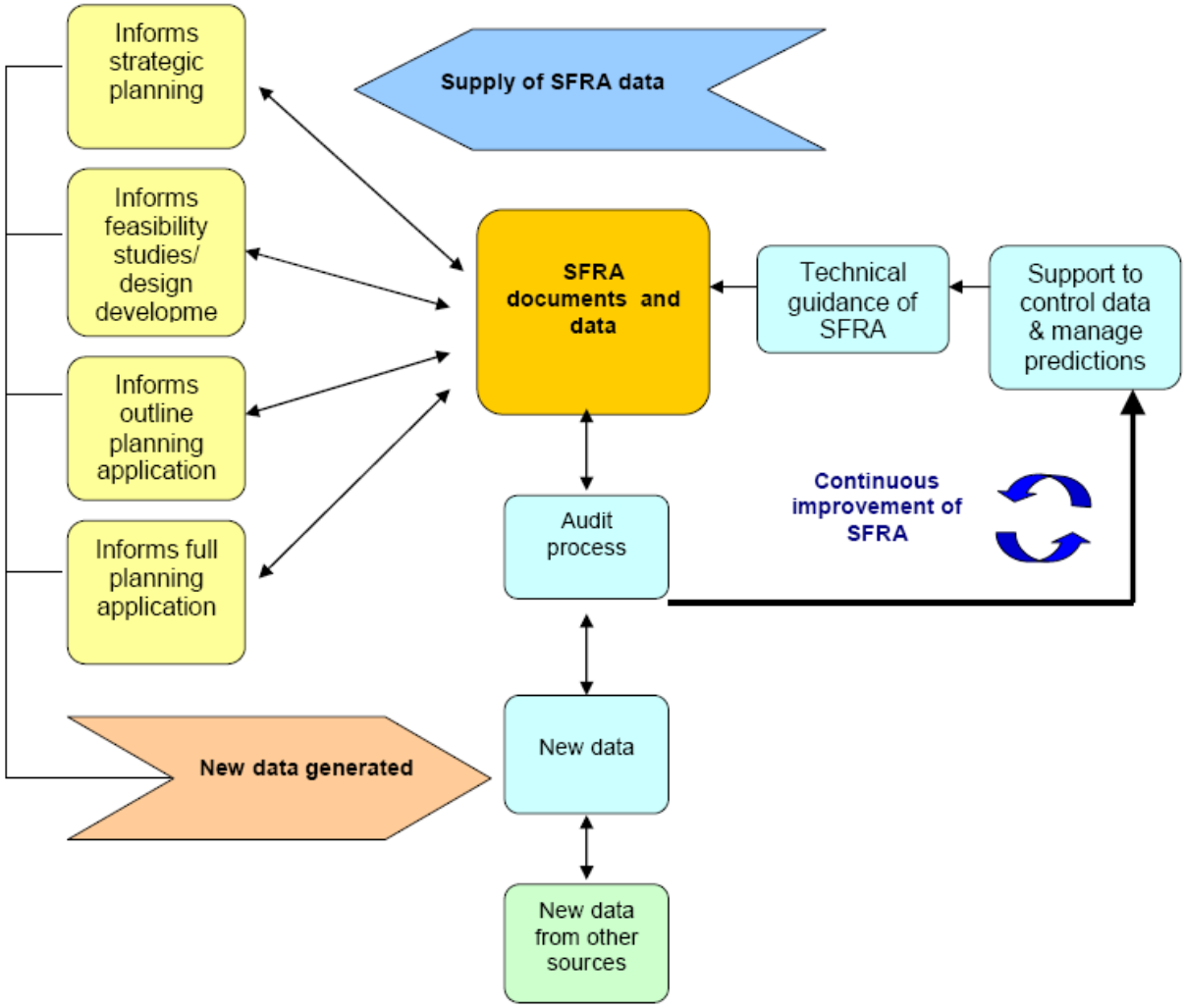
7.4 Data Management System

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

To ensure that the SFRA remains ‘live’ it is important to nominate responsibility for monitoring, managing and maintaining the SFRA, as shown in the figure below. It is recommended that the monitoring of the SFRA is linked to the JCS Councils. By following this process of information dissemination and review, the

management team can ensure a consistent and up to date supply of strategic flood risk information to all levels of the planning process.

Figure 2: Conceptual SFRA Management Process



7.5 MONITORING THE SFRA

It is in the interest of the JCS Councils that the SFRA remains current and up to date. The table below contains a list of datasets that are updated regularly along with the frequency of updates. Updating the SFRA would typically involve obtaining the latest map overlays for example rather than extensive new or updated modelling.

Table 10: Frequency of Dataset Renewal

Datasets	Owner	Frequency of update
Flood Zones	Environment Agency	Quarterly
Catchment Flood Management Plans	Environment Agency	Every five years
National Flood & Coastal Defence Database (NFCDD)	Environment Agency	Ongoing

Datasets	Owner	Frequency of update
Historic flood records	Environment Agency / JCS Councils	Ongoing
Surface Water Flood Maps	Environment Agency	When national modelling is updated (anticipated to be March 2013)

Appendix A Site Assessments - Gloucester

Appendix B Site Assessments - Tewkesbury

Appendix C Site Assessments - Cheltenham

Appendix D Modelling Reports

Appendix E Flood Maps

Appendix F Glossary

Term	Definition
Actual risk	Actual risk is the term given to the flood risk posed from fluvial or tidal sources when taking into account the presence of defences. Where there are no defences then the Actual flood extent is unlikely to differ from the risk presented in the Environment Agency's Flood Zone Maps, however, where defences exist and have been taken into account in detailed modelling then the extents will show the effect that those defences have on flood risk. It should be noted that the Actual risk presented assumes that the flood defences remain effective and fully operational during a flood event and no allowance is made for failure of the defences through breach. If a flood event overtops the defence then the extent reflects the volume of water that overtops the defence and makes no allowance for scour or erosion of the defence under such conditions. Actual risk covers scenarios with a 5%, 1% and 1% plus an allowance for climate change probability of occurring in any given year.
AEP	Annual exceedance of probability. The annual chance of experiencing a flood with the corresponding flood magnitude, i.e. a 1% AEP flood is a flood with a flow magnitude that has a 1% chance of occurring in each and every year
ABD	Areas benefitting from defences. Those areas that are protected against flooding by flood defences with a standard of protection (SoP) equivalent to a 1% AEP flood event.
ABI	Association of British Insurers
Areas Susceptible to Surface Water Flooding (AStSWF)	National scale surface water flood modelling published in 2009. Three bandings are indicated, showing Less to More Susceptible.
Areas Susceptible to Groundwater Flooding (AStGWF)	A strategic scale map showing groundwater flood areas on a 1km square grid. Shows the proportion of each grid square where geological and hydrogeological conditions show that groundwater might emerge.
Breach or failure hazard	Hazards attributed to flooding caused by a breach or failure of flood defences or other infrastructure which is acting as a flood defence.
Building Regulations	Building Regulations promote standards that apply to most aspects of a buildings construction, energy efficiency and the covers drainage and waste disposal
BRE	Building Research Establishment
BW	British Waterways. BW ceased to exist on 2nd July 2012 and it has now been replaced by the Canal and River Trust.
CFMP	Catchment Flood Management Plan: A high-level planning strategy through which the Environment Agency works with their key decision makers within a river catchment to identify and agree policies to secure the long-term sustainable management of flood risk.
CIRIA	Construction Industry Research and Information Association

Term	Definition
Civil Contingencies Act 2004	The Civil Contingencies Act 2004, the bulk of which was enacted in 2005, imposed duties on local bodies to assess the risk of an emergency occurring and to maintain plans for the purposes of responding to emergencies. Emergency includes acts that would have engaged previous civil defence legislation, terrorism and events which threaten serious damage to human welfare or to the environment.
CLG	Communities and Local Government: The Government department responsible for the National Planning Policy Framework (NPPF)**Error! Bookmark not defined.** and the Technical Guidance to the National Planning Policy Framework**Error! Bookmark not defined.**
Climate Change	Long term variations in global temperature and weather patterns caused by natural and human actions.
Consequence	Impact that the flood event would cause if it occurred
DEFRA	Department for Environment, Food and Rural Affairs: The Government department responsible for environmental protection, agriculture, food production and food standards as well as fisheries and rural communities.
DEM	Digital Elevation Model: A 3D model of elevations, usually but not necessarily developed from aerial survey data..
Developable Area	The area or proportion of the site that is developable for a specific type of development/vulnerability class without application of the exception test.
DG5 Register	A water-company held register of properties that have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
Drift Geology	The name for all material of glacial origin found anywhere on land or at sea. Typically refers to deposits of Quaternary age (up to 2.6M years).
DTM	Digital Terrain Model: A 3D model of ground elevations. Often referred to as a "bare-earth" model as features such as buildings and vegetation are removed by a filtering process.
EA	Environment Agency: A non-departmental Agency reporting to DEFRA charged with protecting or enhancing the Environment and managing flood risk and pollution in England.
ESTRY	Hydraulic modelling software developed by WBM to simulate the hydraulics of waterways in 1D. Usually used in combination with a TUFLOW model (see definition below).
Exception Test	The Exception Test should be applied following the application of the Sequential Test. It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, is on developable land, the development is safe and will not increase flood risk elsewhere.
Floodplain	Area of land that borders a watercourse, an estuary or the sea, over which water flows in time of flood, or would flow but for the presence of flood defences where they exist.
Flood Map for Surface Water (FMfSW)	National scale surface water flood modelling published in 2009. Two bandings are provided, 'Surface Water Flooding' and 'Deeper Surface Water Flooding', which indicate surface water flooding greater than 0.1m and greater than 0.3m respectively. There are outputs available for events with a 1 in 30 and 1 in 200 chance of occurring in any given year.
Flood risk	Flood risk is a combination of two components: the chance (or probability) of a particular flood event and the impact (or consequence) that the event would cause if it occurred.

Term	Definition
Flood Hazard	Flood hazard is a function of flood depth, flow velocity and a debris factor (determined by the flood depth). The maximum hazard rating for each point in the 2D hydraulic model is then converted to a flood hazard category:- • Very low caution (very low hazard) • Moderate (danger for some) • Significant (danger for most) • Extreme (danger for all) The guidance is outlined in the DEFRA/Environment Agency research on Flood Risk to People FD2320/TR2 March 2006.
Flood Risk Vulnerability	Classifications presented within the Technical Guidance to the National Planning Policy Framework, which indicates the vulnerability of a specific land-use to flood risk.
FRA	Flood Risk Assessment
Flood risk management	Flood risk management can reduce the probability of occurrence through the management of land, river systems and flood defences, and reduce the impact through influencing development in flood risk areas, flood warning and emergency response.
FRSA	Flood Risk Standing Advice. The Environment Agency's website providing development and flood risk advice for Local Planning Authorities, applicants and agents.
Flood Zones	This refers to the Flood Zones in accordance with Table 1 of the Technical Guidance to the National Planning Policy Framework**Error! Bookmark not defined.**. For the purpose of the SFRA, where the 'actual risk' is referred to this reflects the vulnerability of land to flooding taking into account the presence of flood defences.
FZM	Flood Zone Map. The term used to refer to the Environment Agency's maps that present the currently defined Flood Zones.
Floods and Water Management Act (FWMA)**Error! Bookmark not defined.**	An Act of Parliament which forms part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods. The Act takes forward some of the proposals in three previous strategy documents published by the UK Government – Future Water[4], Making Space for Water**Error! Bookmark not defined.** and the UK Government's response to the Sir Michael Pitt's Review of the Summer 2007 floods[5]. The Act also takes forward parts of the draft Flood and Water Management Bill[6] and takes into account pre-legislative scrutiny of the draft Bill by the Environment, Food and Rural Affairs Committee. The Act was passed in 2010 and is currently being enacted.
Fluvial	Relating to a watercourse (rivers or streams)
FRR	Flood Risk Regulations[7]: Transposition of the EU Floods Directive[8] into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.
Freeboard	The height of the top of a bank, floodwall or other flood defence structure, above the design water level (normally the water level that would occur disregarding any effects from wave action).

[4] Future water: the Government's water strategy for England, February 2008
[5] The Government's Response to Sir Michael Pitt's Review of the Summer 2007 Floods, December 2008
[6] Draft Flood and Water Management Bill, April 2009
[7] Flood Risk Regulations (2009)
[8] EC Floods Directive (2007/60/EC)

Term	Definition
Groundwater	Groundwater is the term used to describe the water stored underground in areas of permeable rocks, known as aquifers. Consistently high levels of groundwater can lead to groundwater flooding.
GEM	The Groundwater Emergence Maps (GEMs) identify those parts of England where, in exceptionally wet winters, groundwater levels could be expected to be at or close to the ground surface. Where possible these maps have been calibrated on observations made in the winter of 2000-01. Where no flooding was reported, or information was not made available, the maps indicated estimated areas based on anticipated groundwater levels using relevant aquifer properties or river baseflow indexes.
Groundwater Rebound	Groundwater rebound is the term given to local or regional groundwater levels that rise back to natural levels as a result of the cessation of activities that had artificially lowered the groundwater level, such as groundwater pumping associated with mining or abstraction of water for use in industrial processes. Because groundwater levels have often been artificially controlled for long periods of time there is risk to vulnerable sub-surface infrastructure built in the intervening time period.
HEC-RAS	Hydraulic modelling software (River Analysis System) developed by the United States Army Hydraulic Engineering Corps (HEC) to simulate the hydraulics of waterways in 1D
ISIS	Hydraulic modelling software developed by Halcrow to simulate the hydraulics of waterways in 1D and 2D.
JFLOW	Hydraulic modelling software developed by JBA to simulate the hydraulics of waterways in 2D.
LFRMS	Local Flood Risk Management Strategy. Under the Flood & Water Management Act 2010**Error! Bookmark not defined.**, a Lead Local Flood Authority (LLFA) must produce a strategy for managing local flood risk from surface run off, ordinary water courses and ground water.
LLFA	Lead Local Flood Authority: Local Authority responsible for taking the lead on local flood risk management. The duties of LLFAs are set out in the Floods and Water Management Act**Error! Bookmark not defined.**.
LiDAR	Light Detection and Ranging, a technique to measure ground and building levels remotely from the air, LiDAR data is used to develop DTMs and DEMs (see definitions above).
LDD	Local Development Documents: Documents describing a Local Planning Authority's strategy for development and use of land within their area of authority. These include Local Plans, Supplementary Planning documents, and Neighbourhood Plans
Local Plan	The plan for the future development of the local area drawn up by the local planning authority in consultation with the community.
Local Sources of Flooding	The flood risk posed from ordinary watercourses, surface water, groundwater, canals and small reservoirs. Any source of flooding other than main rivers, the sea and large reservoirs.
LPA	Local Planning Authority
Main River	Main rivers are a statutory type of watercourse in England and Wales and are usually larger streams and rivers, but may also include some smaller watercourses. A main river is defined as a watercourse marked as such on a main river map. It can include any structure or appliance for controlling or regulating the flow of water in, into or out of a main river. The Environment Agency's powers to carry out flood defence works apply to main rivers only.

Term	Definition
NFCDD	National Flood and Coastal Defence Database. The data held in NFCDD consists of mapping data showing the areas at risk of flooding and data about the defences themselves (their type, location and condition) and the areas that benefit from those defences.
NGR	National Grid Reference
MAFP	Multi-Agency Flood Plan. An emergency plan focussed specifically on the complex issues associated with flooding that can be prepared by a Local Resilience Forum and/or a Local Planning Authority.
NPPF	National Planning Policy Framework (March 2012)**Error! Bookmark not defined.**: the document and its supporting Technical Guidance**Error! Bookmark not defined.** that sets out the Government's planning policies for England and how these are expected to be applied, providing a framework within which local and neighbourhood plans can be produced to reflect local needs and priorities.
Ordinary Watercourse	All watercourses that are not designated main river, and which are the responsibility of Local Authorities or, where they exist, IDBs are termed Ordinary Watercourses.
PAR	Preliminary Appraisal Report. The reporting element of the Preliminary Flood Risk Assessment (PFRA) process
PFRA	Preliminary Flood Risk Assessment: A statutory requirement of the Flood Risk Regulations[7], which implement the requirements of the European Floods Directive[8]. The Floods Directive required PFRAs to be published by 22 December 2011.
PPS25	Planning Policy Statement 25: *Development and Flood Risk* (December 2006)**Error! Bookmark not defined.**. Now replaced, along with its Practice Guide[9], by the National Planning Policy Framework (March 2012)
Probability of Consequence	The probability of a flood event being met or exceeded in any one year. For example, a probability of 1 in 100 corresponds to a 1 per cent or 100:1 chance of an event occurring in any one year.
Receptor	A property, business or land-use that is at risk from flooding.
Residual risk	Flood risks resulting from an event more severe than for which particular flood defences have been designed to provide protection.
RPB	Regional Planning Body
RBMP	River Basin Management Plan. A strategic document that sets out measures to protect and improve the water environment. They have been developed in consultation with organisations and individuals and they identify the main issues for the water environment and the actions that are needed to deal with them.
SAB	SuDS Approval Body. A body that will be set up on the commencement of the National Standards for Sustainable Drainage (likely to be the lead local flood authority) that will be responsible for approving, adopting and maintaining drainage plans and SuDS schemes that meet the National Standards for sustainable drainage systems serving two or more properties.
Sequential risk-based assessment	Priority in allocating or permitting sites for development, in descending order to the Flood Zones set out in Table 1 of the Technical Guidance to the National Planning Policy Framework**Error! Bookmark not defined.**, including the sub divisions in Zone 3. Those responsible for land development plans or deciding applications for development would be expected to demonstrate that there are no reasonable options available in a lower- risk category.

[9] Planning Policy Statement 25: Development and Flood Risk – Practice Guide, December 2009.

Term	Definition
Sequential Test	Test to determine if there are other reasonable available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.
Sewer flooding	Sewer flooding occurs when surface water or foul sewage escapes from the sewerage system due to either hydraulic inadequacy or other causes (blockage, collapse or equipment failure).
SIRS	Sewer Incident Reporting System. A now superseded database of historical incidents associated with United Utilities sewer network. Replaced in 2008 by the Water incident Reporting System (WIRS)
Solid Geology	The bedrock geology underlying soil or drift geology.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection. The actual or design standard of protection afforded by a flood defence, whether formal or informal.
SuDS / SUDS	Sustainable Drainage Systems
Surface water	Any body of water that is not groundwater (for example rivers, estuaries, ponds etc) as well as temporary waters resulting from flooding, run-off etc.
SWMP	Surface Water Management Plan
TUFLOW	Hydraulic modelling software developed by WBM to simulate the hydraulics of waterways in 2D.
WFD	The Water Framework Directive (2000/60/EC)**Error! Bookmark not defined.** came into force in 2000. It was transposed into UK law in 2003 and it establishes a strategic framework for the management of the water environment with the aim of enhancing aquatic ecosystems, promoting the sustainable use of water and reducing water pollution.
Windfall Sites	Sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan

Appendix F: Glossary

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