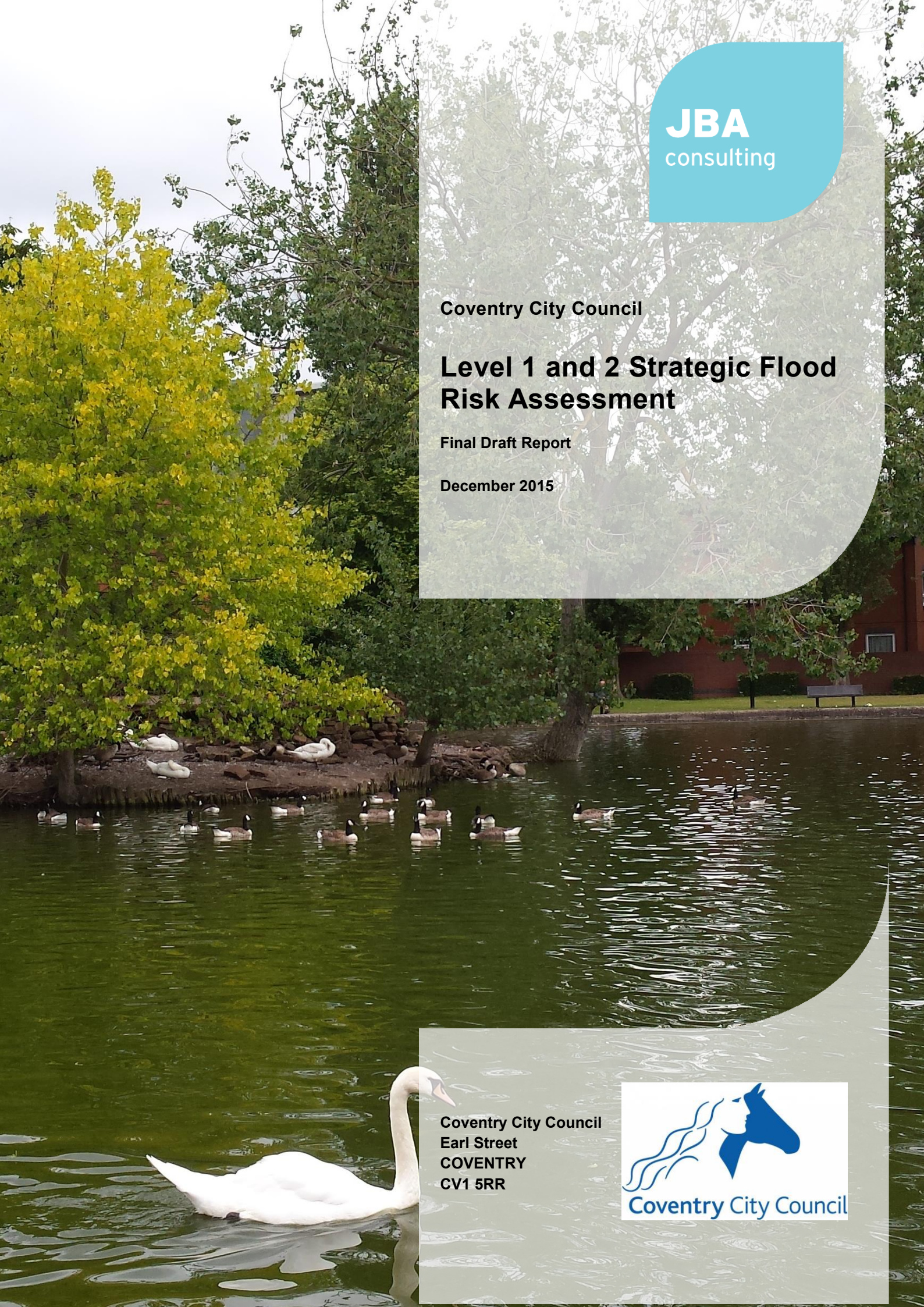

Coventry City Council

Level 1 and 2 Strategic Flood Risk Assessment

Final Draft Report

December 2015

Coventry City Council
Earl Street
COVENTRY
CV1 5RR

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JBA Project Manager

Claire Gardner
The Library
St Philip's Courtyard
Church End
COLESHILL
B46 3AD

Revision History

Revision Ref / Date Issued	Amendments	Issued to
Draft v1.0 (Sept 2015)		• Rob Haigh (Coventry City Council) • Neal Thomas (Coventry City Council) • Martin Ross (Environment Agency)
Final Draft v1.0 (Nov 2015)	Amendments to text based on review comments	• Rob Haigh (Coventry City Council) • Neal Thomas (Coventry City Council) • Martin Ross (Environment Agency)

Contract

This report describes work commissioned by Coventry City Council. The Council's representative for the contract was Rob Haigh.

Prepared by ..... Andrew Waite BSc MRes
Analyst

..... Claire Gardner BSc MSc MCIWEM C.WEM
Chartered Senior Analyst

Reviewed by ..... Alastair Dale BSc PGDip MIAHR
Director

Purpose

This document has been prepared as a Draft Report for Coventry City Council. JBA Consulting accepts no responsibility or liability for any use that is made of this document other than by the Client for the purposes for which it was originally commissioned and prepared.

JBA Consulting has no liability regarding the use of this report except to Coventry City Council.

Acknowledgements

We would like to acknowledge the assistance of Coventry City Council, the Environment Agency, Severn Trent Water, Canal and River Trust, Coventry, Solihull and Warwickshire Resilience Team and planners at the neighbouring authorities of Nuneaton and Bedworth Borough, Rugby Borough, Warwick District, North Warwickshire Borough and Solihull Metropolitan Council.

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Executive Summary

Introduction

This Strategic Flood Risk Assessment (SFRA) 2015 document replaces the Level 1 SFRA originally published by Coventry City Council in July 2008. This report also includes a Level 2 SFRA of possible development locations identified for potential allocation within the Local Plan. The report has been prepared to replace the content included in the previous version of the SFRA and to provide appropriate supporting evidence for the emerging Local Plan.

SFRA objectives

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

1. Level One: where flooding is not a major issue in relation to Strategic Housing Land Availability Assessment (SHLAA) sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
2. Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

The objectives of this SFRA update are a hybrid of Level One and Level Two and seek to:

- provide an updated SFRA (changes to legislation, recent guidance, improved knowledge on flood risk);
- provide a framework for future flood risk analysis through a Level 2 SFRA for potential development locations identified by Coventry City Council; and
- provide a framework for the performance of the Sequential Testing of sites and, where necessary, the consideration of the Exception Test.

The following outputs have been prepared to meet the objectives:

SFRA outputs

Level one outputs

- Appraisal of all potential sources of flooding, including Main River, Ordinary Watercourse, surface water and groundwater.
- Review of historical flooding incidents.
- Mapping of location and extent of functional floodplain.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- An assessment of the potential increase in flood risk due to climate change.
- Areas at risk from other sources of flooding, for example surface water or reservoirs.
- An assessment of the impact of future large-scale developments both within and outside .Coventry
- An assessment of existing flood warning and emergency planning procedures, including assessment of safe access and egress during an extreme event.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- High level screening of proposed development sites against flood risk information.

Level two outputs

The content of the Level Two SFRA includes detailed assessments of potential development sites identified during the Level 1 assessment. These include:

- an assessment of all sources of flooding including
    - fluvial flooding, including depth velocity and hazard mapping;
    - definition and mapping of the functional floodplain;
    - potential increase in flood risk due to climate change;
    - surface water flooding; and
    - groundwater flooding.
- advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff;
- advice on safe access and egress;
- advice on potential strategic solutions to flood risk;
- advice on appropriate policies for sites which could satisfy the first part of the Exception Test and on the requirements that would be necessary for a site-specific Flood Risk Assessment supporting a planning application to pass the second part of the Exception Test; and
- consideration of interrelated issues including.
    - water quality, ecology and green space; and
    - opportunities to restore the natural floodplain.

Summary of Level 1 Assessment

- The SFRA has considered all sources of flooding including fluvial, surface water, groundwater, sewers and reservoir within the study area.
- There are a number of regional policy considerations relating to flood risk management in Coventry City, including Coventry City Council's draft SWMP and LFRMS. Coventry City Council are also preparing a Water Cycle Study.
- The Sequential approach to development and flood risk has been defined with guidance provided for the application of the Sequential and Exception Tests for both the Local Plan and for detailed, site specific flood risk assessments.
- Strategic flood risk solutions have been considered for Coventry, such as the construction of new upstream storage schemes on a number of watercourses, re-naturalisation, considering SuDS at an early stage in the development of a site, and engaging stakeholders to work together to identify issues and provide suitable solutions.
- Emergency planning considerations have been included and the flood warning service coverage assessed; currently there are two Flood Alert Areas and eight Flood Warning Areas (FWAs) covering significant parts of Coventry. Requirements for safe access and egress have also been set out.
- When necessary development and redevelopment within the City Council administrative area shall require a flood risk assessment (FRA) appropriate to the scale of the development and to the scope agreed with the LLFA. The FRA must be produced to the current national and local standards and include information on all current and future flood risk. These documents should utilise the SWMP, PFRA, FRMP and SFRA for Coventry City as sources of information. FRAs should consider flood risk from all sources including residual risk, along with promotion of SuDS to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood. Guidance on flood risk assessments and surface water management has been provided.
- Site-specific FRAs should include assessment of mitigation measures required to safely manage flood risk along with the along with promotion of SuDS to create a conceptual drainage strategy and safe access/ egress at the development in the event of a flood.

The LLFA set out a number of conditions which should be implemented within new or re-developments.

- The potential development sites within the study area were screened to identify sites where additional modelling would be required as part of the Level 2 assessment, for example, sites where there is a watercourse that is not included in the Environment Agency's Flood Zone coverage, or where Flood Zones exist but further modelling was required to identify Flood Zone 3b and climate change as well as depth, velocity and hazard information. New 1D-2D hydraulic models were commissioned as part of this study to understand flood risk at these sites.

  On completion of the modelling, the sites were screened again to provide a summary of risk to each site including: the proportion of the site in each Flood Zone; whether the site is shown at risk in the uFMfSW and, if so, the lowest return period from which the site is at risk; and whether the site is within, or partially within, the Environment Agency's Historical Flood Map. Where sites are shown to be in Flood Zones, flood risk to the potential development sites has been assessed and summarised in more detail in a series of summary tables. There are nine potential development sites for which summary tables have been prepared.

Summary of Level 2 Assessment

Key allocation site issues

The key issues are summarised as follows:

- For all potential allocation sites, with the exception of Walsgrave Hill Farm – Site A (Cov2), the majority of the land within the potential development site is situated within Fluvial Flood Zone 1. Some sites include areas of land that are within a higher Flood Zone, but the Sequential approach to site layout should enable development to be placed outside of higher risk areas.
- Walsgrave Hill Farm – Site A (Cov2) is shown to be highly susceptible to fluvial flooding with approximately 88% of the site located within Flood Zone 2. Consideration is needed on how the site should be developed so that the flood risk is not increased further downstream. The high proportion of the site which is located within the Flood Zones also poses constraints on the implementation of SuDS given that these should be located outside of the 100-year plus climate change flood extent.
- The majority of sites are not associated with major issues regarding surface water flood risk. The only site which is significantly impacted is Walsgrave Hill Farm – Site A (Cov2).
- The following sites are located in groundwater vulnerability zones:
  - Eastern Green SUE Option (bab70).
  - Keresley SUE Option (Cov1).

  This designation requires that special consideration must be taken when including SuDS. A suitable level of treatment should be included prior to discharging, along with establishing an understanding of the constraints applying to particular sites and how SuDS measures can be designed to overcome these in consultation with the relevant bodies (e.g. LLFA).
- Walsgrave Hill Farm – Site C (Cov4) is the only site which has areas within it designated by the Environment Agency as being landfill. For this, site ground investigation will be required to determine the extent of the contamination and the impact this may have on SuDS.
- Walsgrave Hill Farm – Site B (Cov3) and Sutton Stop – Site B (L30) are shown to border Environment Agency designated landfill sites. For these, site ground investigation will be required to determine the extent of the contamination and the impact this may have on SuDS.
- None of the sites specified benefit from formal flood defences. Flood mitigation measures should only be considered if, after a sequential approach, potential development sites cannot be located further away from high risk areas.
- A number of potential development sites are shown to be located in areas where there are concerns over safe access and egress. These sites are listed as follows:

- Canley Regeneration (Cov8).
- Walsgrave Hill Farm – Site A (Cov2).

Consideration must be given so that safe access and egress can be provided to these sites in times of flood from either fluvial flooding or surface water flooding.

- Potential upstream storage should be investigated on the following sites:
  - Eastern Green SUE Option (bab70).
  - Keresley SUE Option (Cov1).
  - Walsgrave Hill Farm – Site C (Cov4).
  - Walsgrave Hill Farm – Site D (Cov4).

  Storage options within these sites have the potential to reduce flood risk downstream from numerous Ordinary Watercourses. This will also attenuation flows from watercourse that contribute to the River Sowe and River Sherbourne, providing protection to other areas of Coventry. This is particular important on the Pickford Brook and Hall Brook which flow through urban areas which existing flood risk issues.
- Pickford Brook requires the development of a detailed hydraulic model of the upper reaches (currently modelled as 2D only) to improve the representation of flood risk through the potential development site.
- When accessing flood risk to Grange Farm (L16) consideration must be given to the influence the pond upstream of the site and what effect this has on flood risk. The pond was represented in the SFRA hydraulic model of the unnamed watercourse using the currently available information on water levels. However, when a site specific FRA is prepared then this feature and the impact of water levels in the pond on flood risk downstream should be investigated in more detail.
- Assessment of flood risk from a breach of the Coventry Canal must be performed when considering applications for development at Grange Farm (L16) which is adjacent to a perched reach. Additionally Sutton Stop – Site B (L30) should also consider the implications of a canal breach.

Recommendations

Site allocations

It is recommended that the outputs from this study are used as an evidence base for the allocation of potential development areas, directing new development to areas of lowest risk. The Council should use the information provided within this SFRA to apply the Sequential Test to their potential site allocations.

The Level 2 detailed site summary tables providing in Appendix A should be used by the Council to apply the Exception Test. In order to pass the Exception Test, the following criteria will need to be met:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk.
- It must be demonstrated that the development will be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall.

These tables also provide information and guidance for developers to be considered at the detailed flood risk assessment and planning application stage.

Future development

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014, when reviewing planning applications for proposed developments at risk of flooding. Planning permission for development affecting watercourses should normally only be granted where:

- the natural watercourse system which provides drainage of land is not adversely affected;
- a minimum 8m width access strip is provided adjacent to the top of both banks of any Main River (5m for Ordinary Watercourses) for maintenance purposes and is appropriately landscaped for open space and biodiversity benefits;

- it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;
- surface water drainage is delivered by SUDS; and
- betterment in the surface water runoff regime is delivered; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk; and
- the application is compliant with conditions set out by the LLFA.

At the planning application stage, developers need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent, inform development zoning within the site and prove, if required, whether the Exception Test can be passed. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk.

Surface water management

Planners should be aware of the conditions for surface water management set out in the SWMP and ensure development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan.

Access

Safe access and egress will need to be demonstrated at development sites. Consideration of alternative access and egress routes should be made in the event that access/ egress routes are inundated with flood water. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered.

Green Infrastructure and WFD

Opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. In addition, consideration should be given to opportunities where it may be possible to improve the WFD status of watercourses, e.g. daylighting culverts, weir removal, river restoration.

Strategic solutions

The information provided in the SFRA should be used as a base for investigating potential strategic flood risk solutions within Coventry. Opportunities to incorporate strategic flood risk solutions, such as storage areas and attenuation ponds, should be investigated as part of potential development proposals. Potential locations which merit further investigation include the upper reaches of the Pickford, Hall and Wyblynd Brooks.

Use of SFRA data

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change. The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA should be **periodically updated** when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by Coventry City Council, the Highways Authority, Canal and River Trust, Severn Trent Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, by checking with the above bodies for any new information to allow a periodic update.

Note on the Environment Agency Flood Map for Planning

Where outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km^2. For this reason, the Flood Map for Planning is not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or

adjacent to the site. Accordingly for site specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue. Where the Flood Map for Planning is based on generalised modelling, developers should undertake a more detailed analysis and assessment of the flood risk at the planning application stage.

Contents

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Abbreviations and Glossary of Terms

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability
Brownfield	Previously developed parcel of land
CC	Climate change - Long term variations in global temperature and weather patterns caused by natural and human actions.
CDA	Critical Drainage Area - A discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure.
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
Cumecs	The cumec is a measure of flow rate. One cumec is shorthand for cubic metre per second; also m^3/s.
Defra	Department for Environment, Food and Rural Affairs
Designated Feature	A form of legal protection or status reserved for certain key structures or features that are privately owned and maintained, but which make a contribution to the flood or coastal erosion risk management of people and property at a particular location.
DG5 Register	A water-company held register of properties which have experienced sewer flooding due to hydraulic overload, or properties which are 'at risk' of sewer flooding more frequently than once in 20 years.
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
FEH	Flood Estimation Handbook
Flood defence	Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).
Flood Risk Area	An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).
Flood Risk Regulations	Transposition of the EU Floods Directive 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.
Floods and Water Management Act	Part of the UK Government's response to Sir Michael Pitt's Report on the Summer 2007 floods, the aim of which is to clarify the legislative framework for managing surface water flood risk in England.
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a main river
FRA	Flood Risk Assessment - A site specific assessment of all forms of flood risk to the site and the impact of development of the site to flood risk in the area.
FRM	Flood Risk Management
FWMA	Flood and Water Management Act
FZ	Flood Zones
GI	Green Infrastructure – a network of natural environmental components and green spaces that intersperse and connect the urban centres, suburbs and urban fringe
Greenfield	Undeveloped parcel of land
Ha	Hectare
Indicative Flood Risk Area	Nationally identified flood risk areas, based on the definition of 'significant' flood risk described by Defra and WAG.
JBA	Jeremy Benn Associates
LFRMS	Local Food Risk Management Strategy
LIDAR	Light Detection and Ranging
LLFA	Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management
LPA	Local Planning Authority

Term	Definition
mAOD	metres Above Ordnance Datum
Main River	A watercourse shown as such on the Main River Map, and for which the Environment Agency has responsibilities and powers
NPPF	National Planning Policy Framework
NRD	National Receptor Database
Ordinary Watercourse	All watercourses that are not designated Main River. Local Authorities or, where they exist, IDBs have similar permissive powers as the Environment Agency in relation to flood defence work. However, the riparian owner has the responsibility of maintenance.
OS NGR	Ordnance Survey National Grid Reference
PFRA	Preliminary Flood Risk Assessment
Pitt Review	Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.
Pluvial flooding	Flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (surface runoff) before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity.
Pound length	Distance of level water impounded between two canal locks.
Qbar	The mean annual flow from a catchment. This is approximately the 2.3-year return period event. Coventry City Council require Qbar to be the natural greenfield runoff rate.
PPG	National Planning Policy Guidance
PPS25	Planning and Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
Resilience Measures	Measures designed to reduce the impact of water that enters property and businesses; could include measures such as raising electrical appliances.
Resistance Measures	Measures designed to keep flood water out of properties and businesses; could include flood guards for example.
Risk	In flood risk management, risk is defined as a product of the probability or likelihood of a flood occurring, and the consequence of the flood.
Return Period	Is an estimate of the interval of time between events of a certain intensity or size, in this instance it refers to flood events. It is a statistical measurement denoting the average recurrence interval over an extended period of time.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SHLAA	Strategic Housing Land Availability Assessment - The Strategic Housing Land Availability Assessment (SHLAA) is a technical piece of evidence to support local plans and Sites & Policies Development Plan Documents (DPDs). Its purpose is to demonstrate that there is a supply of housing land in the District which is suitable and deliverable.
SFRA	Strategic Flood Risk Assessment
SoP	Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100 year standard of protection.
Stakeholder	A person or organisation affected by the problem or solution, or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.
SuDS	Sustainable Drainage Systems - Methods of management practices and control structures that are designed to drain surface water in a more sustainable manner than some conventional techniques
Surface water flooding	Flooding as a result of surface water runoff as a result of high intensity rainfall when water is ponding or flowing over the ground surface before it enters the underground drainage network or watercourse, or cannot enter it because the network is full to capacity, thus causing what is known as pluvial flooding.
SWMP	Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study.
uFMfSW	Updated Flood Map for Surface Water
WFD	Water Framework Directive

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

This issue of the Strategic Flood Risk Assessment (SFRA) 2015 document replaces the Level 1 SFRA originally published by Coventry City Council in January 2008. This 2015 report also includes a Level 2 SFRA of potential development locations identified for potential allocation within the emerging Local Plan. The report has been prepared to replace the content that was included in the previous SFRA and to provide appropriate supporting evidence for the emerging Local Plan.

The 2015 SFRA update will be used in decision making and to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

The key objectives of the review performed during the preparation of the 2015 SFRA are:

2. **To provide an update, taking into account the latest flood risk information and any updates to policy.**

   Since the publication of the last SFRA by Coventry City Council in 2008 there have been a number of changes to policy and guidance. The following are the key changes to policy and guidance which will be updated within this document:

   - Changes to legislation, both relating to flood risk and planning policy, including the Flood Risk Regulations (2009), Flood and Water Management Act (2010), the National Planning Policy Framework (NPPF) (2012), the Localism Act (2011) and the Climate Change Act (2008); and new powers and responsibilities bestowed on Coventry Council as the Lead Local Flood Authority (LLFA) under the Flood and Water Management Act (2010) and their dependencies therefore with the Council's local development and forward planning roles.
   - Recent guidance published in April 2015 regarding the role of LLFAs, Local Planning Authorities and the Environment Agency with regards to SuDS approval.
   - Changes to technical guidance, for example the Consultation on SuDS Regulations and Standards (2011), Defra's Non-statutory technical standards for sustainable drainage systems (March 2015), and NPPF Planning Practice Guidance replacing PPS25 and PPG25.

3. **To provide an update, taking into account the latest flood risk information and any updates to policy.**

   Since the previous SFRA was completed in 2008 there are a number of new data sets available to more accurately assess flood risk in the study area. These datasets will be used within this document to give a more accurate interpretation of flood risk for the study area and include the following

   - improved knowledge of flood risk through modelling and other studies e.g. River Severn Catchment Flood Management Plan (2009), Coventry Preliminary Flood Risk Assessment (2011), and the emerging Coventry Local Flood Risk Management Strategy;
   - draft Coventry Surface Water Management Plan;
   - River Sowe and tributaries fluvial modelling study (2011); and
   - availability of the updated Flood Map for Surface Water (uFMfSW).
   - Publication of the draft Severn Flood Risk Management Plan

4. **To provide individual flood risk analysis for sites identified by the Council as part of their local plan preparation.**

   Local plans set out the Council's spatial strategy to help guide and manage future development in the in the most sustainable way. There have been changes to sites since the 2008 SFRA; the new or amended potential sites will require a detailed assessment under the Level 2 SFRA.

5. **To provide a comprehensive set of maps including, but not limited to**

   - fluvial flood risk, including functional floodplain and climate change;

- surface water risk;
- groundwater risk;
- flood warning coverage;
- WFD and green infrastructure; and
- depth, hazard and velocity mapping, where available.

1.2 SFRA objectives

The Planning Practice Guidance advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

1. Level One: where flooding is not a major issue and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
2. Level Two: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the NPPF's Exception Test. In these circumstances the assessment should consider the detailed nature of the flood characteristics within a Flood Zone and assessment of other sources of flooding.

The objectives of this SFRA update are a hybrid of Level One and Level Two.

1.3 SFRA outputs

To meet the objectives the following outputs have been prepared:

1.3.1 Level one outputs

- Appraisal of all potential sources of flooding, including Main River, Ordinary Watercourse, surface water and groundwater.
- Updated review of historical flooding incidents.
- Mapping of location and extent of functional floodplain.
- Reporting on the standard of protection provided by existing flood risk management infrastructure.
- An assessment of the potential increase in flood risk due to climate change.
- Areas at risk from other sources of flooding, for example surface water or reservoirs.
- An assessment of the impact of future large-scale developments both within and outside Coventry.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and sequential approach to flood risk.
- High level screening of proposed development sites against flood risk information.

1.3.2 Level two outputs

The content of the Level Two SFRA includes detailed assessments of potential development sites identified during the Level 1 assessment. These include:

- an assessment of all sources of flooding including
    - fluvial flooding, including depth velocity and hazard mapping;
    - definition and mapping of the functional floodplain;
    - potential increase in flood risk due to climate change;
    - surface water flooding; and
    - groundwater flooding.
- advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff;

- advice on safe access and egress;
- advice on potential strategic solutions to flood risk;
- advice on appropriate policies for sites which could satisfy the first part of the Exception Test and on the requirements that would be necessary for a site-specific Flood Risk Assessment supporting a planning application to pass the second part of the Exception Test; and
- consideration of interrelated issues including:
    - water quality, ecology and green space; and
    - opportunities to restore the natural floodplain.

1.4 Approach

1.4.1 General assessment of flood risk

The flood risk management hierarchy underpins the risk-based approach and is the basis for making all decisions involving development and flood risk. When using the hierarchy, account should be taken of

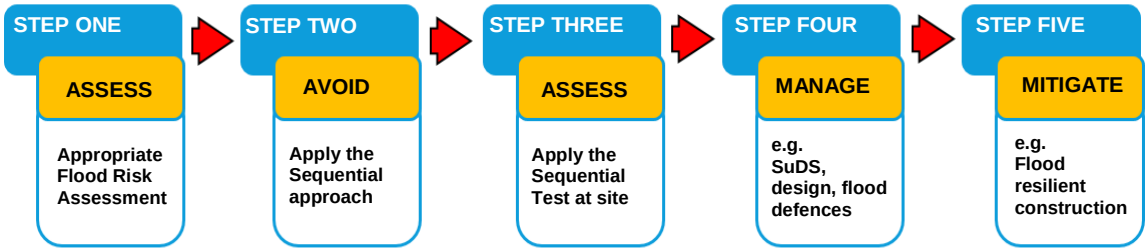
- the nature of the flood risk (the ***source*** of the flooding);
- the spatial distribution of the flood risk (the ***pathways*** and areas affected by flooding);
- climate change impacts; and
- the degree of vulnerability of different types of development (the ***receptors***).

Developments should reflect the application of the Sequential Test using the maps produced for this SFRA. The information in this SFRA should be used as evidence and, where necessary, reference should also be made to relevant evidence in other documents referenced in this report. The Flood Zone maps and flood risk information on other sources of flooding contained in this SFRA should be used where appropriate to apply the Sequential Test.

Where other sustainability criteria outweigh flood risk issues, the decision making process should be transparent. Information from this SFRA should be used to justify decisions to allocate land in areas at high risk of flooding.

The flood risk management hierarchy is summarised in Figure 1-1

Figure 1-1: Flood Risk Management Hierarchy



1.4.2 Technical assessment of flood hazards

Flood risk within Coventry has been assessed using results from computer models supplied by the Environment Agency, existing Environment Agency Flood Zone mapping and additional hydraulic modelling undertaken for the SFRA. The location of the watercourses modelled for the SFRA are shown in Figure 4-3. The following models have been used:

- 1D-2D River Sowe Modelling and Mapping (EA, 2011).
- 1D-2D Canley Brook Modelling and Mapping (EA, 2011).
- 1D-2D Hall Brook Modelling (2015 – undertaken for this SFRA).
- 1D-2D Pickford Brook Modelling (2015 – undertaken for this SFRA).
- 1D-2D modelling of a tributary of the Canley Brook (2015 – undertaken for this SFRA).
- 1D-2D modelling of a tributary of the River Sowe (2015 – undertaken for this SFRA).

1.5 Consultation

The following parties (external to Coventry City Council) have been consulted during the preparation of this version of the SFRA:

- Environment Agency
- Severn Trent Water
- Canal and River Trust
- Coventry, Solihull and Warwickshire Resilience Team
- Neighbouring authorities including
    - Nuneaton and Bedworth Borough;
    - Rugby Borough;
    - Warwick District;
    - North Warwickshire Borough; and
    - Solihull Metropolitan.

1.6 SFRA user guide

Table 1-1: SFRA report contents

Section	Contents
1. Introduction	Provides a background to the study, defines objectives, outlines the approach adopted and the consultation performed.
2 The Planning Framework and Flood Risk Policy	Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study.
Level One Strategic Flood Risk Assessment	
3. How flood risk is assessed	Provides an overview of flooding and risk, Flood Zones, and what they mean.
4.The Sequential, risk based approach	Describes the Sequential approach and application of Sequential and Exception Tests. Describes the modelling and data used for the assessment. Outlines mapping that should be used for the Sequential and Exception Tests
5. Understanding flood risk in Coventry	Gives an introduction to the assessment of flood risk and provides an overview of the characteristics of flooding affecting Coventry City.
6. Flood risk from canals and reservoirs	Summarises the flood risk to Coventry from canals and reservoirs.
7. Cumulative impact of development and cross-boundary issues	Broad scale assessment of areas where the cumulative impact of development may be detrimental to flood risk. An assessment of potential cross boundary flood risk issues as a result of future large scale developments.
8. FRA requirements and guidance for developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. Provides guidance for developers and outlines conditions set by the LLFA that should be followed.
9. Surface water management and SuDS	Advice on managing surface water run-off and flooding
10. Flood warning and emergency planning	Outlines the flood warning service in Coventry and provides advice for emergency planning, evacuation plans and safe access and egress.
11. Flood risk management and policy considerations	Identifies policies at various scales which apply to the SFRA, summarising their implications on development.

Section	Contents
12. Level 1 assessment of potential development sites	Summarise the flood risk from all sources to all sites supplied by Coventry City Council for assessment in the SFRA. Outlines which sites have been taken forward to the Level 2 assessment.
Level Two Strategic Flood Risk Assessment	
12. Level 2 Assessment of potential development sites	Detailed assessment of specific sites to determine variations in flood risk across the site and identify any site-specific flood risk assessment requirements.
13. Green Infrastructure and Water Framework Directive	Summarises the importance and role of Green Infrastructure. Describes the purpose and objectives of the Water Framework Directive and provides an assessment of the current ecological status of watercourses within the Coventry City and implications for development.
14. Strategic Flood Risk Solutions	Identifies potential strategic solutions.
Summary and recommendations	
15. Summary	Reviews Level 1 and Level 2 SFRA.
16. Recommendations	Identifies recommendations for the council to consider as part of Flood Risk Management policy.

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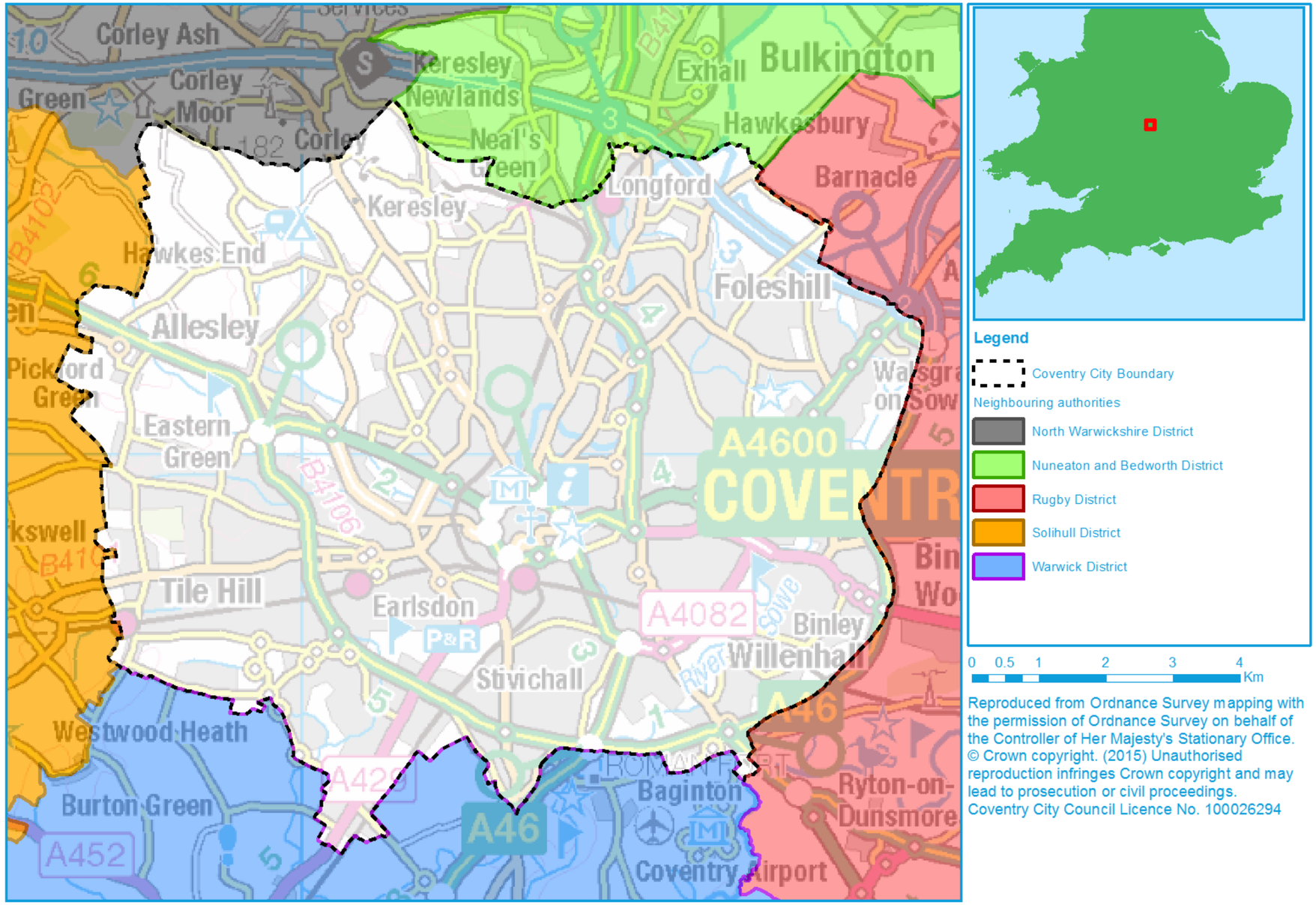
Figure 1-2: Study area



2 The Planning Framework and Flood Risk Policy

2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

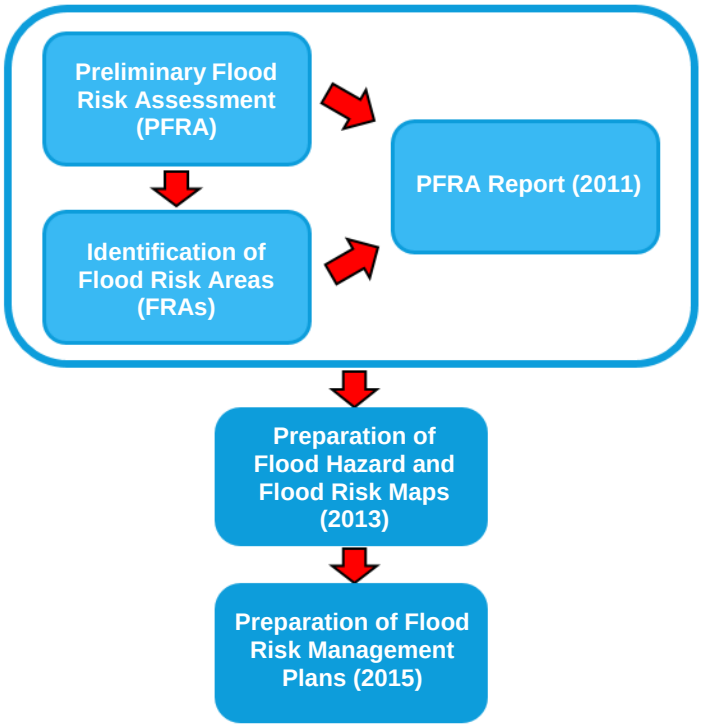
2.2 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

2.2.1 Flood Risk Regulations, 2009

The Flood Risk Regulations (2009) are intended to translate the current EU Floods Directive into UK law and place responsibility upon all Lead Local Flood Authorities (LLFAs) to manage localised flood risk. Under the Regulations, the responsibility for flooding from rivers, the sea and reservoirs lies with the Environment Agency; however, responsibility for local and all other sources of flooding rests with LLFAs. In the instance of this SFRA, the LLFA is Coventry City Council (a Unitary Authority).

Figure 2-1 illustrates the steps that have / are being taken to implement the requirements of the EU Directive in the UK via the Flood Risk Regulations.

Figure 2-1: Flood Risk Regulation Requirements



Under this action plan and in accordance with the Regulations, LLFAs had the task of preparing a Preliminary Flood Risk Assessment (PFRA) report. The PFRA document that covers the study area was published by Coventry City Council in 2011[1].

Under the Regulations the Environment Agency exercised an 'Exception' and did not prepare a PFRA for risk from rivers, reservoirs and the sea. This then made it a requirement for the Environment Agency to prepare and publish a Flood Risk Management Plan (FRMP). The FRMP process adopts the same catchments as used in the preparation of River Basin Management Plans, in accordance with the Water Framework Directive. Accordingly a

[1] Coventry City Council PFRA (2011): http://www.coventry.gov.uk/downloads/download/1594/coventry_pfra_final_report

consultation draft of the River Severn Flood risk Management Plan was issued in 2014 and the final version of the plan is issued in December 2015[2]. The FRMP draws on previous policies and actions identified in Catchment Flood Management Plans and also incorporates information from Local Flood Risk Management Strategies. There are 10 catchments covered by the river Severn Basin and Coventry lies at the head of the Warwickshire Avon Catchment area. The FRMP summarises the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations.

2.2.2 Flood and Water Management Act, 2010

The Flood and Water Management Act (2010)[3] aims to create a simpler and more effective means of managing both flood risk and coastal erosion and implements Sir Michael Pitt's recommendations following his review of the 2007 floods. The FWMA received Royal Assent in April 2010.

Coventry City Council as LLFA has to develop a Local Flood Risk Management Strategy under the Act, in consultation with local partners. This is discussed further in Section 2.2.5. This Strategy acts as the basis and discharge of duty for Flood Risk Management co-ordinated by Coventry City Council. The draft strategy was published for consultation in spring 2015.

Local authorities are responsible for flooding management relating to 'Ordinary Watercourses' (i.e. smaller ditches, brooks), with the Environment Agency responsible for 'Main Rivers'.

When considering planning applications, Local Planning Authorities should consult LLFAs on the management of surface water in order to satisfy that:

- the proposed minimum standards of operation are appropriate
- through the use of planning conditions or planning obligations, there are clear arrangements for on-going maintenance over the development's lifetime.

The FWMA will also update the Reservoirs Act 1975 by reducing the capacity of reservoir regulation from 25,000m^3 to 10,000m^3. Phase 1 has been implemented in 2013 requiring large raised reservoirs to be registered to allow the Environment Agency to categorise whether they are 'high risk' or 'not high risk'.

2.2.3 Lead Local Flood Authorities

The FWMA established Lead Local Flood Authorities (LLFAs). Coventry City Council is also the LLFA for the Coventry City administrative area. Duties for LLFAs include:

- Local Flood Risk Management Strategy (LFRMS): LLFAs must develop, maintain, apply and monitor an LFRMS to outline how they will manage flood risk, identify areas vulnerable to flooding and target resources where they are needed most.
- Flood Investigations: When appropriate and necessary LLFAs must investigate and report on flooding incidents (Section 19 investigations).
- Register of Flood Risk Features: LLFAs must establish and maintain a register of structures or features which, in their opinion, are likely to have a significant effect on flood risk in the LLFA area.
- Designation of Features: LLFAs may exercise powers to designate structures and features that affect flood risk, requiring the owner to seek consent from the authority to alter, remove or replace it.
- Consenting: When appropriate LLFAs will perform consenting of works on Ordinary Watercourses.

On 18 December 2014 a Written Ministerial Statement laid by the Secretary of State for Communities and Local Government set out changes to the planning process that would apply for major development from 6 April 2015. In considering planning applications, local planning authorities should consult the LLFA on the management of surface water, satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, and through use of

[2] https://consult.environment-agency.gov.uk/portal/ho/flood/draft_frmp/consult?pointId=s1407245230549#section-s1407245230549

[3] Flood and Water Management Act (2010): http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

planning conditions or obligations, that there are clear arrangements in place for ongoing maintenance over the lifetime of the development.

In March 2015 the LLFA was made a statutory consultee which came into effect on 15 April 2015. As a result, Coventry City Council, will be required to provide technical advice on surface water drainage strategies and designs put forward for new major developments.

Major developments are defined as

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- Non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of 1 hectare or more.

2.2.4 Coventry Preliminary Flood Risk Assessment (2011)

The Flood Risk Regulations required Coventry City Council (as the LLFA) to prepare and publish a Preliminary Flood Risk Assessment (PFRA) on past and future flood risk from sources of flooding. The PFRA reports on significant past and future flooding from all sources except from Main Rivers and Reservoirs, which are covered by the Environment Agency, and sub-standard performance of the adopted sewer network (covered under the remit of Severn Trent Water).

The PFRA is a high-level screening exercise and considers floods which have significant harmful consequences for human health, economic activity, the environment and cultural heritage. The Regulations require the LLFA to identify significant Flood Risk Areas. The threshold for designating significant flood Risk Areas is defined by Defra and the PFRA is the process by which these locations can be identified. Of the ten national indicative Flood Risk Areas that were identified by the Defra/Environment Agency, none encroach on the administrative area of Coventry City Council and the indicative designations have been accepted.

The following Flood Risk Areas were identified based on critical infrastructure/access routes, sewer/surface water problems and areas prone to significant ponding:

- City Centre
- Sherbourne Fields
- Kingfield Road
- Bennetts Road
- Hen Lane
- Duggins Lane

None of these sites were considered to be nationally significant on the basis of the threshold identified by Defra.

2.2.5 Draft Coventry Local Flood Risk Management Strategy (2015)[4]

Coventry City Council is responsible for developing, maintaining, applying and monitoring a Local Flood Risk Management Strategy for Coventry. The Strategy is used as a means by which the LLFA (Coventry City Council) co-ordinates Flood Risk Management on a day to day basis. The Strategy also sets measures to manage local flood risk i.e. flood risk from surface water, groundwater and Ordinary Watercourses. The Environment Agency is responsible for managing flooding from main rivers and reservoirs, with the LLFA responsible for managing Ordinary Watercourses. The high-level objectives proposed in the Strategy for managing flood risk are:

1. Collaborative working.
2. Understand local flood risk.
3. Natural and historical environmental enhancements.
4. Support communities to become more resilient to flooding.
5. Engage with riparian owners.
6. Manage local flood risk through sustainable development policies and practices.

[4] http://www.coventry.gov.uk/downloads/file/15985/coventry_local_flood_risk_management_strategy_draft

7. Achieve an economically sustainable approach to managing flood risk.

The Strategy also sets out an action plan of how the LLFA intends to achieve these objectives. The action plan sets contains the following information:

- The objective the action relates to.
- The aim of the action.
- The timescale for implementation of the action.
- Potential funding sources.
- Action partners.
- Sources of information.

The Strategy will be updated every three years and the action plan updated annually. Key triggers such as amendments to partner responsibilities, updates to legislation, alterations in the nature or understanding of flood risk or a significant flood event, may also require the update of the Strategy and action plan.

2.3 Localism Act

The Localism Act outlined plans to shift and re-distribute the balance of decision making from central government back to councils, communities and individuals. The Localism Act was given Royal Assent on 15 November 2011.

In relation to the planning of sustainable development, provision 110 of the Act places a duty to cooperate on Local Authorities. This duty requires Local Authorities to "engage constructively, actively and on an ongoing basis in any process by means of which development plan documents are prepared so far as relating to a strategic matter" [5].

The Localism Act also provides new rights to allow local communities to come together and shape new developments by preparing Neighbourhood Plans. This means that local people can decide not only where new homes and businesses should go and but also what they should look like. As neighbourhoods draw up their proposals, Local Planning Authorities will be required to provide technical advice and support.

2.4 National Planning Policy Framework

The National Planning Policy Framework (NPPF)[6] was issued on 27 March 2012 to replace the previous documentation as part of reforms to, firstly, make the planning system less complex and more accessible, and, secondly, to protect the environment and promote sustainable growth. It replaces most of the Planning Policy Guidance Notes (PPGs) and Planning Policy Statements (PPSs) that were referred to in the previous version of the SFRA. The NPPF is a source of guidance for local planning authorities to help them prepare Local Plans and for applicants preparing planning submissions.

Paragraph 100 of the NPPF:

> ***"Local Plans should be supported by a strategic flood risk assessment and develop policies to manage flood risk from all sources, taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as Lead Local Flood Authorities and Internal Drainage Boards. 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".***

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. NPPF sets out Flood Zones, the appropriate land uses for each

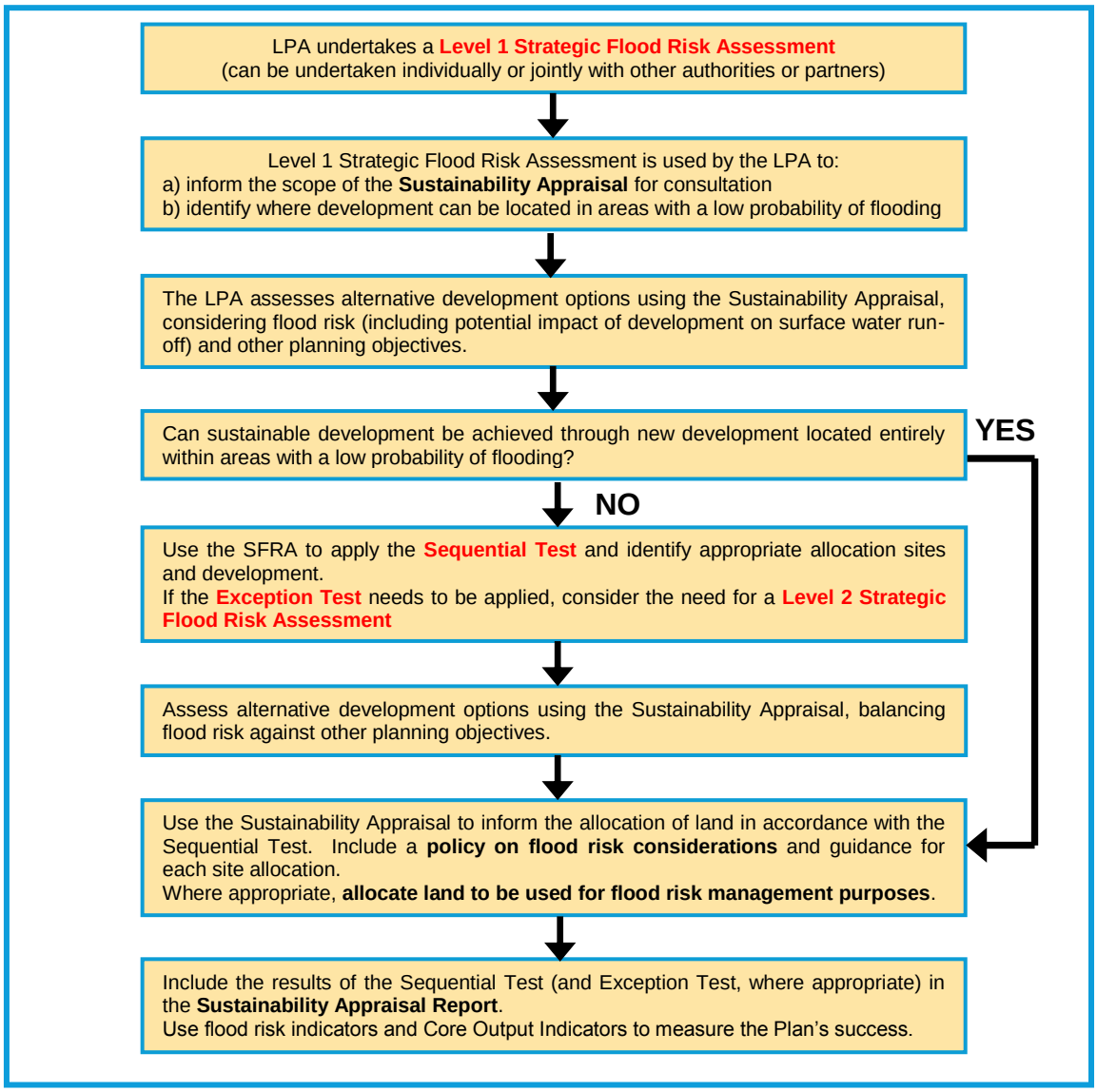
[5] Localism Act 2011: Section 110. http://www.legislation.gov.uk/ukpga/2011/20/section/110

[6] National Planning Policy Framework (Department for Communities and Local Government, March 2012)

zone, flood risk assessment requirements and the policy aims for developers and authorities regarding each Flood Zone. Further details on Flood Zones and associated policy is provided in Table 3-1 and throughout this report.

A description of how flood risk should be taken into account in the preparation of Local Plans is outlined in Diagram 1 contained within the Planning Practice Guidance (Figure 2-2).

Figure 2-2: Flood risk and the preparation of Local Plans†



† Based on Diagram 1 of NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 004, Reference ID: 7-005-20140306) March 2014

2.5 Water Cycle Studies

Climate Change is predicted to present unprecedented new challenges, such as more frequent and extreme rainfall events and rising global temperatures, which are expected to exert greater pressure on the existing infrastructure. Planning for water management therefore has to take these potential challenges into account. A large number of new homes for instance may cause the existing water management infrastructure to be overwhelmed which would result in adverse effects on the environment, both locally and in wider catchments.

Water Cycle Studies assist Local Authorities to select and develop sustainable development allocations so that there is minimal impact on the environment, water quality, water resources, and infrastructure and flood risk. This can be achieved in areas where there may be conflict between any proposed development and the requirements of the environment through the recommendation of potential sustainable solutions.

A Water Cycle Study for Coventry City Council is currently being prepared.

2.6 'The Ripple Effect'[7]

The Ripple Effect is a report exploring the impacts of climate change on urban water systems and proposes methods for identifying ways to build resilience and incorporate water sensitive design in a cost efficient manner. The document was commissioned by UK Technology Strategy Board and Defra and carried out by AECOM and Severn Trent Water in collaboration with Birmingham City Council and Coventry City Council. The report highlights the following key issues within Coventry:

1. Culverted Sherbourne: The watercourse is culverted for the majority of it length under the city centre. This reduces the capacity to support life and has adverse effects on the overall water quality. Additionally the culvert is susceptible to blockage or being overwhelmed by an extreme storm event.
2. Surface Water runoff: Given the highly built up and impermeable nature of the city centre surface water is a significant flood risk to the City.
3. Water efficiency: There is a continual need to reduce the demand for water, helping build resilience of water supply in the West Midlands for the future.

The report gives 10 potential options which could be incorporated in to the regeneration strategy for Coventry City. These options include daylighting the River Sherbourne, providing SuDS retrofit and implementing wide scale water recycling techniques. These potential options are discussed in greater detail in Section 15.

2.7 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. SWMPs establish a long-term action plan to manage surface water in a particular area and are intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

2.7.1 Draft Coventry SWMP (2015)

The SWMP identified the following main flood risks:

- Fluvial flood risk:
  - Main rivers response to rainfall events.
  - Ordinary watercourse response to rainfall events.
- Underground conduits and sewers:
  - Severn Trent Water sewers.
  - Highway drainage.
- Private drainage systems.
- Groundwater.
- Surface water.
- Areas of Critical Drainage problems.

The SWMP sets out current and future actions the Council will implement in the management of surface water flooding:

- Ongoing actions
  - Engage with professional partners to develop flood alleviation schemes.

[7] 'The Ripple Effect': http://www.aecom.com/deployedfiles/Internet/Capabilities/Design%20and%20Planning/Sustainability/SuDS/The%20Ripple%20Effect.pdf

- Planning and development controls to outline the key requirements for the management of surface water.
- Produce an asset register to identify assets within the area.
- Planned maintenance to minimise flood risk from all sources.
- Highway maintenance.
- Reactive maintenance and emergency response.
- Hazard mapping to allow predictions of where flooding could occur.
- Identification of Critical Drainage Problem Areas.
- Flood investigations and allocation of responsibility.

- Future actions:
  - Undertake a hydraulic study of Bablake Ward.
  - SuDS policy and production of SuDS technical guidance.
  - Produce a Community Engagement Plan to allow communities to engage with the Council and partners to promote community engagement.
  - SuDS retrofit.

In addition to the current and future actions, the SWMP discusses conditions that the LLFA will impose upon all developments to reduce the flood risk from development and ensure that future development is resilient to flooding and is sustainable. This is discussed in more detail in Section 8.7.

The SWMP will be reviewed and reissued every three years.

2.8 Catchment Flood Management Plans

Catchment Flood Management Plans (CFMPs) are a high-level strategic plan providing an overview of flood risk across each river catchment. The Environment Agency use CFMPs to work with other key-decision makers to identify and agree long-term policies for sustainable flood risk management.

There are six pre-defined national policies provided in the CFMP guidance and these are applied to specific locations through the identification of 'Policy Units'. These policies are intended to cover the full range of long-term flood risk management options that can be applied to different locations in the catchment.

The six national policies are:

1. no active intervention (including flood warning and maintenance). Continue to monitor and advise.
2. reducing existing flood risk management actions (accepting that flood risk will increase over time).
3. continue with existing or alternative actions to manage flood risk at the current level (accepting that flood risk will increase over time from this baseline).
4. take further action to sustain the current level of flood risk (responding to the potential increases in risk from urban development, land use change and climate change).
5. take action to reduce flood risk (now and/or in the future)
6. take action with others to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits, locally or elsewhere in the catchment.

2.8.1 River Severn CFMP (2009)

The study area is covered by the River Severn CFMP. The primary policy unit for Coventry is 'Policy Unit 13: Coventry Cluster'[8]. The area is covered by Policy Option 5, which is for areas of moderate to high flood risk when the EA can generally take further action to reduce flood risk. The proposed actions to implement this policy are the following:

[8] https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/289103/River_Severn_Catchment_Management_Plan.pdf

- Ensure floodplains are not inappropriately developed. Follow the 'sequential approach' of NPPF and consider land swapping opportunities.
- Encourage compatibility between urban open spaces and their ability to make space for rivers to expand as flood flows occur i.e. use of playing fields. Develop strategies to create 'blue corridors' by developing/redeveloping to link these flood-compatible spaces.
- Raise awareness of flooding among the public and key partners.
- Develop better understanding of flooding from surface water, from drainage systems, and from 'non-main' watercourses.
- Maintain flood warning systems and explore opportunities to improve their effectiveness and coverage.

2.9 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assesses the pressure facing the water environment in River Basin Districts. The WFD aims to achieve at least 'good' status for all water bodies by 2015. The Coventry City Council area falls within the Severn River Basin District.

2.9.1 Severn River Basin Management Plan (2009)

The Severn RBMP identified a number of pressures on the water environment including:

- Abstraction and other artificial flow regulation.
- Non-native species.
- Nitrate.
- Pesticides.
- Phosphate.
- Physical modification.
- Sediment.
- Urban and transport pollution.

The RBMP describes how development planning needs to consider a number of issues relevant to the RBMP including housing locations, sewage treatment options, initiatives to reduce flow to sewage works, water efficiency measures and the reduction of nutrients from diffuse pollution.

The RBMP recognised that 76% of surface water bodies in the Severn River Basin District will not achieve the WFD target of 'good' status by 2015. The RBMP states that greater improvement is limited by understanding of pressures on the water environment, their sources and the action required to tackle them.

2.10 Association of British Insurers Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England

The Association of British Insurers (ABI) and the National Flood Forum have published guidance for Local Authorities with regards to planning in flood risk areas[9]. The guidance aims to assist Local Authorities in England in producing local plans and dealing with planning applications in flood risk areas. The guidance complements the National Planning Policy Framework. The key recommendations from the guidance are:

- Ensure strong relationships with technical experts on flood risk.
- Consider flooding from all sources, taking account of climate change.
- Take potential impacts on drainage infrastructure seriously.
- Ensure that flood risk is mitigated to acceptable levels for proposed developments.
- Make sure Local Plans take account of all relevant costs and are regularly reviewed.

[9] Guidance on Insurance and Planning in Flood Risk Areas for Local Planning Authorities in England (Association of British Insurers and National Flood Forum, April 2012)

2.11 Implications for Coventry City

The new and emerging responsibilities under the Flood and Water Management Act 2010 and the Flood Risk Regulations 2009 are summarised in Table 2-1.

Table 2-1: Roles and responsibilities in Coventry City

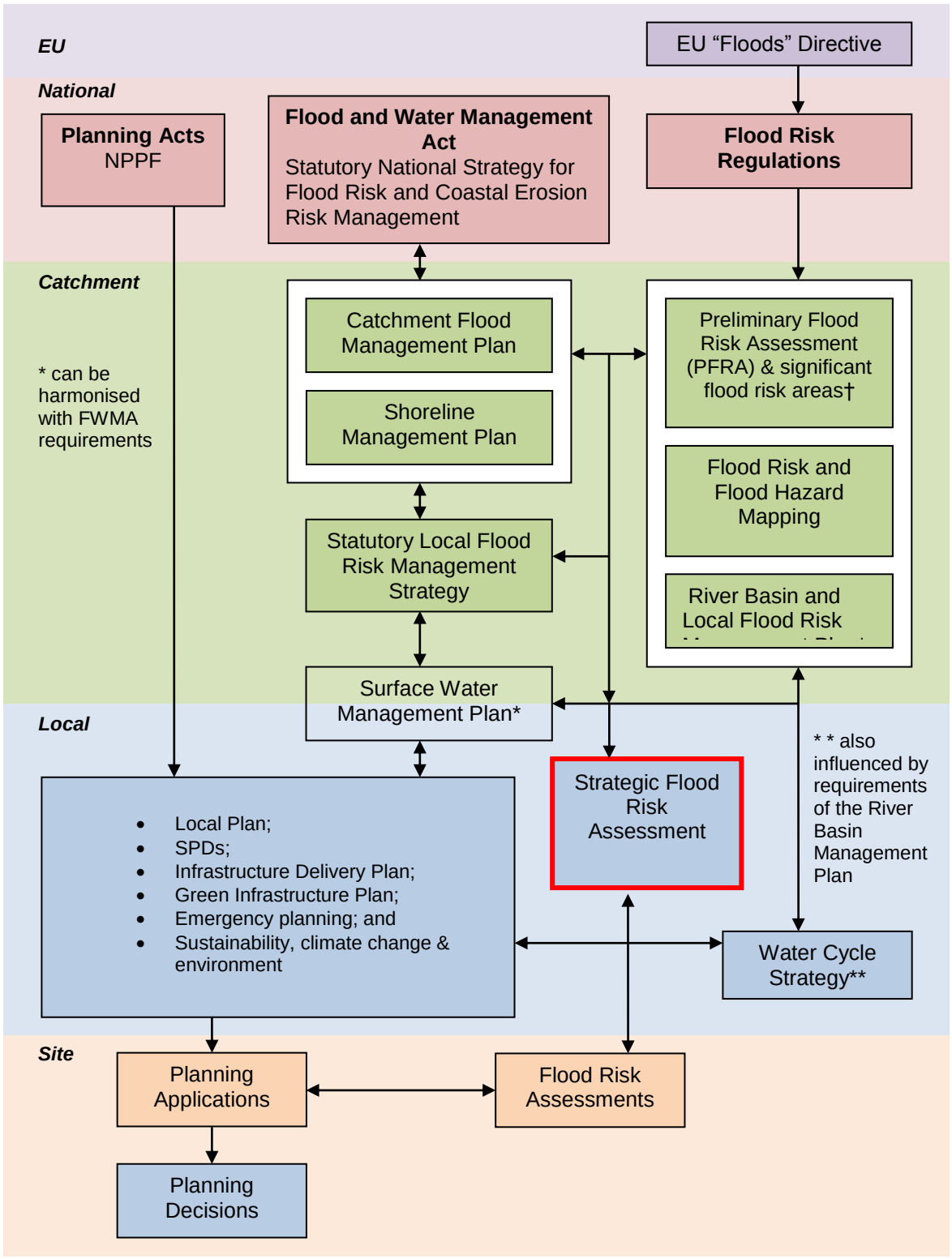
Risk Management Authority (RMA)	Strategic Level	Operational Level
Environment Agency	National Statutory Strategy Reporting and supervision (overview role)	• Preliminary Flood Risk Assessment (per River Basin District)* • Managing flooding from main rivers and reservoirs and communication flood risk warnings to the public, media and partner organisations. • Identifying Significant Flood Risk Area* • Preparation of Flood Risk and Hazard Maps • Preparation of Flood Risk Management Plan • Enforcement authority for Reservoirs Act 1975 • Managing RFCCs and supporting funding decisions, working with LLFAs and local communities. • Emergency planning and multi-agency flood plans, developed by local resilience forums
Lead Local Flood Authority (Coventry County Council)	Input to National Strategy. Formulate and implement Local Flood Risk Management Strategy.	• Responsible for enforcing and consenting works for Ordinary Watercourses, risk assessing Ordinary Watercourses. • Managing local sources of flooding from surface water runoff and groundwater and carrying out practical works to manage flood risk from these sources where necessary. • Preparing and publishing a PFRA • Identifying Flood Risk Areas • Preparing Flood Hazard and Flood Risk Maps • Preparing Flood Risk Management Plans (where local flood risk is significant) • Investigating certain incidents of flooding in Section 19 Flood Investigations • Statutory roles in planning for surface water drainage. • Keeping asset registers of structures and features which have a significant effect on local flood risk. • Acting consistently with LFRMS in realising FRM activity and have due regard in the discharge of other functions of the strategy
Local Planning Authority (Coventry City Council)	Input to National and Local Authority Plans and Strategy (e.g. *Coventry Local Plan* – to develop a spatial strategy for growth within the area which accounts for flood risk)	• Preparation of a Local Plan to guide development. • The competent determining authority for planning applications and have the ultimate decision on the suitability of a site in relation to flood risk and management of surface water run-off. • Responsibilities for emergency planning as a responder to a flood event. • Own and manage public spaces which can potentially be used for flood risk management.

* – Environment Agency did not prepare a PFRA; instead they exercised an exception permitted under the Regulations

Figure 2-3 outlines the key strategic planning links for flood risk management and associated documents. It shows how the Flood Risk Regulations and Flood and Water Management Act, in conjunction with the Localism Act's "duty to cooperate", introduce a wider requirement for the mutual exchange of information and the preparation of strategies and management plans.

SFRAs contain information that should be referred to in responding to the Flood Risk Regulations and the formulation of local flood risk management strategies and plans. SFRAs are also linked to the preparation of Catchment Flood Management Plans (CFMPs), Shoreline Management Plans (SMPs), Surface Water Management Plans (SWMPs) and Water Cycle Strategies (WCSs).

Figure 2-3: Strategic planning links and key documents for flood risk



† See Table 2-1 for roles and responsibilities for preparation of information

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Level One Strategic Flood Risk Assessment

Photo: Pickford Brook at Allesley Park Golf Club

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3 How flood risk is assessed

3.1 Definitions

3.1.1 Flood

Section1 (subsection 1) of the Flood and Water Management Act (FWMA) (2010)[10] defines a flood as:

'any case where land not normally covered by water becomes covered by water'

Section 1 (subsection 2) states that 'it does not matter for the purposes of subsection (1)' whether a flood is caused by

(a) heavy rainfall;
(b) a river overflowing or its banks being breached;
(c) a dam overflowing or being breached;
(d) tidal waters;
(e) groundwater; or
(f) anything else (including any combination of factors).

Note: Sources of flooding under this definition do not include excess surface water from any part of a sewerage system, unless caused by an increase in the volume of rainwater entering or affecting the system, or a flood caused by a burst water main.

3.1.2 Flood Risk

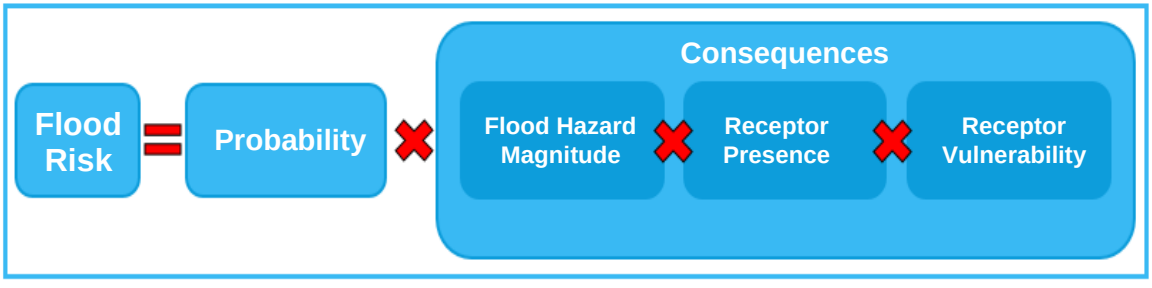
Section 3 (subsection 1) of the FWMA defines the risk of a potentially harmful event (such as flooding) as:

'a risk in respect of an occurrence is assessed and expressed (as for insurance and scientific purposes) as a combination of the probability of the occurrence with its potential consequences.'

Thus it is possible to summarise flood risk as:

Flood Risk = (Probability of a flood) x (Scale of the Consequences)

On that basis it is useful to express the definition as follows:



Using this definition it can be seen that:

- **Increasing the probability or chance of a flood being experienced increases the flood risk:** In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the severity of the flood risk will increase (flooding becomes more frequent or has increased effect).

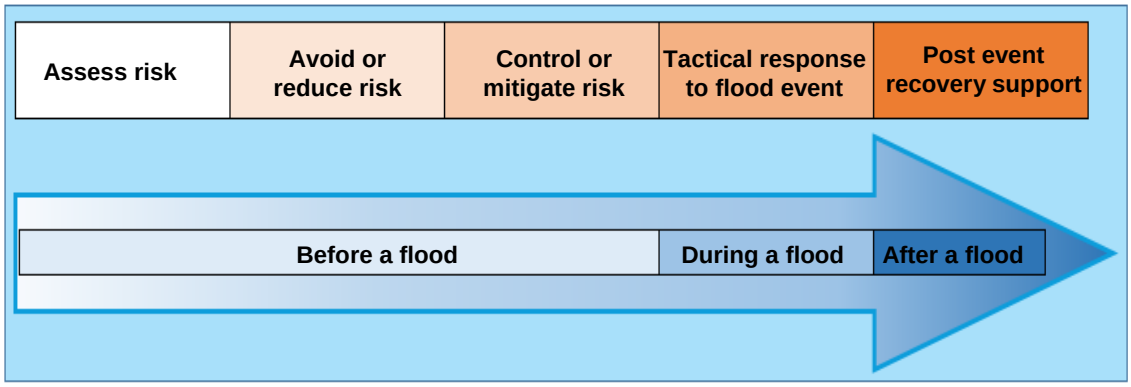
[10] Flood and Water Management Act (2010): http://www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

- **The potential scale of the consequences in a given location can increase the flood risk:**
    - Flood Hazard Magnitude: If the direct hazard posed by the depth of flooding, velocity of flow, the speed of onset, rate of risk in flood water or duration of inundation is increased, then the consequences of flooding, and therefore risk, is increased.
    - Receptor Presence: The consequences of a flood will be increased if there are more receptors affected, for example with an increase in extent or frequency of flooding. Additionally, if there is new development that increases the probability of flooding (for example, increase in volume of runoff due to increased impermeable surfaces) or increased density of infrastructure then consequences will also be increased.
    - Receptor Vulnerability: If the vulnerability of the people, property or infrastructure is increased then the consequences are increased. For example, old or young people are more vulnerable in the event of a flood.

3.2 Using SFRA risk information

This SFRA contains information that can be used at strategic, operational and tactical levels as shown by Figure 3-1.

Figure 3-1: Use of SFRA information



The SFRA will complement the Coventry Local Flood Risk Management Strategy (draft available online[4]) and will assist the LLFA with the stated objectives.

The assessment of flood risk in the SFRA is primarily based on the following three types of information:

1. **Flood zones**
2. **Actual Flood Risk**
3. **Residual Risk**

3.2.1 Flood Zones

The SFRA includes maps that show the Flood Zones. These zones describe the land that would flood if there were no defences present. The NPPF Guidance identifies the following Flood Zones (see Table 3-1). These apply to both Main River and Ordinary Watercourses.

Table 3-1: Flood Zone descriptions

Zone	Probability	Description
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).
		All land uses are appropriate in this zone.
		For development proposals on sites comprising one hectare or above the vulnerability to flooding from other sources as well as from river and sea flooding, and the potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water run-off, should be incorporated in a flood risk assessment.
		Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.1% – 0.5%) in any year.
		Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) as appropriate in this zone. Highly vulnerable land uses are allowed as long as they pass the Exception Test.
		All developments in this zone require an FRA.
		Developers and local authorities should seek opportunities to reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems.
Zone 3a	High	This zone comprises land assessed as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year Developers and the local authorities should seek to reduce the overall level flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage.
		Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable and essential infrastructure are only permitted if they pass the Exception Test.
		All developments in this zone require an FRA.
		Developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. • relocate existing development to land in lower risk zones • create space for flooding by restoring functional floodplain and flood flow pathways and by identifying, allocating and safeguarding open spaces for flood storage.
Zone 3b	Functional Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain should take account of local circumstances.
		Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. Infrastructure must also not increase flood risk elsewhere.
		All developments in this zone require an FRA.
		Developers and local authorities should seek opportunities to: • reduce the overall level of flood risk in the area and beyond through the layout and form of the development, and the appropriate application of sustainable drainage systems. • relocate existing development to land in lower risk zones

The preference when allocating land is, whenever possible, to place all new development on land in Zone 1. Since the Flood Zones identify locations that are not reliant on flood defences, placing development on Zone 1 land means there is no future commitment to spending money on flood banks or flood alleviation measures. It also does not commit future generations to costly long term expenditure that would become increasingly unsustainable as the effects of climate change increase.

3.2.2 Actual Flood Risk

If it has not been possible for all future development to be situated in Zone 1 then a more detailed assessment is needed to understand the implications of locating proposed development in Zones 2 or 3. This is accomplished by considering information on the "actual risk" of flooding. The assessment of actual risk takes account of the presence of flood defences and provides a picture of the safety of existing and proposed development. It should be understood that the standard of protection afforded by flood defences is not constant and it is presumed that the required minimum standards for new development are:

- residential development should be protected against flooding with an annual probability of river flooding of 1% (1 in 100 year chance of flooding) in any year; and
- residential development should be protected against flooding with an annual probability of tidal (sea) flooding of 0.5% (1 in 200 year chance of flooding) in any year.

The assessment of the actual risk should take the following issues into account:

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth then it will be a priority for the Flood Risk Management Strategy to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development (assumed to be 100 years for residential development). Over time the effects of climate change will erode the present day standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present day levels of protection are to be maintained and where necessary land secured that is required for affordable future flood risk management measures.
- The assessment of actual risk can include consideration of the magnitude of the hazard posed by flooding. By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources. This assessment will be needed in circumstances where consideration is given to the mitigation of the consequences of flooding or where it is proposed to place lower vulnerability development in areas that are at risk from inundation.

For information on defences reference should be made to the Environment Agency's Asset Information Management System (AIMS) which contains details on the standard of protection of defences.

3.2.3 Residual Risk

The residual risk refers to the risks that remain in circumstances after measures have been taken to alleviate flooding (such as flood defences). It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a flood with a magnitude greater than that for which the defences or management measures have been designed to alleviate (the 'design flood'). This can result in overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming discharges.
- Or failure of the defences or flood risk management measures to perform their intended duty. This could be breach failure of flood embankments, failure of flood gates to operate in the intended manner or failure of pumping stations.

The assessment of residual risk demands that attention be given to the vulnerability of the receptors and the response to managing the resultant flood emergency. In this instance attention should be paid to the characteristics of flood emergencies and the roles and responsibilities during such events. Additionally, in the cases of breach or overtopping events, consideration should be given to the structural safety of the dwellings or structures that could be adversely affected by significant high flows or flood depths.

3.3 Possible responses to flooding

3.3.1 Assess

The first response to flooding must be to understand the nature and frequency of the risk. The assessment of risk is not just performed as a "one off" during the process, but rather the assessment of risk should be performed during all subsequent stages of responding to flooding.

3.3.2 Avoid

The sequential approach requires that the first requirement is to avoid the hazard. If it is possible to place all new growth in areas at a low probability of flooding then the flood risk management considerations will relate solely to ensuring that proposed development does not increase the probability of flooding to others. This can be achieved by implementing Sustainable Drainage Systems (SuDS) and other measures to control and manage run-off. In some circumstances it might be possible to include measures within proposed growth areas that reduce the probability of flooding to others and assist existing communities to adapt to the effects of climate change. In such circumstances the growth proposals should include features that can deliver the necessary levels of mitigation so that the standards of protection and probability of flooding are not reduced by the effects of climate change. In Coventry City, consideration should be given not only to the peak flows generated by new development but also to the volumes generated during longer duration storm events.

3.3.3 Substitute, Control and Mitigate

These responses all involve management of the flood risk and thus require an understanding of the consequences (the magnitude of the flood hazard and the vulnerability of the receptor).

There are opportunities to reduce the flood risk by lowering the vulnerability of the proposed development. For instance changing existing residential land to commercial uses will reduce the risk provided that the residential land can then be located on land in a lower risk flood zone.

Flood risk management responses in circumstances where there is a need to consider growth or regeneration in areas that are affected by a medium or high probability will include:

- Strategic measures to maintain or improve the standard of flood protection so that the growth can be implemented safely for the lifetime of the development (must include provisions to invest in infrastructure that can adapt to the increased chance and severity of flooding presented by climate change).
- Design and implement measures so that the proposed development includes features that enables the infrastructure to adapt to the increased probability and severity of flooding whilst ensuring that new communities are safe and that the risk to others is not increased (preferably reduced).
- Flood resilient measures that reduce the consequences of flooding to infrastructure so that the magnitude of the consequences is reduced. Such measures would need to be considered alongside improved flood warning, evacuation and welfare procedures so that occupants affected by flooding could be safe for the duration of a flood event and rapidly return to properties after an event had been experienced.

It should be noted that the Flood and Coastal Risk Management Grant in Aid (FCRMGiA) funding arrangements (introduced in 2011) do not make government funds available for any new development implemented after 2012. Accordingly, it is essential that appropriate funding arrangements are established for new development proposed in locations where a long term investment commitment is required to sustain Flood Risk Management (FRM) measures. The strategic investment commitment is required so that in future the FRM measures can be maintained and afforded for the lifetime of the development, since the available funds from

FCRMGiA will potentially not reflect the scale of development that is benefitting. The policy statement Flood and Coastal Resilience Partnership Funding (2013) sets out the arrangements that will apply for the allocation of capital Flood Defence Grant-in-Aid (FDGiA) to flood and coastal erosion risk management projects. Flood and Coastal Resilience Partnership Funding will form part of the Environment Agency's overall capital allocation projects until the end of the 2014/2015 financial year. Under this system, central government contributions will cover the full cost of a scheme if it has high benefits – such as if a high number of houses are protected. However, where the benefits are not high enough for central government contributions to cover the costs, local contributions may be available to top up the funding.

The National Flood and Coastal Erosion Management Strategy[11] summarises the new system:

> *"In essence, instead of meeting the full cost of a limited number of schemes, a new partnership approach to funding could make government money available to pay a share of any worthwhile scheme. The amount in each case will depend on the level of benefits the scheme provides. For example, the number of households protected, or the amount of damage that can be prevented. The level of government funding potentially available towards each scheme can be easily calculated. Local authorities and communities can then decide on priorities and what to do if full funding isn't available. Projects can still go ahead if costs can be reduced or other funding can be found locally."*

There are a number of potential impacts of this change in funding. The Government stated that its proposals will help to:

- Encourage total investment in Flood and Coastal Erosion Risk Management by operating authorities to increase beyond what is affordable to national budgets alone;
- Enable more local choice within the system and encourage innovative, cost-effective options to come forward in which civil society may play a greater role.
- Maintain widespread uptake of flood insurance.

[11] Defra (2011) - The national flood and coastal erosion risk management strategy for England - https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228898/9780108510366.pdf

4 The sequential, risk based approach

4.1 The Sequential, risk-based approach

This approach is designed to ensure areas with little or no risk of flooding (from any source) are developed in preference to areas at higher risk, with the aim of keeping development outside of medium and high flood risk areas (Flood Zones 2 and 3) and other sources of flooding, where possible.

It is often the case that it is not possible for all new development to be allocated on land that is not at risk from flooding. In these circumstances the Flood Zone maps (that show the extent of inundation assuming that there are no defences) are too simplistic. A greater understanding of the scale and nature of the flood risks is required.

When deciding on the ability to manage flood risk for new development located in Zones 2 and 3, consideration must be given to a wide range of issues. The issues to be addressed include how any evacuation of the occupants would be handled, how the new development fits in with the existing flood management provision and, in circumstances where flooding is experienced, how quickly the wider area would recover and return to normal. At some locations it could be found that Flood Risk Management (FRM) measures are more easily integrated alongside proposed new development to address the flood risk issues, usually as a consequence of the prevailing natural or artificial topography. In these circumstances the FRM proposals could be deployed without causing a significant alteration to the design and its place setting. However, even in these circumstances it should be recognised that FRM measures at one location can have the potential to cause an alteration to the flood risk to adjacent property or in flood cells on the opposite bank.

4.2 Applying the Sequential Test and Exception Test in the preparation of a Local Plan

When preparing a Local Plan, the Local Planning Authority should demonstrate it has considered a range of site allocations, using Strategic Flood Risk Assessments to apply the Sequential and Exception Tests where necessary.

The Sequential Test should be applied to the whole Local Planning Authority area to increase the likelihood of allocating development in areas not at risk of flooding. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 4-1).

The Exception Test should only be applied following the application of the Sequential Test and as set out in Table 3 of the NPPF Planning Practice Guidance: Flood Risk and Coastal Change. NPPF Planning Practice Guidance: Flood Risk and Coastal Change describes how the Exception Test should be applied in the preparation of a Local Plan (Figure 4-2).

Figure 4-1: Applying the Sequential Test in the preparation of a Local Plan

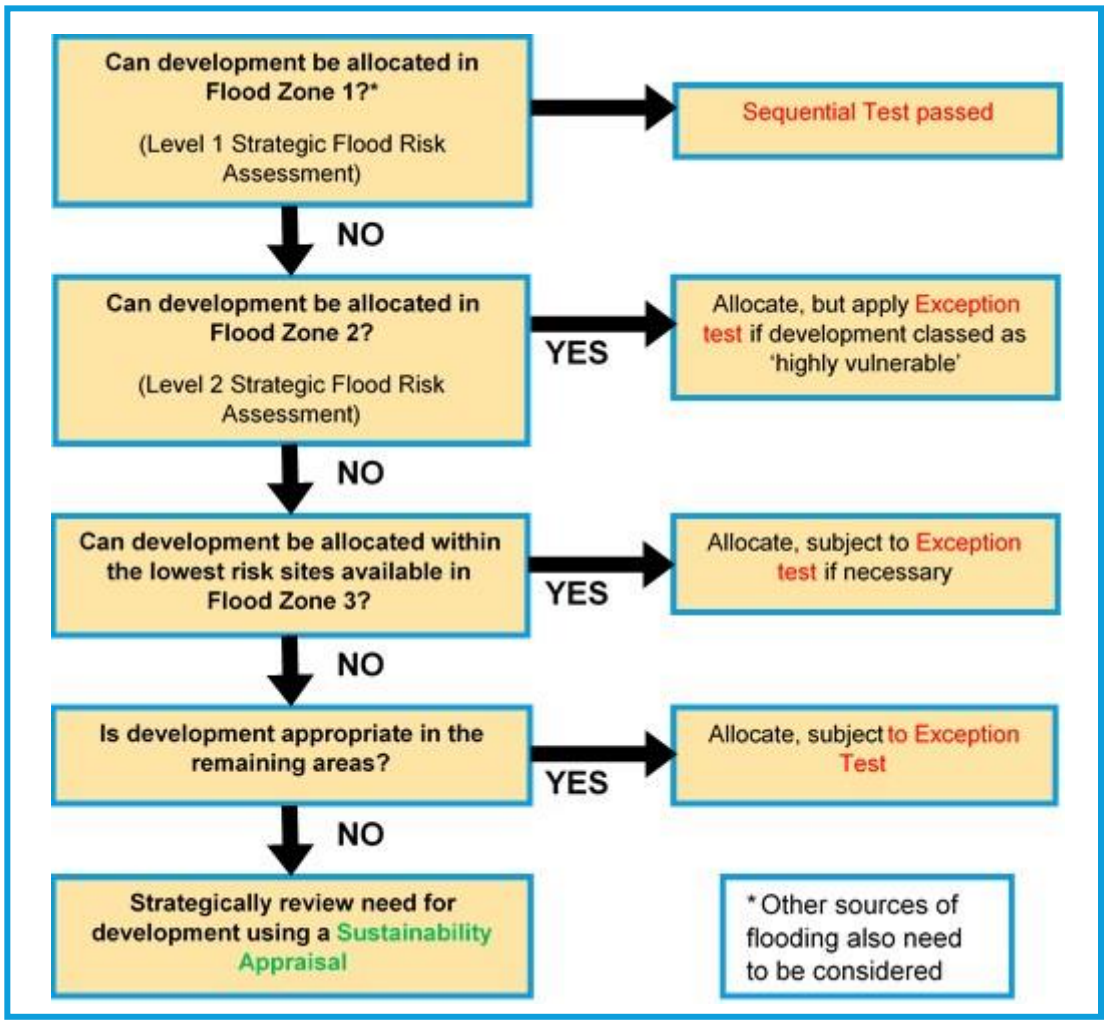
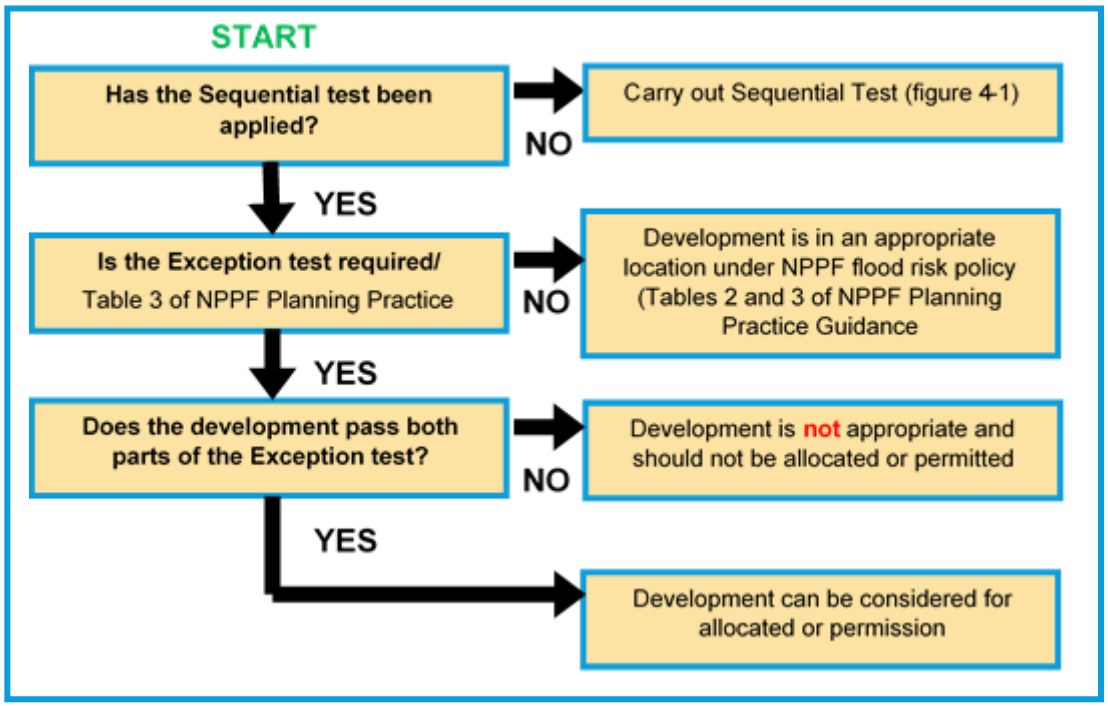


Figure 4-2: Applying the Exception Test in the preparation of a Local Plan



4.3 Applying the Sequential Test and Exception Test to individual planning applications

The NPPF Planning Practice Guidance[12] sets out how developers and planners need to consider flood risk to, and from, the development site, following the broad approach of assessing, avoiding, managing and mitigating flood risk. A checklist for site-specific Flood Risk Assessments is provided in Paragraph 68 of the Guidance.

A site-specific Flood Risk Assessment should be carried out to assess flood risk to, and from, a development. The assessment should demonstrate how flood risk will be managed over a development's lifetime, taking climate change and the user vulnerability into account.

The NPPF Planning Practice Guidance sets out the following objectives for a site-specific Flood Risk Assessment (FRA) and states it should establish

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

4.3.1 Sequential Test

The Sequential Test must be performed when considering the placement of future development and for planning application proposals. The sequential approach to locating development should be followed for all sources of flooding. The Flooding and Coastal Change Planning Practice Guidance to the NPPF gives detailed instructions on how to perform the test.

The Sequential Test does not need to be applied for individual developments under the following circumstances:

- The site has been identified in development plans through the Sequential Test.
- Applications for minor development or change of use (except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site).

It is normally reasonable to presume and state that individual sites that lie in Zone 1 satisfy the requirements of the Sequential Test; however, consideration should be given to risks from all sources, areas with critical drainage problems and critical drainage areas (as defined in SWMPs).

For developments that do not fall under the above categories, local circumstances must be used to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear, in other cases it may be identified by other Local Plan policies[12]. A pragmatic approach should be taken when applying the Sequential Test.

Coventry City Council, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied, and will need to be satisfied that the proposed development would be safe and not lead to increased flood risk elsewhere.

The information provided in this SFRA can be used to:

- Identify the area to be assessed (including alternatives) on the Flood Zone Maps that are provided with this assessment.
- Establish the risk of flooding from other sources.
- Follow the instructions given in the Planning Practice Guidance.

[12] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 033, Reference ID: 7-056-20140306) March 2014

4.3.2 Exception Text

If, following application of the Sequential Test it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if deemed appropriate. The aim of the Exception Test is to ensure that more vulnerable property types, such as residential development can be implemented safely and are not located in areas where the hazards and consequences of flooding are inappropriate. For the Test to be satisfied, both of the following elements have to be accepted for development to be allocated or permitted:

1. **It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.**

   Local Planning Authorities will need to consider what criteria they will use to assess whether this part of the Exception Test has been satisfied, and give advice to enable applicants to provide evidence to demonstrate that it has been passed. If the application fails to prove this, the Local Planning Authority should consider whether the use of planning conditions and / or planning obligations could allow it to pass. If this is not possible, this part of the Exception Test has not been passed and planning permission should be refused[13].

2. **A site-specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.**

   The site-specific Flood Risk Assessment should demonstrate that the site will be safe and the people will not be exposed to hazardous flooding from any source. The following should be considered[14]:

   - The design of any flood defence infrastructure.
   - Access and egress.
   - Operation and maintenance.
   - Design of the development to manage and reduce flood risk wherever possible
   - Resident awareness.
   - Flood warning and evacuation procedures.
   - Any funding arrangements required for implementing measures.

The NPPF and Technical Guidance provide detailed information on how the Test can be applied.

4.4 Summary of SFRA mapping for all sources of flood risk

4.4.1 Fluvial

The data used to prepare the fluvial mapping for this study is based on the results from hydraulic models either provided by the Environment Agency or prepared for the purposes of this SFRA and is summarised as follows:

- 1D-2D River Sowe Modelling and Mapping Study (2010/11). This model includes the River Sherbourne, Canley Brook, Withy Brook and Brookstray.
- Hydraulic models using ISIS-TUFLOW and ESTRY-TUFLOW have been developed to determine Flood Zone 3a, Flood Zone 3b and Flood Zone 2, as well as the effects of climate change, for a number of main watercourses flowing through or adjacent to sites. These watercourses included:
  - Hall Brook.
  - Pickford Brook.
  - An unnamed watercourse flowing from Exhall through Foxfod where it joins the River Sowe at Alderman's Green.

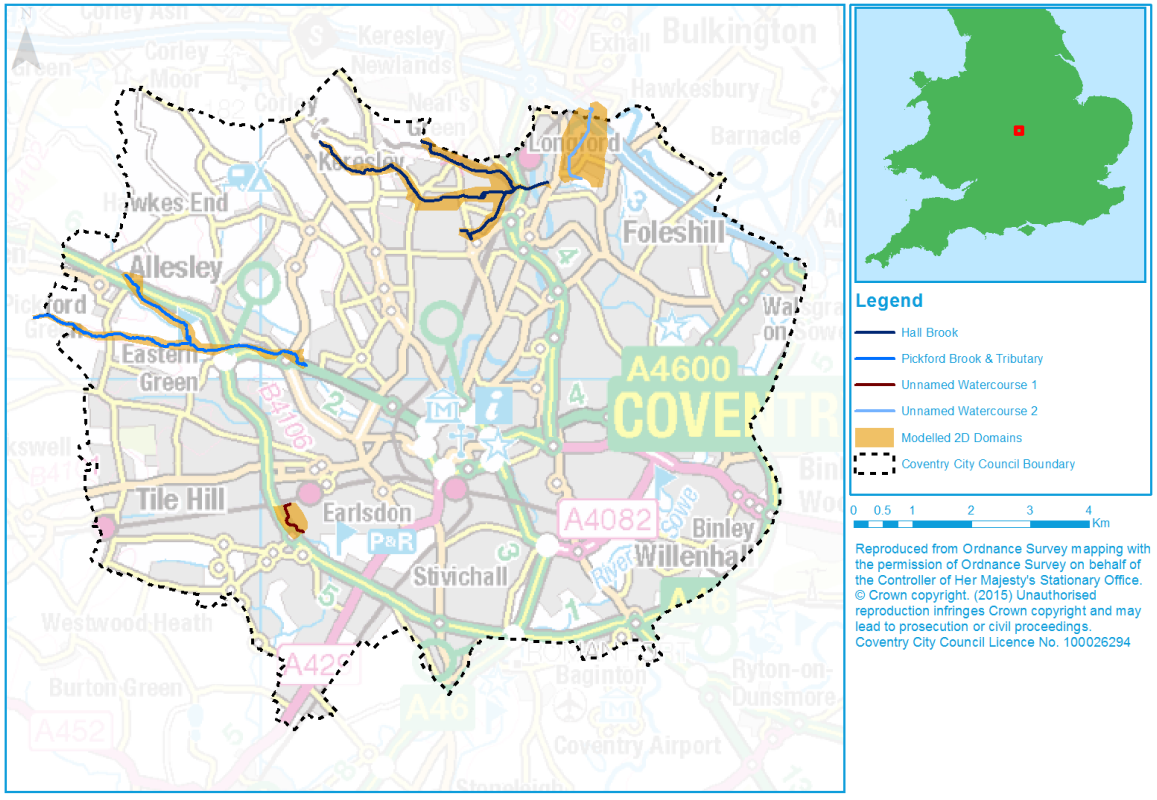
[13] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 037, Reference ID: 7-056-20140306) March 2014

[14] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 038, Reference ID: 7-056-20140306) March 2014

- An unnamed watercourse flowing through Lime Tree Park, through Coventry Business Park before joining the Canley Brook just downstream of Henry Parkes Road.

The detailed hydraulic models of the Hall Brook, Pickford Brook and unnamed watercourses were informed by detailed channel survey collected by Maltby Land Survey Ltd in July 2015. The channel survey collected detailed information of all key structures within or crossing the watercourses as well as the channel geometry in reaches of open watercourse. The watercourse is represented in a 1-dimensional domain by either ISIS or ESTRY models. Both are hydraulic modelling software which can provide flow, velocity and depth information for a watercourse at each cross sections. The floodplain (2D domain) was in all cases represented by TUFLOW. This is a 2D modelling package which using topographic information (in this study's case represented by LIDAR) to represent the topography of the floodplain, so if water is shown to get out of bank, it will follow the most suitable path. The benefit of providing these 1D-2D hydraulic models is that flood risk can be more accurately mapped, and that the models will be available at a later date if developers are required to simulate different scenarios as part of a detailed Flood Risk Assessment (FRA). The location of the watercourses modelled for the SFRA is provided in Figure 4-3.

Figure 4-3: Watercourses modelled for the SFRA



4.4.2 Surface Water

Mapping of surface water flood risk in Coventry City has been taken from the updated Flood Map for Surface Water (uFMfSW) published online by the Environment Agency. This information is based on a national scale map identifying those areas where surface water flooding poses a risk. Surface water flood risk is subdivided into the following four categories:

- **High**: An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- **Medium**: An area has a chance of flooding between 1 in 100 (0.1%) and 1in 30 (3.3%) each year.
- **Low**: An area has a chance of flooding between 1 in 1000 (0.1%) and 1in 100 (1%) each year.
- **Very Low**: An area has a chance of flooding of less than 1 in 1000 (0.1%) each year.

4.4.3 Hazard Maps

Hazard mapping has also been produced for Coventry City using data, where available, derived from the results of Environment Agency hydraulic modelling and the detailed modelling undertake for the Council as part of this SFRA. The hazard rating is calculated using data generated by the 1D-2D linked models and utilises the classifications of hazard presented in DEFRA's R&D Technical Note FD2320: Flood Risk Assessment.

4.4.4 Suite of Maps

All of the mapping can be found in the appendices to this SFRA and is presented in the following structure:

- Appendix B: Watercourses in Coventry
- Appendix C: Environment Agency Flood Zone Mapping
- Appendix D: Climate Change Mapping
- Appendix E: WFD Classification of watercourses
- Appendix F: Surface Water Mapping
- Appendix G: Groundwater Mapping
- Appendix H: Flood Warning Coverage

Note: the Flood Zones presented in Appendix C will differ from the Environment Agency's Flood Map for Planning because flood zones for the Hall Brook, Pickford Brook, and two unnamed watercourses have been defined from detailed modelling for the purposes of this study. The Flood Map for Planning does not contain Flood Zones for these watercourses.

4.5 Other relevant flood risk information

The mapping prepared for the detailed site summary tables in Appendix A provides information on:

- The extent of fluvial flooding.
- The depth of fluvial flooding.
- Fluvial flood water velocity.
- Hazard from fluvial flood water.
- Surface water flooding.

Users of this SFRA should also refer to other relevant information on flood risk where available and appropriate. This information includes:

- River Severn Catchment Flood Management Plan.
- Coventry Local Flood Risk Management Strategy (expected publication date: 2015).
- Coventry Surface Water Management Plan (expected publication date: 2015).
- Coventry Water Cycle Study (expected publication date: 2015).
- Flood Risk Management Plan in accordance with the Flood Risk Regulations (available in 2015) – Environment Agency and Lead Local Flood Authority.
- Environment Agency's Asset Information Management System (AIMS) – users should note that recently completed schemes may not yet be included in this dataset.

5 Understanding flood risk in Coventry City

5.1 Historical flooding

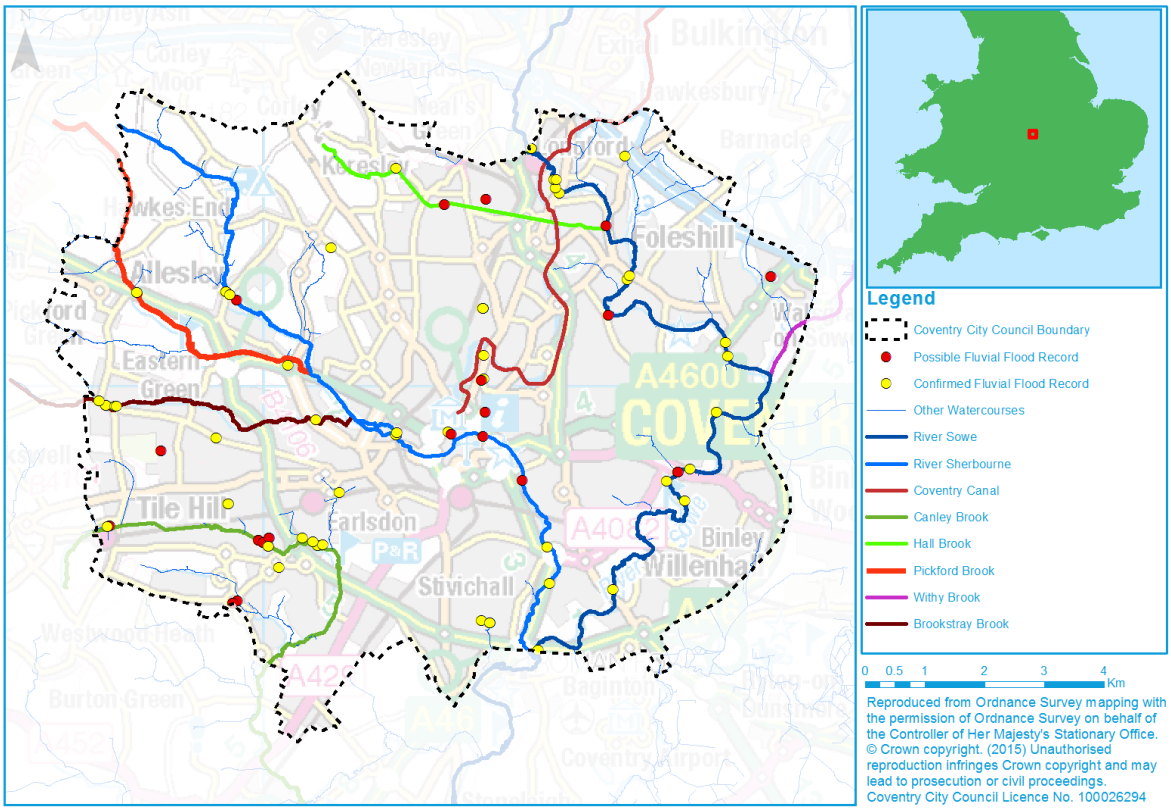
Coventry City has a history of documented flood events with the main source being from 'fluvial' (river/watercourse networks) sources.

Significant historical fluvial flood events in Coventry City include:

- Large scale flooding in October 1998, autumn 2000, February 2002, New Year 2003, February 2004, the summer of 2007 and November 2012.
- Flooding from the River Avon, notably in January 1985 and April 1998.

Coventry City Council records details in total 103 fluvial flood records from 1954 to 2008. The location of these records is shown in Figure 5-1.

Figure 5-1: Historical Fluvial Flooding Records



Details of this flooding are summarised as follows:

- Coventry City Council records detail 18 incidents of flooding between 1954 and 2007 in the vicinity of the River Sowe. The majority of these records are either in April 1998 (8) and 2007 (3). Of the 15 records 8 have been shown to impact highways.
- The 2 most recent records (recorded in 2008) are located on the Pickford Brook and its tributaries in the west of the Coventry.
- The vast majority of recorded incidents are from the River Sowe, River Sherbourne, Brookstay Brook or Canley Brook. The remainder of flood records are located near unnamed Ordinary Watercourses with Coventry City.
- Extensive flooding has occurred within the study area mainly from the River Sherbourne where reports are available between 1800 to the mid-1990s. The River Sherbourne has been substantially culverted and since the last major works to the watercourse in the late 1950/60 no major flooding has been reported.

5.1.1 November 2012 flooding

Between Tuesday 20 November to Saturday 24 November 2012 Coventry received over 84mm of rainfall, over which 37mm fell on the Saturday alone. Many of the watercourses within Coventry reached high levels and some overtopped, flooding mainly highway and some property flooding. The Environment Agency provided the following details of the flooding that occurred for the preparation of this SFRA. Note: the information provided is based on flooding reported to the Environment Agency's Drainage and Management team. There may have been other flooding which was not reported. The information is summarised as follows:

- Fluvial flooding occurred from the River Sherbourne at Washbrook Lane and Butt Lane. The flooding settled on the highway and footpath preventing traffic and pedestrians from passing. Over 14 properties were affected.
- Fluvial flooding from the Hall Brook as a result of surface water runoff from neighbouring agricultural land. Six properties were affected.
- The Canley Brook at Duggins Lane completely submerged two access footbridges to property, as well as flooding the interior a one property and the gardens of three others.
- A tributary of the River Sherbourne bypassed a culvert on Brick Hill Lane, flowing directly into the carriageway before re-joining the watercourse on the opposite side of the carriageway. No properties were reported to be affected.
- A combination of surface water and overtopping of Brookstray caused a deep pond to form at the Browns Lane/Benner Lane Junction, flooding four properties and preventing traffic from passing.
- Gardens of four properties at Rowley's Green Lane were flooded as a result of overtopping of the River Sowe.
- Surface water flooding was also reported at:
    - Woodway Lane (three properties affected).
    - Elphin Close (one property affected).
    - Bromleigh Drive (one property affected).
    - Papenham Green, Wolfe Lane and Hancock Green (carriageway flooding, no properties affected).
    - Ted Pitts Lane (carriageway flooding, no properties affected).
    - Lentons Lane (four gardens affected).
    - Washbrook Lane (carriageway flooded to depths of 400mm, no properties affected).

5.2 Topography, geology, soils and hydrology

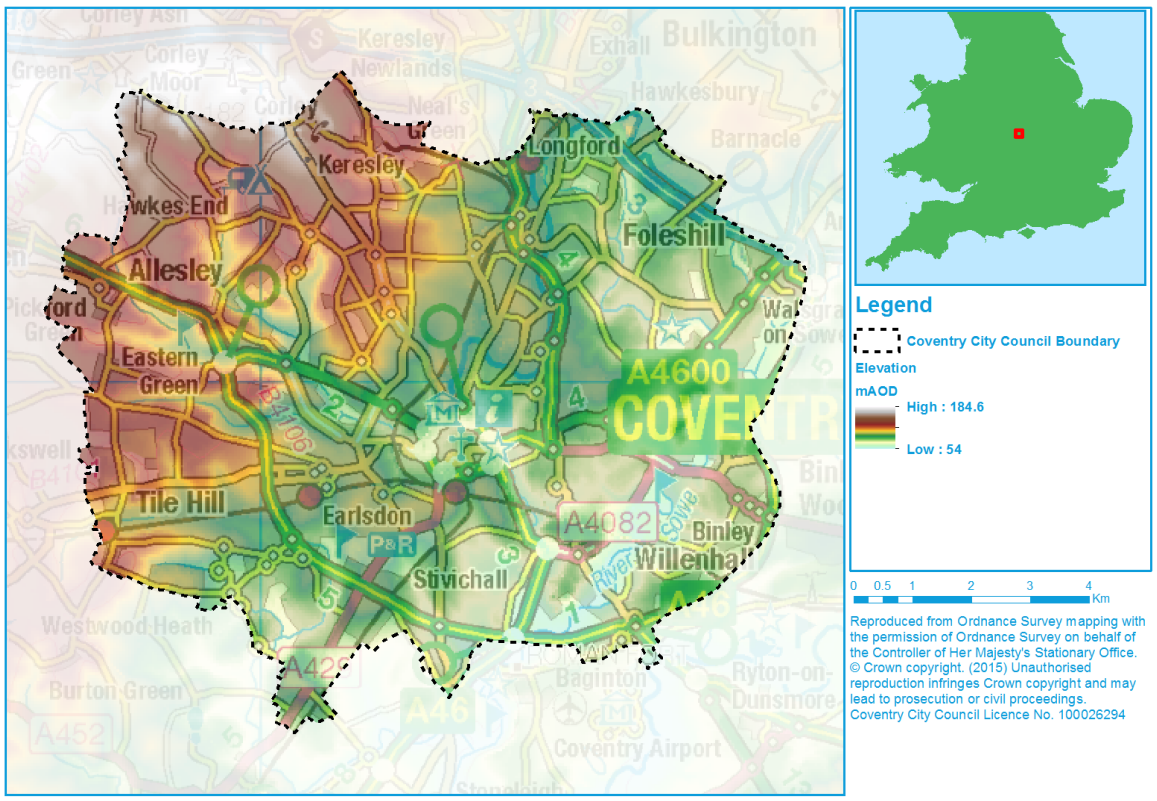
Coventry City study area covers an area of approximately 99km^2 and has a population of approximately 316,960 (2011 census)[15]. The largest ward in Coventry City is Foleshill with a population of approximately 20,000. Other sizable wards include Henley, Upper Stoke, Radford, Longford and Wyken.

5.2.1 Topography

The topography of the study area can be seen in Figure 5-2 and is primarily comprised of higher elevations and steeper slopes located in the north-west. These areas reach approximately 160m AOD, decreasing in a south-east direction towards the lowest elevations in the vicinity of Willenhall, Binley and Stivichall. Elevations in this region are approximately 65m AOD. The main watercourses originating from the higher ground in the west are the Pickford Brook and the River Sherbourne.

[15] Coventry City Council http://www.coventry.gov.uk/info/9/local_information_and_statistics/1833/census_2011_ward_profiles

Figure 5-2: Coventry City Topography



5.2.2 Geology and soils

The geology of the catchment can be an important influencing factor on the way that water runs off the ground surface. This is primarily due to variations in the permeability of the surface material and bedrock stratigraphy.

The study area consists mainly of sedimentary rocks deposited over three district geological periods. The oldest rock sequences are from the Carboniferous period and consist of mudstones and clay rich rocks. The remainder of the study area is represented by Permian sandstones or Triassic argillaceous rocks. Sandstone formations are typically associated with well-draining soils whereas argillaceous rocks are often clay rich and associated with poorly drained soils. This represents approximately 70% of study area. Figure 5-3 shows the arrangement of the various bedrock formations throughout the study area.

Superficial (at the surface) deposits in Coventry City consist of mainly clays, sands and gravels. Figure 5-4 shows the arrangement of the various superficial deposit formations throughout the study area.

Figure 5-3: Bedrock deposits in Coventry City area

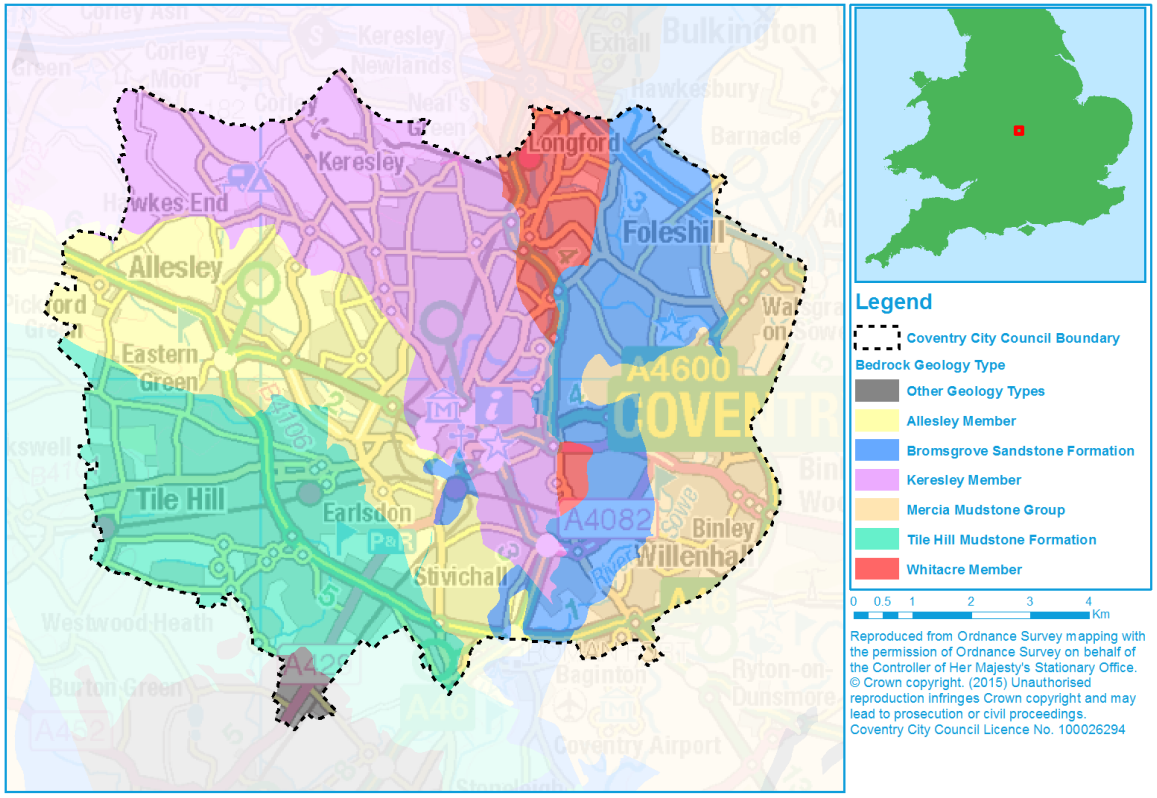
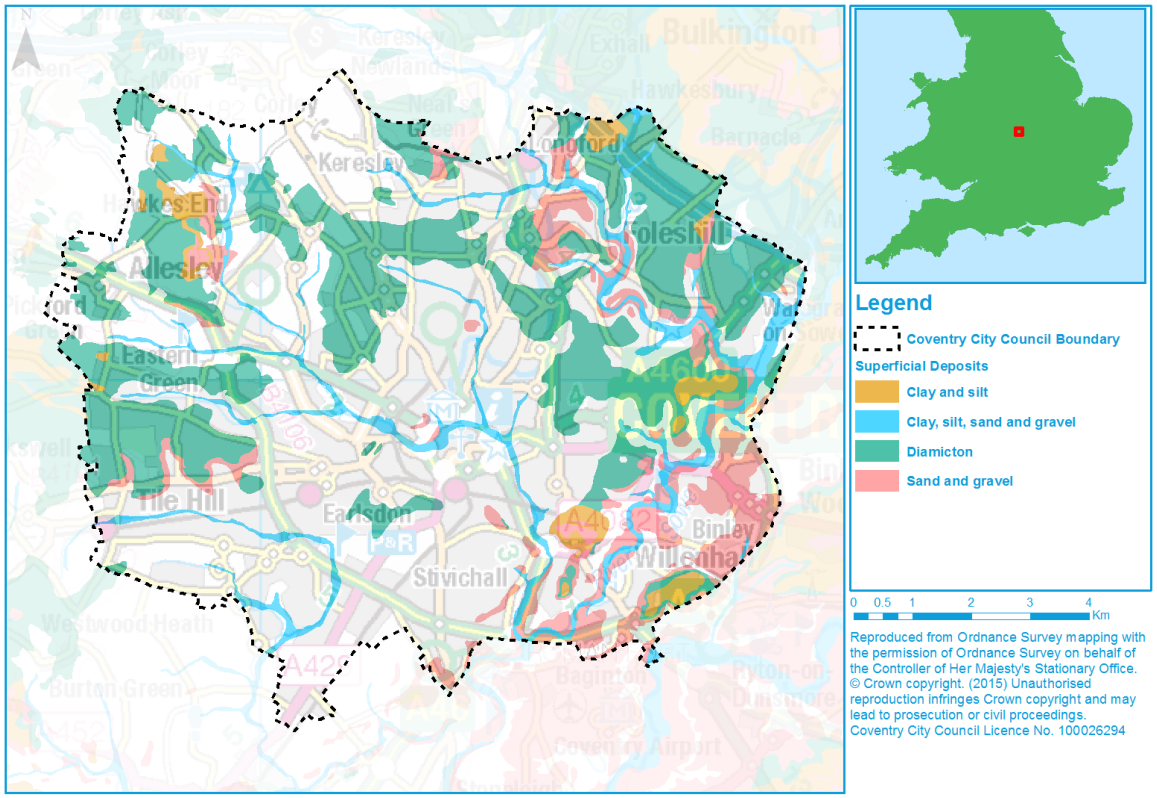


Figure 5-4: Superficial deposits in Coventry City area



5.2.3 Hydrology

The principal watercourses flowing through the SFRA area are:

- The River Sowe.
- The River Sherbourne.
- Canley Brook.
- Withy Brook.

Tributaries to these watercourses include primarily smaller Ordinary Watercourses (many of which are named) and unnamed drains. A summary of the principal watercourses in the SFRA area are provided in Table 5-1.

The River Sherbourne and River Sowe catchments receive approximately between 650-690mm of rain on average per year. In adjoining catchments, there are similar levels of average rainfall per year.

Table 5-1: Watercourses in the study area

Watercourse name	Classification	Description
River Sowe	Main River	A tributary of the River Avon, which enters Coventry City from the north-east and flows in a south-westerly direction.
River Sherbourne	Main River	A tributary of the River Sowe originating approximately 8km north-west of Coventry City and flows in a south-easterly direction through the city centre. The watercourse is culverted for approximately 1.7km underneath the city centre re-emerging at Gosford Street (SP 3419 7886)
Canley Brook	Main River	A tributary of the Finham Brook. Flows in a south-easterly direction, exiting the study area approximately 3km upstream of its confluence with the Finham Brook.
Withy Brook	Main River	A tributary of the River Sowe. Flows in a predominately southerly direction until its confluence with the River Sowe.
Pickford Brook	Ordinary Watercourse	A tributary of the River Sherbourne. Flows in a south-easterly direction towards its confluence with the River Sherbourne adjacent to the Holyhead Road (SP 30781 80231).
Hall Brook	Ordinary Watercourse	A tributary of the River Sowe. Flowing in a south-easterly direction through the northern portion of the city. The confluence with the River Sowe is near Wood End (SP 36164 82419).
Wyblynd Brook	Ordinary Watercourse	A tributary of the Hall Brook. Rising near Prologis Park, it flows in a south-easterly direction, through Holbrooks to its confluence with the Hall Brook near Phoenix Way.
Smite Brook	Ordinary Watercourse	A tributary of the River Sowe. The majority of the watercourse is located outside of the study area. The watercourse flows in a westerly direction flowing into Coombe Pool (SP 38974 79370), downstream of Coombe Pool the Smite Brook continues for approximately 500m before its confluence with the River Sowe (SP 37990 79476)
Foleshill to Bell Green Watercourse	Ordinary Watercourse	Tributary of the River Sowe flowing for approximately 1.3km from Foleshill (Spring Road) to its confluence with the River Sowe in Bell Green (SP 35953 81608).
Brookstray Brook	Ordinary Watercourse	Tributary of the River Sherbourne flowing through Upper Eastern Green to its confluence with the River Sherbourne in Chapel Fields (SP31484 79505).
Coventry Canal	Canal	Starting at the Coventry Canal Basin (SP 33284 79573) the canal follows a meandering north-easterly direction through the city before exiting the study area near Foxford (SP 35478 84458)
Oxford Canal	Canal	A small portion of the Oxford Canal is located within the study area, following parallel to the M6 motorway in a south-easterly direction.
Old Main Pit Canal Arm	Canal	Small reach of canal connecting the Wyken Basin to the Oxford Canal at Whiting's Bridge (SP370272 83382)

NOTE: This table is based on information found within the Environment Agency's Detailed River Network (DRN) database therefore there may be a number of Ordinary Watercourses within the study area which are not included within this table.

5.3 Fluvial flood risk

The primary fluvial flood risk to Coventry City is associated with the River Sowe and the River Sherbourne. The River Sowe is predominately located in a rural setting with a limited number of properties at risk from flooding until increased development from the mid-1950s. Following the development of land adjacent to the watercourse there is still little indication of flooding to property with only a small number of flood records. However, there are noticeable development pressures on urban areas such as Binley, Walsgrave and Willenhall with developments bordering the existing floodplain.

The River Sherbourne represents the greatest flood risk to the city centre of Coventry which a large section culverted underneath the city centre. This system was constructed in the 1950s and is considered to be capable of conveying flows up to the approximately the 1 in 60annual probability event level. A Halcrow modelling study of the River Sherbourne (as part of the River Sowe hydraulic model - 2006) indicated that the culvert system is not surcharged until the 1 in 100 annual probability event flood event. This is thought to match local knowledge. Other areas identified in the superseded Coventry SFRA (2008) as being at flood risk from the River Sherbourne are listed below:

- High value commercial property above the River Sherbourne as it travels through the city centre.
- Properties in Spon End / The Butts in the vicinity of the River Sherbourne.
- A number of properties on the upper reaches of the River Sherbourne in the vicinity of Allesley.

Table 5-2 and Table 5-3 detail a number of key areas for flood risk which are located on Main Rivers and Ordinary Watercourses within Coventry City. These areas are highlighted based on existing flood mapping and information collated as part of this SFRA. This not an exhaustive list of risk areas but a general overview.

Table 5-2: Areas at risk from Main River flooding

Location	Grid Reference	Main Watercourse
Basston Bridge	(SP 34460 83930)	River Sowe
Longford	(SP 34910 83310)	River Sowe
Bell Green	(SP 35910 81550)	River Sowe
Wyken Green	(SP 36320 81280)	River Sowe
Hospital grounds by Wyken Green	(SP 37790 80640)	River Sowe
Industrial properties in Walsgrave	(SP 38840 81020)	River Sowe
Binley Road, Stoke	(SP36930 78618)	River Sowe
Industrial properties in Walsgrave	(SP 37790 80640)	River Sowe
Allesley	(SP 29442 81529)	River Sherbourne
Allesley Old Road / Prince of Wales Road	(SP 30979 79369)	River Sherbourne
Pavilion Way	(SP 31888 79373)	River Sherbourne
Spon End Industrial Estate	(SP 32212 79182)	River Sherbourne
Spon End / Upper Spon Street	(SP 32346 79002)	River Sherbourne
Recycling complex adjacent to the railway in Cheylesmore	(SP34710 77670)	River Sherbourne
Properties near in north-eastern Cheylesmore	(SP 34930 76940)	River Sherbourne
Gulson Road Industrial Estate	(SP 34249 78817)	River Sherbourne
University Hospital	(SP 38502 80557)	Withy Brook
Commercial & residential properties in Tile Hill	(SP 28410 77770)	Canley Brook
Prior Deram Walk / Templars Field	(SP 29837 77484)	Canley Brook
The Riddings	(SP 30920 77350)	Canley Brook
The Shrubberies / Canon Hill Road (highways)	(SP 31165 76164)	Canley Brook

Table 5-3: Areas at risk from Ordinary Watercourse flooding

Location	Grid Reference	Ordinary Watercourse
Broad Lane, Upper Eastern Green	SP 27479 79633	Brookstray Brook
Allesley Old Road / Prince of Wales Road	SP309077 79370	Brookstray Brook
A4114 (Holyhead Road / Pickford Brook Highway)	SP 30128 80463	Pickford Brook
Brick Hill	SP 27880 81613	Pickford Brook
Watery Lane	SP 32236 83611	Hall Brook
Manor Farm	SP 31754 83572	Hall Brook
Holbrooks	SP 33312 83095	Hall Brook / Wyblynd Brook

5.3.1 Local Knowledge from Coventry City staff

As part of the initial stages of the SFRA, questionnaires were distributed to Coventry City Council staff to gather local knowledge of flooding which may not be found in existing documentation. This included information of historical flooding events. The list below is of locations where fluvial historical flood events have been noted:

- Keresley Brook Road / Halford Lane: Flooding originating from the Keresley Brook.
- The Riddings: Flooding from watercourses in the vicinity.
- Sir Henry Parkes Road: Flooding due to raised levels in rivers.
- Holbrooks Lane: This is primarily surface water flooding but has been included in this section as the problem is possibly associated with Springfield Brook culvert.
- Rowleys Green Lane: Flooding originating from the River Sowe.
- Broad Lane / Banner Lane: Flooding originating from Guphill Brook culvert.
- Butt Lane: Flooding of adjacent properties caused by increased levels in the River Sherbourne.
- Bennetts Road: Flooding likely relating to blocked culverts.
- Kingfield Road: Flooding originating from Springfield Brook Culvert during heavy rain.

5.4 Flood defences, assets and structures

The Environment Agency and Coventry City Council have confirmed that there are no formal flood defences within Coventry City.

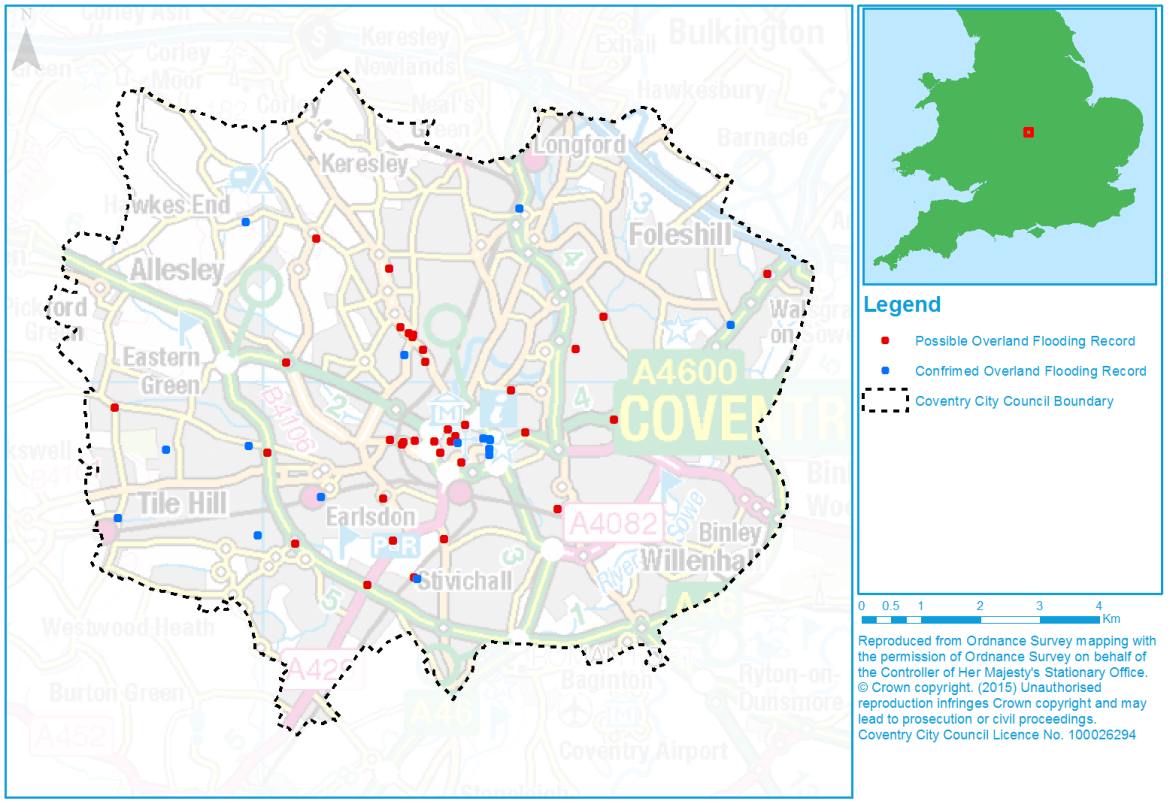
5.5 Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours and usually occurs in lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding. The draft Surface Water Management Plan (SWMP) conducted by Coventry City Council in 2011, estimates that approximately 10,600 properties are at risk from surface water flooding.

The updated Flood Map for Surface Water (uFMfSW) predominantly follows topographical flow paths of existing watercourses or dry valleys with some isolated ponding located in low lying areas.

Flood records relating to surface water provided by Coventry City Council are shown in Figure 5-5. The majority of surface water flood records are clustered within central Coventry or along Radford Road (B4098). There are shown to be a number of flood records in the south-western portion of Coventry City which would appear to correlate with the location of the Brookstay Brook and the Canley Brook. It is likely that surface water is likely to originate from the interaction of the sewer network and the watercourse to which they outfall.

Figure 5-5: Surface Water Flooding Records



As well as using the uFMfSW maps to determine surface water hotspots, questionnaires were completed by Coventry City Council staff to gather local knowledge of flooding which may not be found in existing documentation. This information included information of historical surface water flooding events. The list below is of locations where historical surface water flooding events have been recorded:

- Coats of Arms Bridge Road: Flooding originating from highway and War Memorial Park.
- Foleshill Road / St Pauls Road.
- Holbrooks Lane: Surface water flooding possibly associated with Springfield Brook culvert.
- Barker Butts Lane / Moseley Avenue.
- Elphin Close: Flooding originating from President Kennedy School.
- Bourchier Close: Flooding to properties relating from field runoff.
- Washbrook Lane / Butt Lane / Browns Lane / Windmill Hill: Flooding to junction by field runoff.
- Hawkes Mill Lane: Surface water flooding from highway in intense rain.
- Brownshill Green Road: Surface water flooding from Coundon Hall Park to care homes.
- Grange Walk: Surface water flooding from highway due to lack of infrastructure.
- Theddingworth Close: Flooding originating from Ernesford Grange Primary School.

5.6 Groundwater flooding

In comparison to fluvial flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Under the Flood and Water management Act (2010), LLFAs have powers to undertake risk management functions in relation to groundwater flood risk. Groundwater level monitoring records are available for areas on Major Aquifers. However, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high water table in mudstones, clays and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of

elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Groundwater rebound may become an issue in areas where a decrease in industrial demand means less abstraction is taking place. An example would be elevated groundwater levels in Keresley. Coventry City has reports of elevated groundwater levels as a result of the closure of coal mining operations and associated pumping in 1991. The 2013 Warwickshire Avon Catchment Abstraction Management Strategy, describes the Coventry Groundwater Management Unit as having "restricted water available for licencing" which suggests there is still high demand in groundwater abstraction in this area.

As part of the SFRA deliverables, mapping of the whole Borough has been provided showing the Areas Susceptible to Groundwater Flooding (AStGWF). The Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic-scale map showing groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for PFRA studies and allow the LLFAs to determine whether there may be a risk of flooding from groundwater. This data shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

The AStGWF data should be used only in combination with other information, for example local data or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

The AStGWF mapping for Coventry City can be found in Appendix G.

5.7 Flooding from artificial sources

Sewer flooding occurs when intense rainfall overloads the sewer system capacity (surface water, foul or combined), and/or when sewers cannot discharge properly to watercourses due to high water levels. Sewer flooding can also be caused when problems such as blockages, collapses or equipment failure occur in the sewerage system. Infiltration or entry of soil or groundwater into the sewer system via faults within the fabric of the sewerage system, is another cause of sewer flooding. Infiltration is often related to shallow groundwater, and may cause high flows for prolonged periods of time.

Since 1980, the Sewers for Adoption guidelines have meant that most new surface water sewers have been designed to have capacity for a rainfall event with a 1 in 30 chance of occurring in any given year, although until recently this did not apply to smaller private systems. This means that, even where sewers are built to current specification, they are likely to be overwhelmed by larger events of the magnitude often considered when looking at river or surface water flooding (e.g. a 1 in 100 chance of occurring in a given year). Existing sewers can also become overloaded as new development adds to the discharge to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

Historical incidents of flooding are detailed by Severn Trent Water through their DG5 register. This database records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. For confidentiality reasons this data has been supplied on a postcode basis. Data covers all reported incidences as of July 2015. The DG5 register is shown in Table 5-4.

Table 5-4: DG5 Register recorded flood incidents

Post Code	Recorded Flood Incidents	Post Code	Recorded Flood Incidents
CV1 4	1	CV4 9	1
CV2 1	1	CV5 6	2
CV2 3	6	CV5 7	3
CV2 4	4	CV5 8	1
CV2 5	1	CV5 9	3
CV3 1	3	CV6 1	5
CV3 2	2	CV6 2	3
CV3 4	3	CV6 3	1
CV3 5	3	CV6 4	5
CV3 6	3	CV6 6	1
CV4 7	7	CV6 9	1
CV4 8	1		
Total: 61			
Note: Based on information exported on 14/07/15			

The DG5 register indicates a total of 61 recorded flood incidents in Coventry City. The more frequently flooded postcodes are CV4 7 (7), CV2 3 (6) and CV6 4 (5). It is important to recognise the DG5 register does not contain information about properties and areas at risk of sewer flooding caused by operational issues such as blockages. Also the register represents a snap shot in time and will get outdated with properties being added to the register following rainfall events, whilst risk will be reduced in some locations by capital investment in increase the capacity of the network. As such the sewer flooding flood risk register is not a comprehensive 'at risk register'.

As well as using the DG5 dataset to determine approximate sewer flooding hotspots, questionnaires were completed by Coventry City Council staff to gather local knowledge of flooding which may not be found in existing documentation. This information included information of historical sewer flooding events. The list below is of locations where historical sewer flooding events have been noted:

- Broad Lane.
- Duggins Lane / Cromwell Lane / Station Avenue.
- Albany Road / Earlsdon Street.
- Chesholme Road: Flooding from STW combined sewer in high intensity rain.
- Kingfield Road: Flooding from Springfield Brook Culvert and STW SW sewers in heavy rain.

5.7.1 Flooding from reservoirs

Reservoirs are artificial lakes where water is collected and stored behind a man-made structure and released under control either to reduce the flow magnitudes in downstream channels or to meet a requirement when needed for purposes such as irrigation, municipal needs or hydroelectric power[16]. A reservoir is considered large if volume exceeds 10,000 cubic metres[17]. However, at the time of preparing this version of the SFRA special measures relating to the assessment and designation of reservoir risk only apply to reservoirs with a storage capacity greater than 25,000 cubic metres. Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area.

[16] Defra – national flood and coastal erosion risk management strategy for England (2011): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/228898/9780108510366.pdf

[17] Flood and Water Management Act 2010 - www.legislation.gov.uk/ukpga/2010/29/pdfs/ukpga_20100029_en.pdf

Reservoirs with an impounded volume greater than 25,000m^3 are governed by the Reservoir Act 1975, as amended by provisions in the Flood and water Management Act, 2010 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Acts means that the risk of flooding from reservoirs is relatively low.

Although there are no large reservoirs within Coventry City, outlines from the National Inundation Reservoir Mapping (NIRIM) study show worst case inundation extents of three reservoirs impacting Coventry City. The three reservoirs are all located outside the Coventry City administrative area and are the following:

- Meriden No A.
- Meriden No B.
- Coombe Pool.

For more information please see Section 6.5.

5.7.2 Flooding from canals

Canal water flow is controlled by artificial structures (such as locks) to ensure that flow remains below a level that can be conveyed within the canal. Therefore such watercourses rarely flood as they are generally designed to retain a controlled volume of water rather than collect and convey water running off from adjacent land. However, intense rainfall can increase the risk of flooding from canals through increased artificial conveyance between catchments or interaction of this watercourse with another which may cause water to back up and spill out of the channel. The other potential source of flooding is from a failure in the structure of the canal channel that results in a sudden cascade of water onto adjacent land.

The Coventry Canal and Oxford Canal are the only two canals located within Coventry City. The Oxford Canal is located in the north-eastern portion of the Coventry City Administrative area, north of the M6 motorway. The Coventry Canal begins at the Coventry Canal Basin (SP 33256 79574) and meanders in a north-easterly direction, exiting the administrative area south of Exhall (SP 35470 84442). There is only one record of a canal breach which happened on 15th December 1978 at Bishopgate Green. This was the result of excavation works on a construction site at the time. The flood extent extended a significant distance through Coventry impacting both industrial and residential properties. For more information please refer to Section 6.2

5.8 The impact of climate change

5.8.1 Fluvial flooding

Climate change mapping has been provided in Appendix C as well as the site-specific summary tables provided in Appendix A. The effect tends to be an increase in the mapped flood extent. Smaller watercourses in the study area tend to be in areas of steeper topography with quite confined floodplains, and in these cases increases in flow do not result in a significant increase in flood extent.

However, climate change does not just affect the extent of flooding. It is important to remember that even where extent does not significantly increase; flooding is likely to become more frequent under a climate change scenario. For example, what is currently an event with a 2% probability of occurring in any one year, may increase to say a 5% probability under climate change.

The impact of an event with a given probability is also likely to become more severe. For example as water depths, velocities and flood hazard increase, so will the risk to people and property. Although qualitative statements can be made as to whether extreme events are likely to increase or decrease over the UK in the future, there is still considerable uncertainty regarding the magnitude of the localised impact of these changes.

Revised climate change allowances will be published in late 2015 to reflect the climate projections in UK Climate Projections (UKCP09). The main change is allowances for peak river flow that are based on river basin districts.

Once published, the allowances for climate change set out in the new guidance should be used when assessing climate change.

Further details regarding the uncertainties in predicting the impacts of climate change is documented in

- **Environment Agency (2011) Adapting to Climate Change: Advice for Flood and Coastal Erosion Risk Management Authorities. September 2011; and**
- **UK Climate Projections (UKCP09)**

5.8.2 Surface Water

Climate change is predicted to increase rainfall intensity in the future by up to 30%. This will increase the likelihood and frequency of surface water flooding across catchments, but particularly in impermeable urban areas that are already susceptible.

5.8.3 Groundwater

The effect of climate change on groundwater flooding problems, and those watercourses where groundwater has a large influence on winter flood flows, is more uncertain. Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months.

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6 Flood risk from canals and reservoirs

6.1 Introduction

6.2 Flood risk from canals

Canals do not generally pose a direct flood risk as they are a regulated waterbody. The residual risk from canals tends to be associated with lower probability events such as overtopping and embankment failure (breach and sudden escape of the water retained in the canal channel).

The residual risk associated with canals is more difficult to determine as it depends on a number of factors including, for example, the source and magnitude of surface water runoff into the canal, the size of the canal, construction materials and level of maintenance. The probability of the risk of a breach is managed by continued maintenance.

6.2.1 Overtopping

The level of water in canals is normally controlled by the level and size of weirs. When surface water enters a canal, the level of water rises. The water level may then reach a point in which it discharges from the canal through control structures such as weirs. Should the capacity of these control structures be exceeded, or should they become blocked, overtopping may occur.

6.2.2 Breach

Breaches or embankment failure may be caused by a number of factors including:

- Culvert collapse.
- Overtopping.
- Animal burrowing.

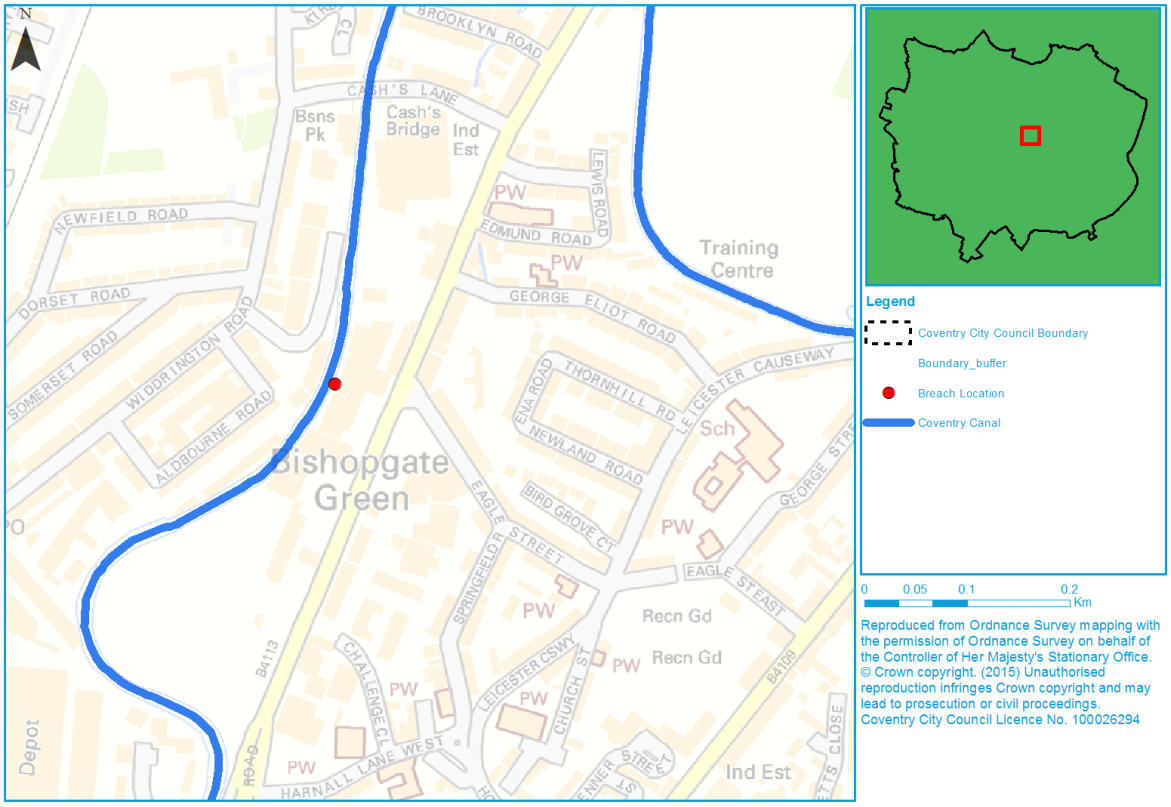
Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind the embankment. The volume of water released during a breach is dependent on the upstream pound length (i.e. the distance between locks) and how quickly the operating authorities can react to prevent further water loss, for example by the fitting of stop boards to restrict the length of the canal that can empty through the breach, or repair of the breach.

6.3 Recorded flood incidents from the Coventry Canal

The Canal and River Trust were contacted for this study and provided the following information on the only known flooding incident involving the Coventry Canal within Coventry City.

- The incident happen on the 15th December 1978 at Bishopgate Green (see Figure 6-1).
- The failure of the embankment was caused by the removal of an existing building and excavation works which removed approximately 1/3 of the canal embankment. Previously the building provided reinforcement to the canal embankment. Removal of the building left the embankment (which is predominantly constructed of clay, silt and sand) vulnerable to the weather and failure.
- Flooding extended over a significant distance through Coventry flooding not only local residences but also a number of industrial properties. Flooding extended down Foleshill Road towards Swanswell Pool and extended further in a south, south-easterly direction. No digital representation of the flood extent was available at the time of this study.

Figure 6-1: Location of December 1978 Canal Breach



6.4 Flood risk from the Coventry Canal

In addition to overtopping or breach, there is a potential for flooding indirectly from the canal. There are a number of culverts passing under the Coventry canal in Coventry City. The majority of these are part of the sewer network conveying watercourse and surface water to watercourses such as the River Sowe. In these cases a blockage of the culvert will have an impact on land far removed from the initial blockage location. Additionally where the River Sowe passes beneath the canal there is potential for the capacity of these culverts be exceeded, or the culverts become blocked, causing water from the watercourse to back up, potentially causing flooding. The Canal and River Trust have no record of any incidences where this has happened, although it should be noted they do not specifically monitor or have comprehensive records of this type of flooding scenario.

The canal also has the potential to act as a flow path for water from one river catchment to another. Within Coventry City the canal is perched above all Main Rivers or Ordinary Watercourses and as such would not interact and become a flow path from river catchment to another. The only instance which would allow interaction between one river catchment and the canal would be if there was to be a breach.

Of the strategic development sites being assessed within this SFRA only three are within the vicinity of Coventry Canal. These sites are the following:

- L16
- L30
- L33

The site with the highest risk from the canal is L16 (See Figure 6-2). The site is shown to be located at a lower level than the canal with the embankment at its narrowest in the north western portion of the site. Given the proximity of the motorway any breach is highly likely to be channelled through the site. Given the extent of the 1978 canal breach, any development within this site should include a detailed assessment of how a canal breach would impact the site as part of a site specific FRA.

Figure 6-2: Coventry Canal Topography in the vicinity of Strategic Site L16

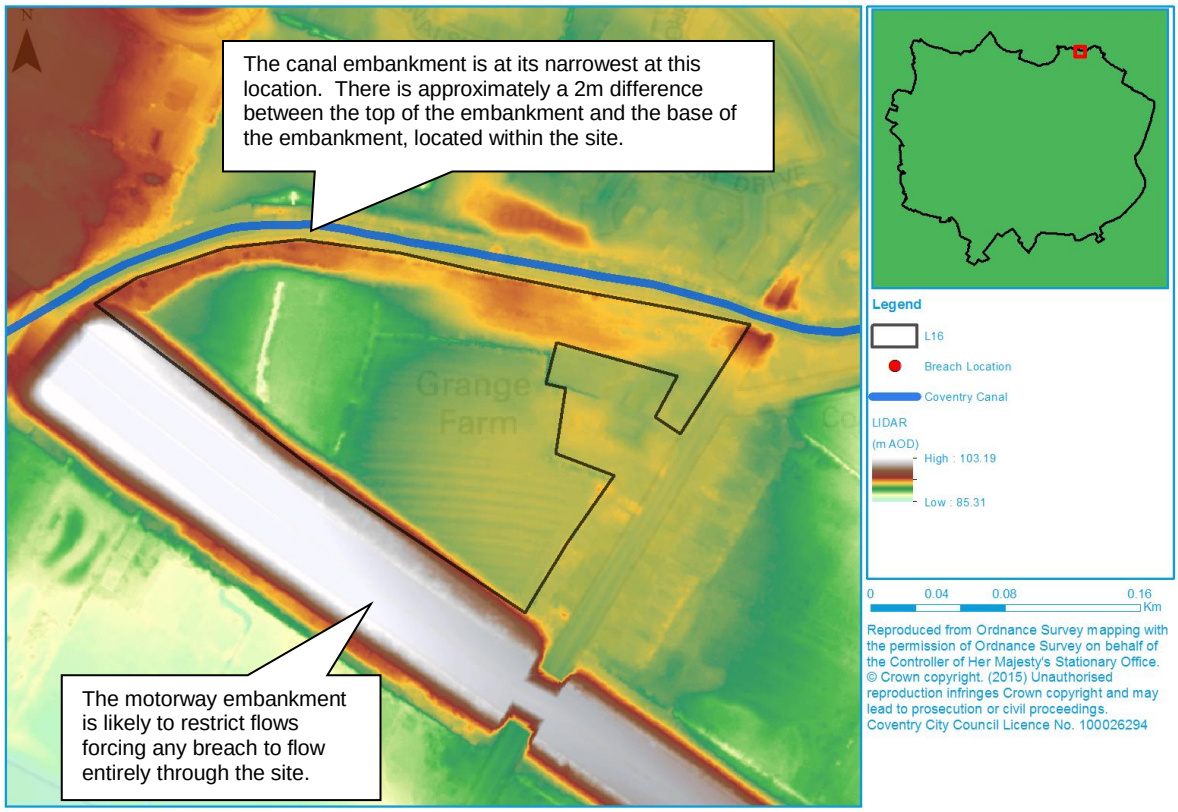
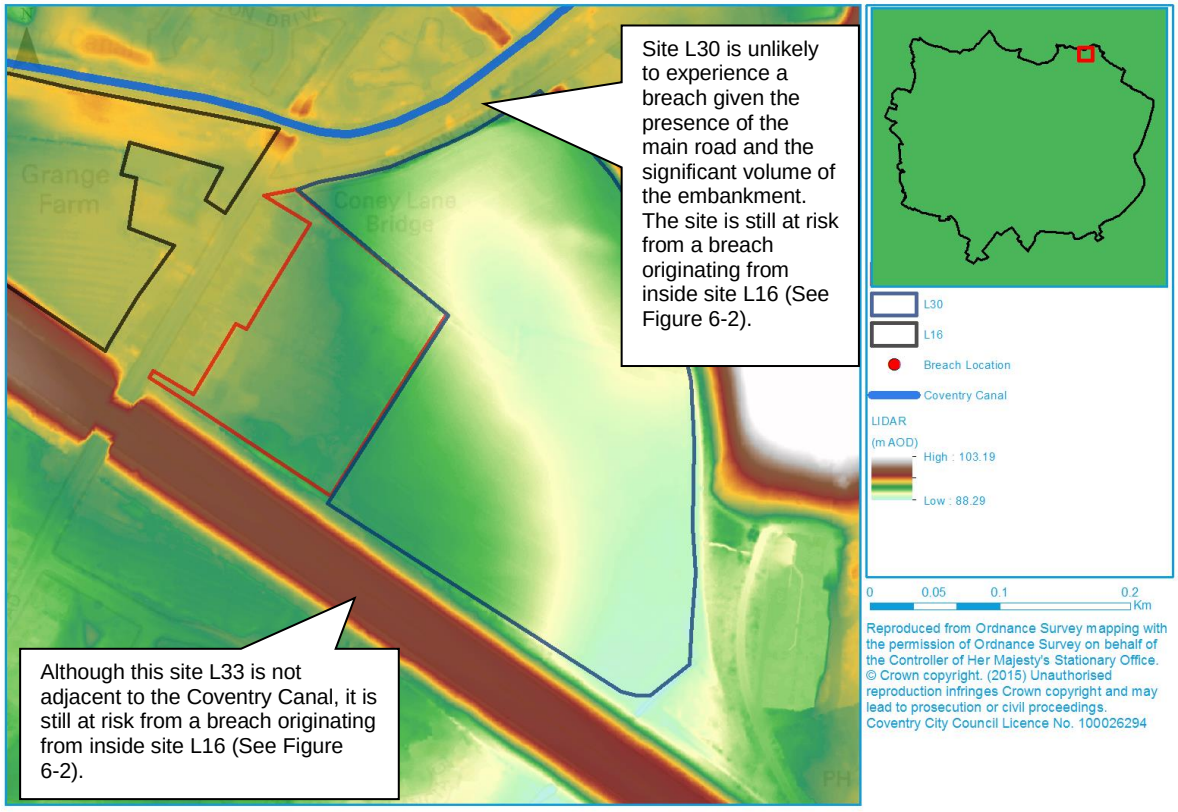


Figure 6-3: Coventry Canal Topography in the vicinity of Strategic Sites L30 and L33



Strategic sites L30 and L33 are also at risk from canal breaches as shown in Figure 6-3. Strategic site L33 is located away from the canal embankment but is likely be impacted by a breach within L16 as the motorway embankment is likely to direct flow of breach waters towards the site. L30 is located in closer proximity to Coventry Canal; however, it is unlikely to have a breach within its boundary. The embankment between the canal and the site is of a significant volume that it is unlikely to fail. The site, like L33, is still at risk from breaches originating within the L16 site boundary. Any developments within either site should include a detailed assessment of how a canal breach would impact the site as part of a site specific FRA.

6.5 Flood risk from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are listed on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is relatively low. Recent changes to legislation under the Flood and Water Management Act require the Environment agency top designate the risk of flooding from reservoirs over 25,000 cubic metres and at some time in the future to consider the risk from reservoirs with a volume greater than 10,000 cubic metres. The Environment agency is currently progressing a 'Risk Designation' process so that the risk is formally determined.

Reservoir flooding is very different from other forms of flooding. It may happen with little or no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate, but it is less likely than flooding from rivers of surface water. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

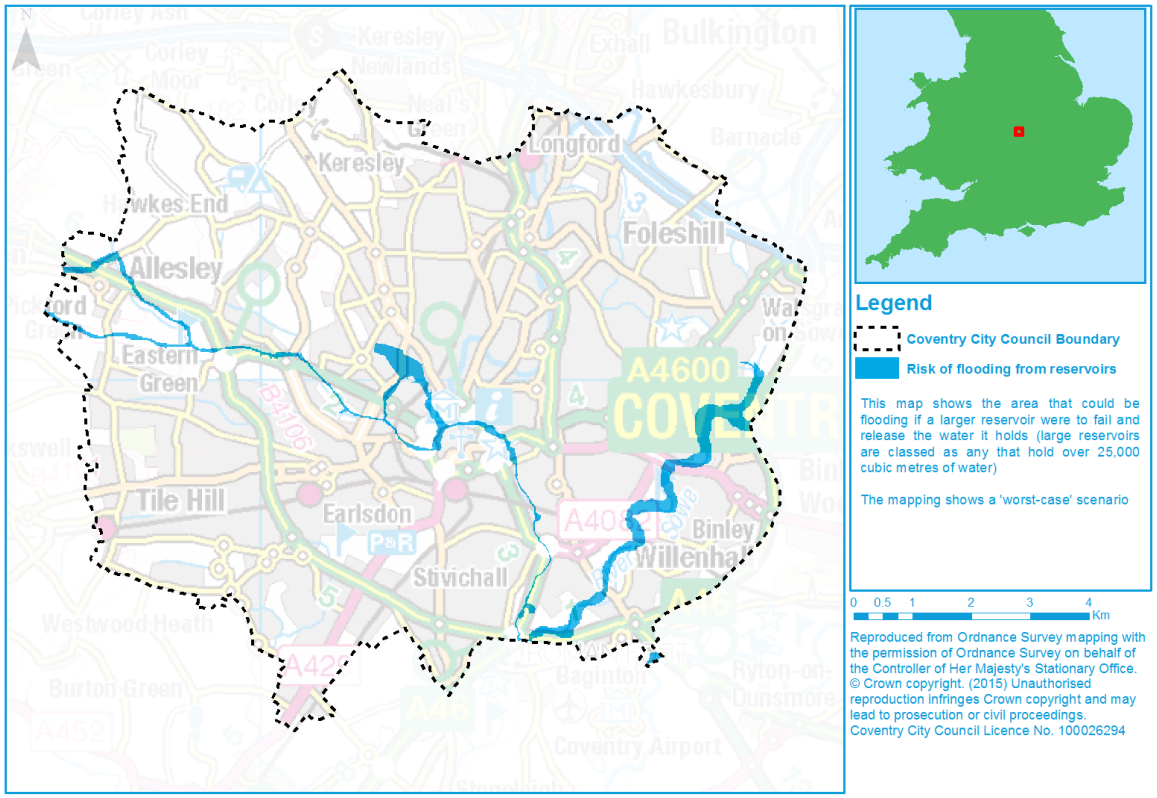
The risk of inundation to Coventry City as a result of reservoir breach or failure of a number of reservoirs within the area was assessed as part of the National Inundation reservoir Mapping (NIRIM) study. No reservoirs are located within Coventry City; however, reservoirs outside of the area whose inundation mapping is shown to affect Coventry City are detailed in Table 6-1 and shown in in Figure 6-4.

The Environment Agency maps represent a credible worst case scenario. In these circumstances it is the time to inundation, the depth of inundation, the duration of flooding and the velocity of flood flows that will be most influential.

Table 6-1: Reservoirs that may potentially affect Coventry in the event of a breach

Reservoir	Location (grid reference)	Reservoir owner	Environment Agency area	Local authority
Meriden No.3 A	426047 281894	Severn Trent Water	Staffordshire, Warwickshire and West Midlands	Solihull
Meriden No.3 B	426171 282003			
Coombe Pool	438310 279216	Coventry City Council	Staffordshire, Warwickshire and West Midlands	Warwickshire

Figure 6-4: Reservoir Flood Mapping



The risk to development from reservoirs is residual but developers should consider reservoir flooding during the planning stage.

- Developers should seek to contact the reservoir owner to obtain information which may include
    - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
    - operation: discharge rates / maximum discharge;
    - discharge during emergency drawdown; and
    - inspection / maintenance regime.
- Developers should apply the sequential approach to locating development within the site. The following questions should be considered
    - can risk be avoided through substituting less vulnerable uses or by amending the site lay-out?
    - can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted? and
    - can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?
- Consult with relevant authorities regarding emergency plans in case of reservoir breach
- In addition to the risk of inundation those considering development in areas affected by breach events should also assess the potential hydraulic forces imposed by the rapid flood event and check that that the proposed infrastructure fabric can withstand the loads imposed on the structures by a breach event.

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7 Cumulative impact of development and cross-boundary issues

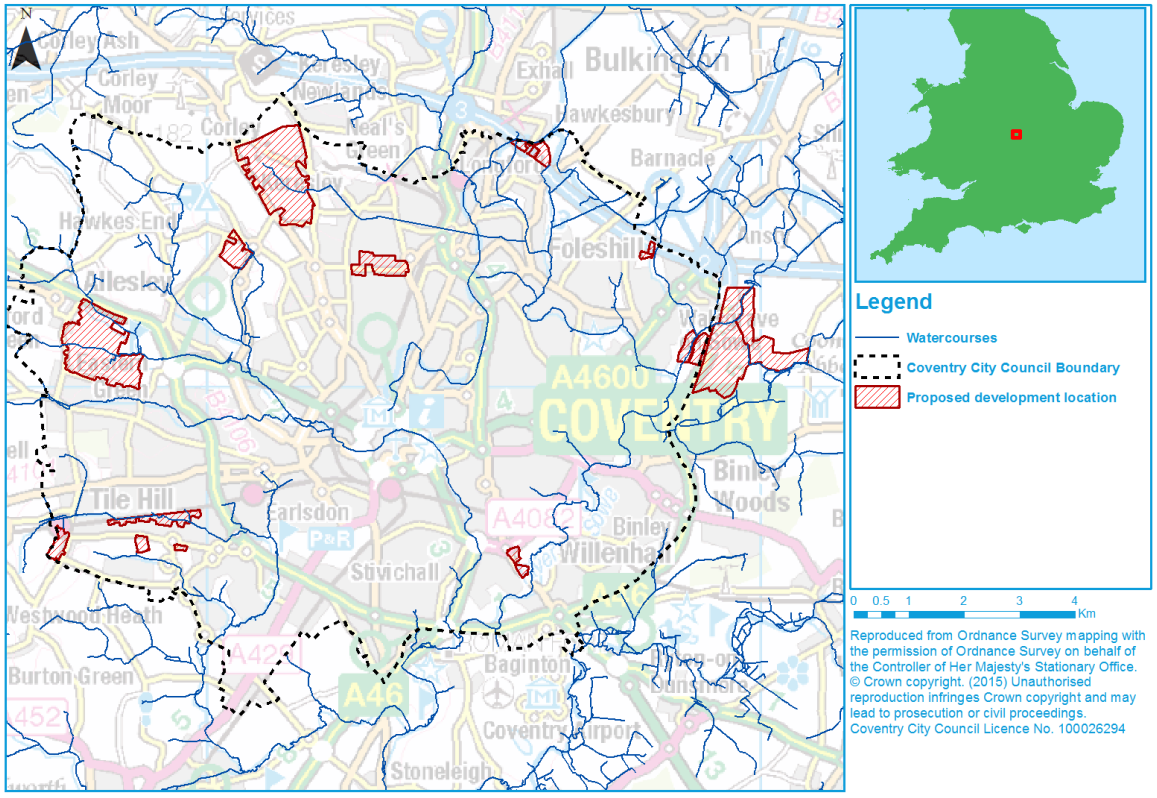
7.1 Cumulative impact of development

When allocating land for development, consideration must be given to the potential cumulative impact of the loss of floodplain storage volume. The effect of the loss of volume should be assessed, at both the development and elsewhere within the catchment and, if required, the scale and scope of appropriate mitigation should be identified. Whilst the loss of storage for individual developments may only have a minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

A high level assessment has been undertaken of the potential cumulative impact of development in Coventry. The location of the potential development locations has been assessed against the Environment Agency's Flood Zones, the outlines derived by the modelling undertaken for this SFRA and the uFMfSW to undertake a broad scale assessment of areas where there is currently flood risk issues and where the cumulative impact of development has potential to make flood risk worse if preventative measures are not put in place.

The majority of the identified potential development locations are located on the outer fringes of Coventry (Figure 7-1). Many of these sites have watercourses flowing through them or alongside their boundaries which go on to flow through Coventry and join the River Sowe or River Sherbourne. Depending on the location, size and nature of development within the possible sites, there is the potential for loss of storage and floodplain connectivity in the upper reaches of these watercourses which could potentially increase flood risk downstream.

Figure 7-1: Potential development locations



However, the conditions set out by Coventry City Council in their SWMP mean the issue of cumulative impact should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and in many cases the development should be used to improve the flood risk.

7.2 Cross-boundary issues

Future large-scale development, both within and outside Coventry City can have the potential to affect flood risk to existing development and surrounding areas. Coventry City has boundaries with the following Local Authorities:

- Nuneaton and Bedworth Borough
- Rugby Borough
- Warwick District
- North Warwickshire Borough
- Solihull Metropolitan

Neighbouring authorities were contacted and, where possible, Local Plans and SFRAs were reviewed to assess whether there are any proposed large-scale developments that may affect flood risk in the SFRA area.

The topography of the study area means that a large number of the watercourses rise in the Coventry City and connect either with the River Sowe or River Sherbourne within the Council Boundary. The main exceptions are the River Sowe which has its source in Nuneaton and Bedworth Borough before it flows through Coventry City and on into Warwick District, and the Withy and Smite Brooks which have their source in Rugby Borough before joining the River Sowe within Coventry City. Therefore, the neighbouring authorities which have the potential to affect flood risk within Coventry City are Nuneaton and Bedworth Borough and Rugby Borough. The authority that may potentially be affected by Coventry City is Warwick District. The topography of the area means North Warwickshire Borough and Solihull Metropolitan Councils will have negligible impact on flood risk in Coventry. Both authorities have confirmed that they do not have any development proposed in the areas bordering Coventry City Council.

7.2.1 Nuneaton and Bedworth Borough

Nuneaton and Bedworth Borough Plan: Preferred Options (part 2 of 2)[18] shows a potential strategic housing site at Hospital Lane. The increase in impermeable area in this location has the potential to increase runoff entering the Breach Brook which is a tributary of the River Sowe. However, if appropriate drainage is adopted at the site, the likelihood of any significant effect on the level of flood risk within Coventry is low. It would be a requirement that consideration was given to the wider catchment implications of drainage mitigation measures, rather than just assessing immediate local effects.

Due to the topography and the direction of watercourse flow, development in Coventry will not affect flood risk within Nuneaton and Bedworth Borough.

7.2.2 Rugby Borough

The Rugby Borough Local Plan is still in development and at the time of preparation of this SFRA they did not have any definitive proposals for site allocation. The main risk to flooding in Coventry would be any large scale development in the Withy or Smite Brook catchments as both these watercourses are tributaries of the River Sowe. Again it would be a requirement that consideration is given to the wider catchment implications of drainage mitigation measures, rather than just assessing immediate local effects.

Due to the topography and the direction of watercourse flow, development in Coventry will not affect flood risk within Rugby Borough.

7.2.3 Warwick District

All the watercourses within the Coventry City boundary drain into the River Sowe (or the River Sherbourne which is, itself a tributary of the River Sowe), which flows through the area into Warwick District where it joins the River Avon.

Although none of the potential development locations identified by Coventry are located on the boundary with Warwick District, any increase in flow in the River Sowe as a result of

[18] http://www.nuneatonandbedworth.gov.uk/downloads/file/1116/borough_plan_preferred_options_part_2_of_2_2013

development elsewhere in Coventry City can potentially increase flood risk within Warwick District.

However, conditions imposed by Coventry City Council should allow for mitigation measures so any increase in runoff as a result of development is properly managed and should not exacerbate flood risk issues either within, or outside of, Coventry City.

Warwick District Council has a number of strategic sites located on the boundary with Coventry City including

- University of Warwick
- Baginton, Bubbenhall and Coventry Airport
- Burton Green

Of these, only the Baginton, Bubbenhall and Coventry Airport site is located adjacent to the River Sowe. The topography of the area means development in Warwick District will not affect the level of flood risk within Coventry.

7.2.4 Water quality considerations

In addition to cross-boundary issues regarding flood risk, there are also cross-boundary issues relating to water quality. Development should consider the quality of the water that is released from sites and the impact it may have on the water quality on any receiving water bodies. Many of the watercourses within Coventry are classed as 'poor overall status' by Water Framework Directive (WFD) requirements (see section 14.3). Development or agriculture in the upper catchments of watercourses that flow across boundaries into Coventry City can potentially impact on the quality of water of these watercourses.

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8 FRA requirements and guidance for developers

8.1 Over-arching principles

This SFRA focuses on delivering a strategic assessment of flood risk within Coventry City. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk at a site are fully addressed. Some sites may additionally be put forward for the Exception Test following the Sequential Test if the Sequential Test indicates the proposed development inappropriate or unsuitable. These will require further work in a detailed Flood Risk Assessment (FRA). Any site that does not pass the Exception Test should not be allocated for development.

It is the responsibility of the developer to provide an FRA with an application.

It should be acknowledged that a detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. Where the FRA shows that a site is not appropriate for a particular usage, a lower vulnerability classification may be appropriate.

8.2 Requirements for flood risk assessments

The aim of an FRA is to demonstrate that the development is protected to the 1 in 100 year flood scenario and is safe during the design flood event, including an allowance for climate change. This includes assessment of mitigation measures required to safely manage flood risk. Development proposals requiring FRAs should

- Be performed in accordance with the requirements of the Sequential and, when necessary, Exception Tests;
- not increase flood risk, either upstream or downstream, of the site, taking into account the impacts of climate change;
- seek to not increase surface water volumes or peak flow rates from greenfield Qbar rates, which would result in increased flood risk to the receiving catchments;
- use opportunities provided by new development to, where practicable, reduce flood risk within the site and elsewhere;
- ensure that where development is necessary in areas of flood risk (after application of Sequential and Exception Tests), it is made safe from flooding for the lifetime of the development, taking into account the impact of climate change; and
- consider all sources of flood risk, including fluvial, surface water and drainage.

FRAs for sites located in the Coventry City area should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and Coventry City Council. In circumstances where FRA's are prepared for windfall sites then they should include evidence that demonstrates the proposals are in accordance with the policies described in the Local Plan.

8.3 Mitigation measures

In accordance with the Flood Risk Management Hierarchy described in Figure 1-1, mitigation measures should be seen as a last resort to address flood risk issues. Consideration should first be given to minimising risk by planning sequentially across a site. Once risk has been minimised as far as possible, only then should mitigation measures be considered.

Often the determining factor in deciding whether a particular development is appropriate is the practical feasibility, financially viability and long term maintenance implications of flood risk mitigation rather than technical limitations. Detailed technical assessments are required in the FRA to assess the practical feasibility, together with a commercial review by the developer of the cost of the mitigation works and how contributions will be made for their long term maintenance. At the SFRA stage, broad assumptions must be made regarding the feasibility of flood risk mitigation to highlight sites with greater development potential. The formulation of measures that not only provides an appropriate standard of protection to new development, but also reduces the risk to existing communities will be an important consideration.

Attention must also be paid to the provision of safe access and egress during flood events, including climate change, and how this is linked to flood warning and emergency evacuation where necessary. The Emergency Services and local authority should be consulted on the evacuation and rescue capabilities and any advice or requirements included.

There should be no interruption to flood flows or loss of flood storage as a result of any proposed development. Flood storage compensation may be appropriate for sites on the edge of the existing floodplain or within a flood cell.

Whilst it might be possible to identify appropriate flood mitigation measures for some sites, it is worth noting that in some instances the findings of individual FRAs may determine that the risk of flooding to a proposed development is too great and mitigation measures are not feasible or appropriate. In these instances, the development is likely to be subject to an objection by the Environment Agency.

The minimum acceptable standard of protection against flooding for new residential property within flood risk areas is the 1 in 100 year event for fluvial flooding and 1 in 100 year storm for surface water flooding, Developments susceptible to flood risk resulting from blockage or exceedance of structures should be protected beyond the 1 in 100 year plus climate change scenario. An allowance for climate change over the lifetime of the development must be made when assessing each of these scenarios. The measures chosen will depend on the nature of the flood risk.

8.4 Reducing flood risk

8.4.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones, to higher ground, while more flood-compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. However, vehicular parking in floodplains should be based on the nature of parking, flood depths and hazard including evacuation procedures and flood warning.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

8.4.2 Raised floor levels

The raising of floor levels within a development avoids damage occurring to the interior, furnishings and electrics in times of flood. If it has been agreed with the Environment Agency that, in a particular instance, the raising of floor levels is acceptable, they should be raised to a minimum of 300mm above the maximum water level caused by a 1 in 100-year event plus climate change (assumed as a 20% increase in flow over the next 20 to 100 years). This additional height that the floor level is raised above the maximum water level is referred to as the “freeboard”. Additional freeboard may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

Many areas currently situated within Flood Zone 2 may become part of Flood Zone 3a in the future due to the effects of climate change, therefore it is essential that the potential risk of flooding in the future is considered when planning development.

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels.

Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route. However, access and egress would still be an issue, particularly when flood duration covers many days.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone will be required to pass the Exception Test.

8.4.3 Development and raised defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain. It would be preferable for schemes to involve an integrated flood risk management solution.

Temporary or demountable defences are not acceptable forms of flood protection for a new development but might be appropriate to address circumstances where the consequences of residual risk are severe. In addition to the technical measures the proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate.

8.4.4 Modification of ground levels

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken at locations where raising ground levels could adversely affect existing communities and property.

In most areas of fluvial flood risk, raising land above the floodplain would reduce conveyance or flood storage in flood the floodplain and could adversely impact flood risk downstream or on neighbouring land.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated).

Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Raising levels can also create areas where surface water might pond during significant rainfall events. Any proposals to raise ground levels should be tested to ensure that it would not cause increased ponding or build-up of surface runoff on third party land.

Any proposal for modification of ground levels will need to be assessed as part of a detailed flood risk assessment.

8.4.5 Developer contributions

In some cases, and following the application of the sequential test, it may be necessary for the developer to make a contribution to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS).

Defra's Flood and Coastal Risk Management Grant in Aid (FCRMGiA)[19] can be obtained by operating authorities to contribute towards the cost of a range of activities including flood risk management schemes that help reduce the risk of flooding and coastal erosion. Some schemes are only partly funded by FCRMGiA and therefore any shortfall in funds will need to be found from elsewhere when using Resilience Partnership Funding, for example local levy funding, local businesses or other parties benefitting from the scheme.

For new development in locations without existing defences, or where the development is the only beneficiary, the full costs of appropriate risk management measures for the life of the assets proposed must be funded by the developer.

However, the provision of funding by a developer for the cost of the necessary standard of protection from flooding or coastal erosion does not mean the development is appropriate as other policy aims must also be met. Funding from developers should be explored prior to the

[19] Principles for implementing flood and coastal resilience funding partnerships (Environment Agency, 2012)

granting of planning permission and in partnership with the local planning authority and the Environment Agency.

The appropriate route for the consideration of strategic measures to address flood risk issues is the Local flood Risk Management Strategy (LFRMS) prepared by the Lead Local flood Authority. The LFRMS should describe the priorities with respect to local flood risk management, the measures to be taken, the timing and how they will be funded. It will be preferable to be able to demonstrate that strategic provisions are in accordance with the LFRMS, can be afforded and have an appropriate priority.

The Environment Agency is committed to working in partnership with Developers to reduce flood risk. Where assets are in need of improvement or a scheme can be implemented to reduce flood risk, the EA request that Developers contact them to discuss potential solutions.

8.4.6 Buffer strips

The LFRMS Standing Condition ensures the provision of a buffer strip to 'make space for water', allow additional capacity to accommodate climate change and ensure access to the watercourse, structures and defences is maintained for future maintenance purposes.

It also enables the avoidance of disturbing riverbanks, adversely impacting ecology and having to construct engineered riverbank protection. Building adjacent to riverbanks can also cause problems to the structural integrity of the riverbanks and the building itself, making future maintenance of the river much more difficult.

8.4.7 Resilience measures

There may be instances where flood risk to a development remains despite implementation of such planning measures as those outlined above. For example, where the use is water compatible, where an existing building is being changed, where residual risk remains behind defences, or where floor levels have been raised but there is still a risk at the 1 in 1,000-year scenario. In these cases (and for existing development in the floodplain), additional measures can be put in place to reduce damage in a flood and increase the speed of recovery. These measures should not normally be relied on for new development as an appropriate mitigation method. Most of the measures should be regarded as reducing the rate at which flood water can enter a property during an event and considered an improvement on what could be achieved with sand bags. They are often deployed with small scale pumping equipment to control the flood water that does seep through these systems. The following measures are often deployed:

Permanent barriers

Permanent barriers can include built up doorsteps, rendered brick walls and toughened glass barriers.

Temporary barriers

Temporary barriers consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.

Wet-proofing

Interior design measures to reduce damage caused by flooding. For example:

- Electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level
- Water-resistant materials for floors, walls and fixtures
- Non-return valves to prevent waste water from being forced up bathrooms, kitchens or lavatories
- If redeveloping existing basements for non-residential purposes, new electrical circuitry installed at a higher level with power cables being carried down from the ceiling rather than up from the floor level to minimise damage if the development floods

Resilience measures will be specific to the nature of flood risk, and as such will be informed and determined by the FRA.

Community Resilience Measures

These include demountable defences that can be deployed by local communities to reduce the risk of water ingress to a number of properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.

8.5 Making Space for water

The NPPF sets out a clear policy aim in Flood Zone 3 to create space for flooding by restoring functional floodplain.

All new development close to rivers should consider the opportunity presented to improve and enhance the river environment. Developments should look at opportunities for river restoration and enhancement as part of the development. Options include backwater creation, de-silting, in-channel habitat enhancement and removal of structures. When designed properly, such measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and increasing biodiversity. Social benefits are also gained by increasing green space and access to the river.

Consideration for making space for water should also be applied to surface water generated by impermeable surfaces. All new developments should aim to incorporate SuDS to minimise the amount of surface water that is generated. Through a sequential design, known areas of flood risk from surface water can be set aside as open space to ensure flow routes are not blocked, preventing water from building up to potentially dangerous depths. The provision of SuDS also allows water related features to become part of the landscape, offering improved aesthetics to a development and removing the need for underground storage or culverting.

8.6 Reducing flood risk from other sources

8.6.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and for this reason many conventional flood defence and mitigation methods are not suitable. The only way to fully reduce flood risk would be through building design (development form), ensuring floor levels are raised above the water levels caused by a 1 in 100-year plus climate change event. Site design would also need to preserve any flow routes followed by the groundwater overland to ensure flood risk is not increased downstream.

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off of the site. Developers should provide evidence and ensure that this will not be a significant risk.

When redeveloping existing buildings it may be acceptable to install pumps in basements as a resilience measure. However, for new development this is not considered an acceptable solution.

8.6.2 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. The development must improve the drainage infrastructure to reduce flood risk on site and regionally. It is important that a drainage impact assessment shows that this will not increase flood risk elsewhere, and that the drainage requirements regarding runoff rates and SuDS for new development are met.

If residual surface water flood risk remains, the likely flow routes and depths across the site should be modelled. The site should be designed so that these flow routes are preserved and building design should provide resilience against this residual risk.

When redeveloping existing buildings, the installation of some permanent or temporary flood-proofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream

of the public sewerage system. These need to be carefully installed and must be regularly maintained. Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This must be demonstrated with suitable modelling techniques.

8.6.3 Sustainable Drainage Systems

Sustainable Drainage Systems (SuDS) aim to mimic the natural processes of Greenfield surface water drainage by encouraging water to flow along natural flow routes and thereby reduce runoff rates and volumes during storm events while providing some water treatment benefits. SuDS also have the advantage of provided effective Blue and Green infrastructure and ecological and public amenity benefits when designed and maintained properly.

The inclusion of SuDS within developments should be seen as an opportunity to enhance ecological and amenity value, and promote Green Infrastructure, incorporating above ground facilities into the development landscape strategy. SuDS must be considered at the outset, during preparation of the initial site conceptual layout to ensure that enough land is given to design spaces that will be an asset to the development rather than an after-thought. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

More detailed guidance on the use of SuDS is providing in Section 9.

8.7 Coventry City Council Surface Water Management Plan Development Conditions

Coventry City Council, as LLFA, is a statutory consultee for major planning applications.

The LLFA can also provide advice on minor development on a non-statutory basis, as the cumulative effect of large numbers of minor development in an area could have a significant effect on surface water drainage.

Coventry City Council, as LLFA, has devised a suite of conditions on development which are imposed on a site-specific basis. The aims of these conditions is to reduce to flood risk to, and from, the development and ensure future development is sustainable and resilient to flood risk from any source.

The provision of SuDS is a necessity, and should be focussed on the reduction of peak and total discharge.

Coventry City Council requires drainage discharge rates of Qbar greenfield minus 20% for developed and formally developed sites.

The design must also consider, and provide for, surface water exceedance flows appropriately routed to and through the development.

The conditions also seek to deliver improvements in water quality for compliance with the Water Framework Directive (WFD).

The use of technologies such as green roofs and water reuse systems and strongly encouraged.

In addition to the conditions imposed by the LLFA, further conditions may be applied by the Environment Agency where Main Rivers are affected, and by other statutory consultees within the Risk Management Authority remit.

8.7.1 Discharge from development

The Council require that rainwater runoff from a drainage system shall discharge to one of the following (listed in order of priority):

1. An appropriate soakaway or some other surface infiltration system, or where not reasonably practicable;

2. Reduced peak and total discharge to a watercourse, or where not reasonably practicable;
3. Reduced peak and total discharge to the public sewer network.

8.7.2 Design principles

The Council require all developments to adhere to the following design standards

- Watercourses must have a 5m way leave, from the top of bank on either side, to allow access for future maintenance. This way leave also applied to the sides of culverted watercourses
- Pockets of green infrastructure are to be utilised to minimise the total area of hard surfacing within development sites
- Where an area is susceptible to any form of flood risk, building floor levels will need to be raised to a level agreed with the LLFA in writing, alongside the employment of flood resilient construction. In areas at risk of fluvial flooding from Main River, the Environment Agency recommend that finished flood levels are set no lower than 300mm above the 1 in 100 year plus climate change flood level
- Cellular storage is to be designed in such a way that flow surcharges into a continuous storage void, silting of the storage void is minimised through design and that the storage void is maintainable.
- Flows and discharges are to be attenuated and managed within individual development plots where possible to reduce the size requirements of strategic and regional SuDS features. Non-residential development will require attenuation and the management of total flows and discharges within plot with more stringent requirements. Additionally greater emphasis will be placed on the management of water quality
- The use of dish channels, slot drains or other proprietary channel drainage systems within the highway is discouraged. Highway drainage must be in the form of gully drainage systems; however, kerb drainage systems can be utilised where expressly agreed in writing with the LLFA.
- The use of open air SuDS features should be implemented in all development sites, locally onsite and as part of a strategic approach. The joint use of space for sustainable drainage solutions combined with amenity should be maximised. The use of these features will provide learning opportunities and increase the interaction of people with water as well as managing discharges and water quality.
- Exceedance flow routing resulting from rainfall and blockage scenarios, including flow direction and depth, must be mapped and agreed with the LLFA. The hazard rating of exceedance flows should also be considered.
- Groundwater levels for development will need to be monitored seasonally to inform the sustainable drainage solution design.

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9 Surface water management and SuDS

9.1 Role of the LLFA and Local Planning Authority in surface water management

From April 2015 local planning policies and decisions on planning applications relating to major development (10 dwellings or more) or major commercial development should ensure that sustainable drainage systems for management of run-off are put in place. The approval of sustainable drainage solution lies with the Local Planning Authority.

In April 2015 Coventry City Council was made a statutory consultee on the management of surface water and, as a result, will be required to provide technical advice on surface water drainage strategies and designs put forward for new major developments.

Major developments are defined as

- residential development: 10 dwellings or more, or residential development with a site area of 0.5 hectares or more where the number of dwellings is not yet known; and
- non-residential development: provision of a building or buildings where the total floor space to be created is 1,000 square metres or more or, where the floor area is not yet known, a site area of 1 hectare or more.

The LLFA will also provide advice on minor development on a non-statutory basis.

When considering planning applications, local planning authorities should seek advice from the relevant flood risk management bodies, principally the LLFA on the management of surface water (including what sort of SuDS they would consider to be reasonably practicable), satisfy themselves that the proposed minimum standards of operation are appropriate and ensure, through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the development's lifetime. Judgement on what SuDS system would be reasonably practicable should be through reference to Defra's technical standards and should take into account design and construction costs.

It is essential that the consideration of sustainable drainage takes place at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS. Proposals should also comply with the key SuDS principles regarding solutions that deliver multiple long-term benefits. These principles are:

- **Quantity:** should be able to cope with the quantity of water generated by the development at the agreed rate with due consideration for climate change via a micro-catchment based approach
- **Quality:** should utilise SuDS features in a "treatment train" that will have the effect of treating the water before infiltration or passing it on to a subsequent water body
- **Amenity/Biodiversity:** should be incorporated within "open space" or "green corridors" within the site and designed with a view to performing a multifunctional purpose

Coventry City Council should

- promote the use of SuDS for the management of run off;
- ensure their policies and decisions on applications support and compliment the building regulations on sustainable rainwater drainage, giving priority to infiltration over watercourses and then sewer conveyance;
- incorporate favourable policies within development plans;
- adopt policies for incorporating SuDS requirements into Local Plans;
- encourage developers to utilise SuDS whenever practical, if necessary, through the use of appropriate planning conditions; and
- develop joint strategies with sewerage undertakers to further encourage the use of SuDS.

9.2 What is meant by Surface Water Flooding?

For the purposes of this SFRA, the definition of surface water flooding is that set out in the Defra SWMP guidance. Surface water flooding describes flooding from sewers, drains, and ditches that occurs during heavy rainfall in urban areas.

Surface water flooding includes

- **pluvial flooding:** flooding as a result of high intensity rainfall when water is ponding or flowing over the ground surface (overland surface runoff) before it either enters the underground drainage network or watercourse or cannot enter it because the network is full to capacity;
- **sewer flooding:** flooding that occurs when the capacity of underground water conveyance systems is exceeded, resulting in flooding inside and outside of buildings. Normal discharge of sewers and drains through outfalls may be impeded by high water levels in receiving waters which may cause water to back up and flood on the urban surface. Sewer flooding can also arise from operational issues such as blockages or collapses of parts of the sewer network; and
- **overland flows entering the built up area from the rural/urban fringe:** includes overland flows originating from groundwater springs.

9.3 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are water management practices which aim to enable surface water to be drained in a way that mimics (as closely as possible) the run-off and drainage prior to site development.

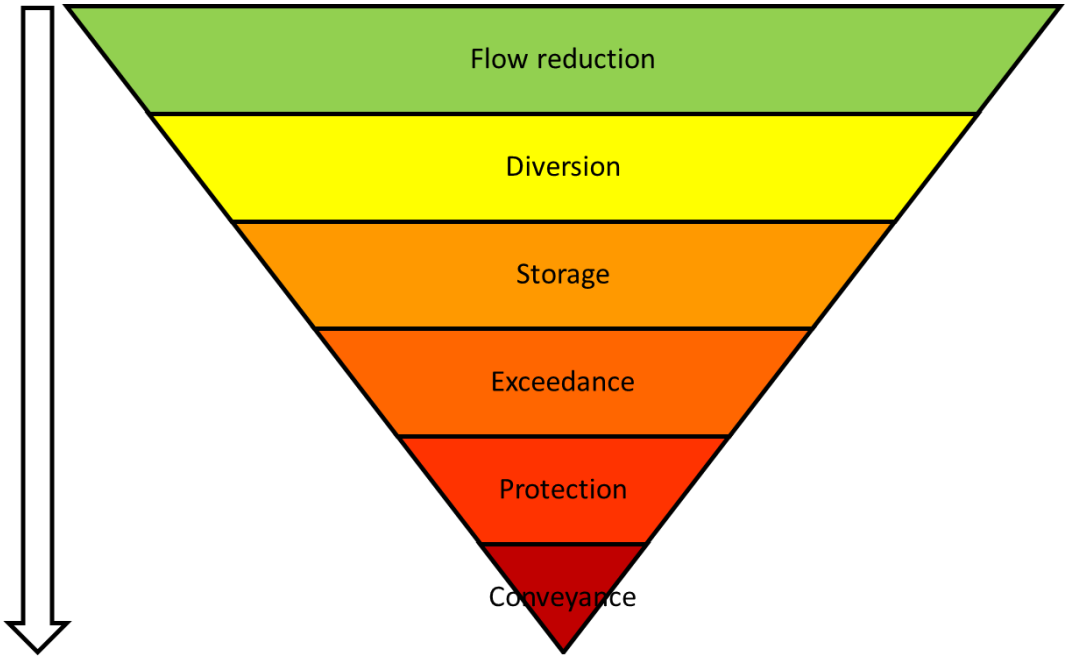
There are a number of ways in which SuDS can be designed to meet surface water run-off, water quality, and biodiversity and amenity goals. Given this flexibility, SuDS are generally capable of overcoming or working alongside various constraints affecting a site, such as restrictions on infiltration, without detriment to achieving these goals.

The inclusion of SuDS within developments should also be seen as an opportunity to enhance ecological and amenity value as well as promote Green Infrastructure by incorporating above ground facilities into the landscape development strategy. SuDS must be considered at the outset and during preparation of the initial conceptual site layout to ensure that enough land is given to design spaces that will be an asset to the development as opposed to an ineffective afterthought. SuDS should be designed in management trains to optimise the performance as a whole. Management trains use SuDS in series to reduce flows and improve the quality of surface runoff. For SuDS trains to work effectively it needs to be ensured that appropriate techniques are selected based on the objectives for drainage and the site specific constraints. It is recommended that on all developments source control is implemented as the first stage of a management train allowing for improvements in water quality and reducing or eliminating runoff from smaller, more frequent, rainfall events.

All new major development proposals should ensure that sustainable drainage systems for management of run-off are put in place. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and existing drainage arrangements is essential.

The draft Surface Water Management Plan for Coventry sets out a hierarchy of risk decisions for the management of surface water shown in the Surface Water Management Pyramid in Figure 9-1. This pyramid forms the basis of surface water management in Coventry City.

Figure 9-1: Coventry Surface Water Management Pyramid



- **Flow reduction (reducing the total flow discharged from a site):** Reducing the flows arriving at, or leaving, the site will cause flood risk to be reduced, both at the new development and to areas further downstream
- **Diversion (Re-route flow routes around the site to greenspace):** By re-routing watercourses and flow routes past development the residual risk and damaged to properties can be reduced. Flows can be routed to greenspaces. Additionally flows can be diverted using hard infrastructure (e.g. carriageways) providing protection to property. Care must be taken to ensure that diverting flow does not exacerbate problems elsewhere
- **Storage (store flows to reduce flood risk):** Risk of flooding to properties can be reduced by storing flood flow volumes in purpose built storage areas such as open storage ponds. These have the additional benefit of improving biodiversity and habitat
- **Exceedance (route exceedance flows using infrastructure):** When a system fails the flows often result in damage to property. Flood risk assessments should be used to plan for system exceedance by modelling of exceedance flow routing. In extreme events exceedance flows may be diverted from away from dwellings using carriageway and footway features to open spaces
- **Protection (protecting properties from flooding when it occurs):** Property level protection (e.g. built in flood barriers, air brick guards, non-return valves) can reduce the impact flooding has on property and business by reducing the level of damage, when none of the above management measures can be applied, and is considered a last line of defence
- **Conveyance (convey flows away through enlarging channels or sewers):** Enlarging watercourses or sewers can remove flows from areas where it causes flooding. However, this flow may cause flooding elsewhere so should only be used when none of the other options can be applied and it should be ensured flood risk is not increased elsewhere

9.4 Types of SuDS Systems

There are many different SuDS techniques that can be implemented in attempts to mimic pre-development drainage (Table 9-1). The suitability of the techniques will be dictated in part by the development proposal and site conditions. Advice on best practice is available from the Environment Agency and the Construction Industry Research and Information Association (CIRIA).

Coventry City Council will produce SuDS guidance which will include local information and requirements once the National Standards have been approved.

Table 9-1: Examples of SuDS techniques and potential benefits

SuDS Technique	Flood Reduction	Water Quality Treatment & Enhancement	Landscape and Wildlife Benefit
Living roofs	✓	✓	✓
Basins and ponds	✓	✓	✓
Constructed wetlands	✓	✓	✓
Balancing ponds	✓	✓	✓
Detention basins	✓	✓	✓
Retention ponds	✓	✓	✓
Filter strips and swales	✓	✓	✓
Infiltration devices	✓	✓	✓
Soakaways	✓	✓	✓
Infiltration trenches and basins	✓	✓	✓
Permeable surfaces and filter drains	✓	✓	
Gravelled areas	✓	✓	
Solid paving blocks	✓	✓	
Porous pavements	✓	✓	
Tanked systems	✓		
Over-sized pipes/tanks	✓		
Storm cells	✓		

When installing SuDS consideration should be given to water recycling technologies which can be incorporated into the design. The use of such technologies offers a means to not only reduce the amount of water which is dealt with by the drainage system but also help ease water available issues for the region as a whole. Example of water recycling could be the collection of water from roofs which could be stored and used for internal infrastructure (e.g. flushing toilets) or for watering local planting.

9.4.1 SuDS constraints

The design of a SuDS system will be influenced by a number of physical and policy constraints. These should be taken into account and reflected upon during the conceptual, outline and detailed stages of SuDS design. Such physical and policy factors include

- **topography:** steep slopes making it difficult to implement shallow SuDS and increasing the velocity of runoff to the SuDS feature;
- **land availability:** lack of open space suitable for certain SuDS features;
- **contaminated land/pollutants:** presence of contaminated land and pollutants that are at risk of being mobilised by SuDS features;
- **groundwater conditions:** high groundwater levels making infiltration SuDS features unfeasible;
- **geology and soil permeability**: poor permeability limiting infiltration; and

- **future adoption and maintenance possibilities:** uncertainty regarding future maintenance and responsibility.

Table 9-2 details how some of these constraints may be overcome.

Table 9-2: Overcoming SuDS constraints

Constraint	Recommendation
Topography	Check dams can be used to slow flows. Additionally features can form a terraced system with additionally SuDS components such as ponds used to slow flows.
Land availability	SuDS can be built into urban areas with features such as permeable paving and green roofs.
Contaminated land/pollutants	Infiltration SuDS should be restricted. Shallow surface SuDS should be used to minimise disturbance to the underlying soil. Infiltration should also not be allowed to reduce treatment requirements. Linings can be used to prevent infiltration.
Groundwater conditions	Non-infiltrating features can be used. Features can be lined with an impermeable line or clay to prevent the egress of water into the feature.
Geology and soil permeability	Shallow surface SuDS features which do not rely on infiltration can be used.
Future adoption and maintenance	Local Planning Authority should ensure development proposals, through the use of planning conditions or planning obligations, have clear arrangements for on-going maintenance over the development's lifetime.

For SuDS techniques that are designed to encourage infiltration, it is imperative that the water table is low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes. Where sites lie within or close to groundwater protection zones (GSPZs) or aquifers, further restrictions may be applicable and guidance should be sought from the LLFA.

9.5 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise the underlying bedrock. The maps show the vulnerability of groundwater at a location based on the hydrological, hydrogeological and soil properties within a one kilometre grid square.

Two maps are available

- Basic groundwater vulnerability map: this shows the likelihood of a pollutant discharged at ground level (above the soil zone) reaching groundwater for superficial and bedrock aquifers and is expressed as high, medium and low vulnerability
- Combined groundwater vulnerability map: this map displays both the vulnerability and aquifer designation status (principal or secondary). The aquifer designation status is an indication of the importance of the aquifer for drinking water supply.

The groundwater vulnerability maps should be considered when designing SuDs

9.6 Groundwater Source Protection Zones (GSPZ)

In addition to the AStGWF data the Environment Agency also defines Groundwater Source Protection Zones in the vicinity of groundwater abstraction points. These areas are defined to protect areas of groundwater that are used for potable supply, including public/private potable supply, (including mineral and bottled water) or for use in the production of commercial food and drinks. The GSPZ requires attenuated storage of runoff to prevent infiltration and contamination. The definition of each zone is shown below:

- Zone 1 (Inner Protection Zone) – Most sensitive zone: defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres
- Zone 2 (Outer Protection Zone) – Also sensitive to contamination: defined by a 400 day travel time from a point below the water table. This zone has a minimum radius around the source, depending on the size of the abstraction
- Zone 3 (Total Catchment) - Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75. Individual source protection areas will still be assigned to assist operators in catchment management
- Zone 4 (Zone of special interest) – A fourth zone SPZ4 or 'Zone of Special Interest' usually represents a surface water catchment which drains into the aquifer feeding the groundwater supply (i.e. catchment draining to a disappearing stream). In the future this zone will be incorporated into one of the other zones, SPZ 1, 2 or 3, whichever is appropriate in the particular case, or become a safeguard zone

9.6.1 GSPZs in Coventry

Six GSPZ have been identified in Coventry City Council. They are located in the following areas:

- Watery Lane
- Brownshill Green
- London Road
- Lower Eastern Green, Alderminster Road
- Spon End
- Green Lane

A seventh GPSZ has been identified just outside the Coventry administrative area at Eaves Green. The locations of the GPSZs are shown in Figure 9-2.

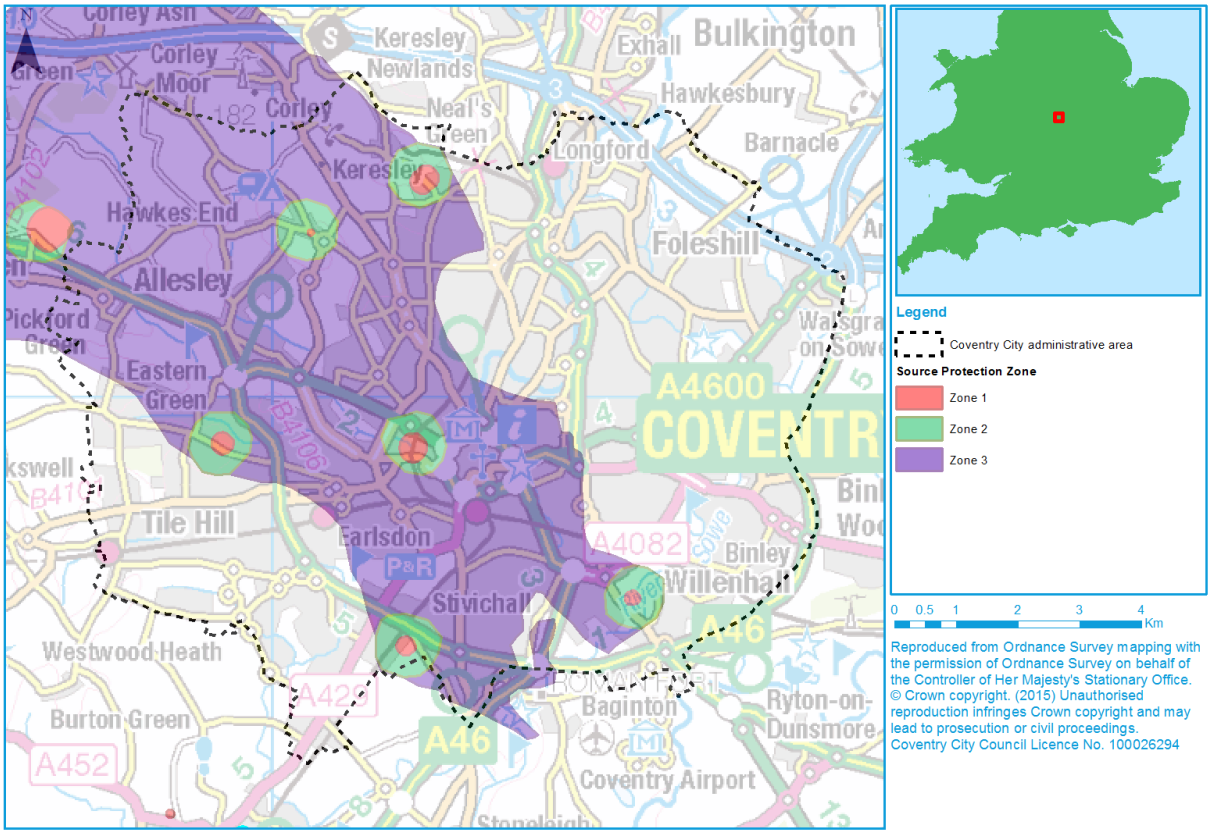
9.7 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies.

The level of nitrate contamination will potential influence the choice of SuDS and should be assessed as part of the design process.

The whole of the Coventry City Council area is classed as a surface water NVZ. In addition, the area in the west of area around Brownshill Green, Allesley and Keresley is classed as a groundwater NVZ.

Figure 9-2: Groundwater Source Protection Zones



9.8 Level 1 and 2 Assessment of Surface Water Flood Risk

In assessing the surface water flood risk across the Coventry City administrative area, the Environment Agency's updated Flood Map for Surface Water (uFMfSW) has been used (Appendix F). These maps are intended to provide a consistent standard of assessment for surface water flood risk across England and Wales in order to help LLFAs, the Environment Agency and any potential developers to focus their management of surface water flood risk.

The uFMfSW is derived primarily from identifying topographical flow paths of existing watercourses or dry valleys that contain some isolated ponding locations in low lying areas. They provide a map which displays different levels of surface water flood risk depending on the annual probability of the land in question being inundated by surface water (Table 9-3).

Table 9-3: uFMfSW risk categories

Category	Definition
High	Flooding occurring as a result of rainfall with a greater than 1 in 30 chance in any given year (annual probability of flooding 3.3%)
Medium	Flooding occurring as a result of rainfall of between 1 in 100 (1%) and 1 in 30 (3.3%) chance in any given year.
Low	Flooding occurring as a result of rainfall of between 1 in 1,000 (0.1%) and 1 in 100 (1%) chance in any given year.
Very Low	Flooding occurring as a result of rainfall with less than 1 in 1,000 (0.1%) chance in any given year.

Although the uFMfSW offers improvement on previously available datasets, the results should not be used to understand flood risk for individual properties. The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be considered to more accurately illustrate the flood risk at a site specific

scale. Such an assessment will use the uFMfSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location.

9.8.1 Level 2 SFRA assessment of potential SuDS for potential development locations

As part of this SFRA, an investigation has been undertaken to identify potentially suitable SuDS for each of the potential development locations.

This is based on catchment characteristics and additional datasets such as the Areas Susceptible to Ground Water flooding (AStGWf) map and Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site by site basis. The OS Opendata Terrain_50 dataset was used as a basis for determining the topography and average slope across each potential development location. This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. This should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site specific investigation should be conducted to determine what SuDS techniques could be utilised on a particular development.

10 Flood warning and emergency planning

10.1 Flood emergencies

The City Council considers flooding an **emergency situation.** This SFRA report further demonstrates that Coventry is not immune to flood risk and challenges remain to manage this risk.

Emergency planning is one option to help manage flood related incidents. Emergency planning is a core component of civil protection and public safety practices and seeks primarily to prevent, or secondly mitigate the risk to life, property, businesses, infrastructure and the environment. In the UK, emergency planning is performed under the direction of the 2004 Civil Contingencies Act (CCA).

From a flood risk perspective, emergency planning can be broadly split into three phases: before, during and after a flood. The measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb, respond to and recover from flooding. In development planning, a number of these activities are already **integrated** in national building control and planning policies e.g. the NPPF.

Emergency planning and flood risk management links

- 2004 Civil Contingencies Act: http://www.legislation.gov.uk/ukpga/2004/36/contents
- DEFRA (2014) National Flood Emergency Framework for England: https://www.gov.uk/government/publications/the-national-flood-emergency-framework-for-england
- Government guidance for public safety and emergencies is available at: https://www.gov.uk/topic/public-safety-emergencies/emergencies-preparation-response-recovery

Safety is a key consideration for any new development and includes the likely impacts of climate change and, where there is a residual risk of flooding, the availability of adequate flood warning systems for the development, safe access and egress routes and evacuation procedures. It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for sites at risk of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels)[20] and for essential ancillary sleeping or residential accommodation for staff required by uses in this category [water-compatible development], subject to a specific warning and evacuation plan. Flood warning and evacuation plans may also be referred to as an emergency flood plan or flood response plan.

10.2 Existing Flood Warning Systems

The Environment Agency (EA) is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as *Main Rivers*) and coastal flooding in England. The EA supplies Flood Warnings via the Floodline Warnings Direct (FWD) service, to homes and business within Flood Zones 2 and 3. Using the latest available technology, EA staff monitor rainfall, river levels and sea conditions 24 hours a day and use this information to forecast the possibility of flooding. If flooding is forecast, warnings are issued using a set of four easily recognisable codes, shown below in Table 10-1. Generic advice and examples on actions to be taken on receipt of the warning are shown in the column called “What to do”.

Flood warnings are disseminated to people registered to receive flood warnings via the FWD service using the following communication methods; phone, text and / or e-mail. Warnings may also be reported in news and weather bulletins. The EA have a Floodline number (0345 988 1188) and a quick-dial number specific to the Flood Warning Area, which the public can call to receive more detailed information regarding the flood warning.

It is the responsibility of individuals to sign-up this service, in order to receive the flood warnings via FWD. Registration and the service is free and publically available. It is recommended that any household considered at risk of flooding signs-up. Developers should also encourage those

[20] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 056, Reference ID: 7-056-20140306) March 2014

owning or occupying developments, where flood warnings can be provided, to sign up to receive them. This applies even if the development is defended to a high standard.

Coventry falls within the Staffordshire, Warwickshire and West Midlands Area. Prior to the EAs removal of the Regional tier of management in April 2014, Coventry fell in the Midlands Region of the EA.

Table 10-1: Environment Agency Flood Warnings Explained

Flood Warning Symbol	What it means	What to do
	**Flood Alerts** are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advice notice of the possibility of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.	• Be prepared to act on your flood plan • Prepare a flood kit of essential items • Monitor local water levels and the flood forecast on the EA website • Stay tuned to local radio or TV • Alert your neighbours • Check pets and livestock • Reconsider travel plans
	**Flood Warnings** warn people of expected flooding and encourage them to take action to protect themselves and their property.	• Move family, pets and valuables to a safe place • Turn off gas, electricity and water supplies if safe to do so • Seal up ventilation system if safe to do so • Put flood protection equipment in place • Be ready should you need to evacuate from your home • 'Go In, Stay In, Tune In'
	**Severe Flood Warnings** warn people of expected severe flooding where there is a significant threat to life	• Stay in a safe place with a means of escape • Co-operate with the emergency services and local authorities • Call 999 if you are in immediate danger
Warnings no longer in force	Informs people that river or sea conditions begin to return to normal and no further flooding is expected in the area. People should remain careful as flood water may still be around for several days.	• Be careful. Flood water may still be around for several days • If you've been flooded, ring your insurance company as soon as possible

10.2.1 Coventry Flood Alert and Warning Areas

The flood warning service was extended to cover Coventry in 2012. There are currently two Flood Alert Areas and eight Flood Warning Areas (FWAs) covering significant parts of Coventry.

Appendix H shows the FWA coverage for Coventry. If your home or business falls within the FWA coverage, this means that the EA can provide you with flood warnings.

10.2.2 Groundwater alerts

In selected areas, the EA can provide a groundwater alert / warning. These tend to be for communities located on chalk bedrock or known have a history of groundwater flooding[21]. If a groundwater alert is issued, this does not necessarily mean that properties within its coverage are definitely at risk. The EA note that the alerts cover large areas that could be affected if groundwater levels are high and that groundwater is difficult to predict as the location of the flooding is normally related to the local geology. The EA only provide a limited groundwater alert service and this does not currently cover the Coventry area.

There are currently no national systems offering flood warnings for flooding from Ordinary Watercourses, surface water, sewer, road and drainage sources or reservoir / flood management infrastructure failure.

10.3 Lead times and onset of flooding

Flood Alerts and Warnings provide advanced notification that flooding is possible or expected. The time from when the alert or warning is issued to the onset of property flooding (termed the lead time) can provide time for people to prepare for flooding (see the "What to do" column in Table 10-1). The EA endeavour to give a two hour lead time for issuing Flood Warnings; however, for fast responding catchments and areas at risk of flash flooding, this may not be possible.

A failure or breach of flood defences can cause immediate and rapid inundation to areas located near the vicinity of the breach or failure. Such incidents can pose a significant risk to life given the near lack of warning and lead time to prepare or respond.

For developers it is therefore important to consider how to manage the consequences of events that are un-foreseen or for which no warnings can be provided. A typical example would be managing the residual risk of a flood defence breach or failure (see section 3.2.3 for further information on residual risk).

10.4 Managing flood emergencies

10.4.1 Local arrangements

The Coventry, Solihull and Warwickshire Resilience Team (CSWRT) is a single unified team formed of emergency planning officers that represent Coventry City Council as well as the Solihull and Warwickshire local authorities. The CCA places a number of statutory duties on local authorities which the CSWRT carries out e.g. putting emergency plans in place (see part 1 of the CCA for the full list of duties).


OFFICIAL

Coventry

Multi-Agency Flood Plan

Flood

If you have received a severe weather or flood alert/warning, refer to your internal procedures and implement business continuity measures as appropriate

If you have received notification of activation of this plan, contribute to and participate in the multi-agency arrangements as instructed and refer to your roles & responsibilities in Section 9 (pg21)

For full contact details of agencies referenced in this plan please refer to the WMC LRF contact list

CSW Resilience Team

Dec. 2014 Version 1.0

The 2014 **Coventry Multi-agency Flood Plan** (MAFP), was produced by CSWRT and is designed to aid responders in delivering an effective and coordinated response. The MAFP is an over-arching plan based on the identified risk of flooding within Coventry. It sets out arrangements and provides information for a multi-agency response to a flood event or potential flooding incidents affecting the Coventry area. It aims to facilitate effective response to the threat of flooding by initiating a multi-agency response at the earliest possible stage.

The multi-agency response is divided into four levels: business as usual activity, level 1 low level incidents, level 2 partial MAFP activation and level 3 full MAFP activation. The MAFP sets out the roles and responsibilities of Category 1 and 2 responders under each of these four levels but does not detail the

21 Environment Agency (2014) Flood Warning Data Integrity Guide: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297923/Flood_Warning_-_Data_Integrity_Guide_v2_0.pdf

operational responses of individual organisations.

Weather advisory products and services are used to inform triggers and actions in the plan. When any alert is issued by the Met Office, EA or Flood Forecasting Centre (FFC) the City Council will start monitoring current conditions and liaise with internal and external partners on local impacts (level 1). A partner may request a multi-agency meeting to review the current conditions, local intelligence and response arrangements. The results of any monitoring and local intelligence will inform whether the situation should be escalated to a level 2 or level 3 emergency.

The MAFP stresses that the mechanisms involved with fluvial and pluvial flooding mean that flooding has the potential to occur anywhere within the city and under various conditions. The MAFP does not list 'At Risk' communities or any community level response plans. However, Parish / Community Group Emergency Plans are supporting documents to the MAFP. The existing SFRA flood maps are included as appendices and members of the public are encouraged to visit the CSWRT website for further information on how to prepare and respond to flooding.

10.4.2 Coventry City Council's role (existing development)

In the emergency response, Coventry City Council will primarily be responsible for (but not limited to)

- providing immediate and emergency shelter and welfare for survivors (those not requiring medical supporting) and their friends and family via evacuation, rest, humanitarian and other centres not requiring medical support;
- supporting the other Category 1 and 2 responders and provide resources (where required and in the remit of the local authority);
- mobilising and co-ordinate activities of the voluntary sector agencies;
- leading the recovery effort and provide long-term welfare to survivors;
- maintaining local authority services; and
- if appropriate, implementing a multi-agency response, as detailed in the MAFP[22].

The provision of sandbags is not a statutory function of Coventry City Council. The Council has a sandbag policy which outlines the criteria for providing sandbags, the decision making process used to determine the provision of sandbags, how the sandbags will be delivered and the means for their disposal. The Council will follow this policy to decide and prioritise which residents need the sandbags the most, particularly as resources are limited. It is therefore important that residents acknowledge and understand this policy. The policy is available to view on their website.

The City Council is also the decision maker and will decide whether or not to grant planning permission for development applications in its administrative area. It should be noted that proposed new development that places additional burden on the existing response capacity of the Council will not normally be considered to be appropriate.

> The EA has produced a guidance document, to advice on how to use sandbags properly for flood protection, downloadable from their website.

10.5 Emergency planning and development

10.5.1 NPPF

The NPPF Flood Risk Vulnerability and Flood Zone 'Compatibility' table seeks to avoid inappropriate development in areas at risk from all sources of flooding. It is essential that any development which will be required to remain operational during a flood event is located in the lowest flood risk zones to ensure that in an emergency, operations are not impacted on by flood water. For example, the NPPF classifies police, ambulance and fire stations and command centres that *are required* to be operational during flooding as Highly Vulnerable development,

[22] HM Government (updated 2013) Emergency Response and Recovery, non-statutory guidance accompanying the Civil Contingencies Act 2004: https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/253488/Emergency_Response_and_Recovery_5th_edition_October_2013.pdf

which is not permitted in Flood Zones 3a and 3b and only permitted in Flood Zone 2 providing the Exception Test is passed. Essential infrastructure located in Flood Zone 3a or 3b must be operational during a flood event to assist in the emergency evacuation process. All flood sources such as fluvial, surface, groundwater, sewers and artificial sources (such as canals and reservoirs) should be considered. In particular sites should be considered in relation to the areas of drainage critical problems highlighted in the Coventry SWMP.

The outputs of this SFRA should be compared and reviewed against any emergency plans and continuity arrangements within Coventry. This includes the nominated rest and reception centres (and perspective ones), to ensure evacuees are outside of the high risk flood zones and will be safe during a flood event.

10.5.2 Safe access and egress

The NPPF Planning Practice Guidance outlines how developers can ensure safe access and egress to and from development in order to demonstrate that development satisfies the second part of the Exception Test[23]. Access considerations should include the voluntary and free movement of people during a 'design flood' as well as for the potential of evacuation before a more extreme flood. The access and egress must be functional for changing circumstances over the lifetime of the development. The NPPF Planning Practice Guidance sets out that:

- Access routes should allow occupants to safely access and exit their dwellings in design flood conditions. In addition, vehicular access for emergency services to safely reach development in design flood conditions is normally required; and
- Where possible, safe access routes should be located above design flood levels and avoid flow paths including those caused by exceedance and blockage. Where this is unavoidable, limited depths of flooding may be acceptable providing the proposed access is designed with appropriate signage etc. to make it safe. The acceptable flood depth for safe access will vary as this will be dependent on flood velocities and risk of debris in the flood water. Even low levels of flooding can pose a risk to people in situ (because of, for example, the presence of unseen hazards and contaminants in floodwater, or the risk that people remaining may require medical attention).

The depth, velocity and hazard mapping from this SFRA update should help inform the provision of safe access and egress routes.

As part of an FRA, the developer should review the acceptability of the proposed access in consultation with Coventry City Council and the Environment Agency. Site and plot specific velocity and depth of flows should be assessed against standard hazard criteria to ensure safe access and egress can be achieved.

10.5.3 Potential evacuations

During flood incidents, evacuation may be considered necessary. The NPPF Planning Guidance states practicality of safe evacuation from an area will depend on[24]:

1. the type of flood risk present, and the extent to which advance warning can be given in a flood event;
2. the number of people that would require evacuation from the area potentially at risk;
3. the adequacy of both evacuation routes and identified places that people could be evacuated to (and taking into account the length of time that the evacuation may need to last); and
4. sufficiently detailed and up to date evacuation plans being in place for the locality that address these and related issues.

The vulnerability of the occupants is also a key consideration. The NPPF and application of the Sequential Test aims to aims to avoid inappropriate development in flood risk areas. However, developments may contain proposals for mixed use on the same site. In this instance, the NPPF

[23] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 039, Reference ID: 7-056-20140306) March 2014

[24] NPPF Planning Practice Guidance: Flood Risk and Coastal Change (paragraph 057, Reference ID: 7-057-20140306) March 2014

Planning Practice Guidance states that layouts should be designed so that the most vulnerable uses are restricted to higher ground at lower risk of flooding, with development which has a lower vulnerability (parking, open space, etc) in the highest risk areas, unless there are overriding reasons to prefer a different location[25]. Where the overriding reasons cannot be avoided, safe and easy evacuation routes are essential.

The EA and DEFRA provide standing advice for undertaking flood risk assessments for planning applications. Please refer to the government website for the criteria on when to following the standing advice. Under these criteria, you will need to provide details of emergency escape plans for any parts of the building that are below the estimated flood level. The plans should show

- single storey buildings or ground floors that don't have access to higher floors can access a space above the estimated flood level, e.g. higher ground nearby;
- basement rooms have clear internal access to an upper level, e.g. a staircase; and
- occupants can leave the building if there's a flood and there's enough time for them to leave after flood warnings[26].

Situations may arise where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. developments located immediately behind a defence and at risk of a breach). These allocations should be assessed against the outputs of the SFRA and where applicable, a site-specific Flood Risk Assessment to help develop emergency plans.

10.5.4 Flood warning and evacuation plans

Flood warning and evacuation plans is a potential mitigation measure to manage the residual risk, as listed in the NPPF Planning Practice Guidance. It is a requirement under the NPPF that a flood warning and evacuation plan is prepared for

- sites at risk of flooding used for holiday or short-let caravans and camping and are important at any site that has transient occupants (e.g. hostels and hotels); and
- essential ancillary sleeping or residential accommodation for staff required by uses in this category [water-compatible development], subject to a specific warning and evacuation plan.

A flood warning and evacuation plan should detail arrangements for site occupants on what to do before, during and after a flood as this will help to lessen its impact, improve flood response and speed up the recovery process. The EA provides practical advice and templates on how to prepare a flood plans for individuals, communities and businesses (see text box for useful links). The Council encourages the preparation of flood plans, using the Environment Agency flood plan template.

Guidance documents for preparation of flood response plans

- Environment Agency (2012) Flooding – minimising the risk, flood plan guidance for communities and groups
  https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/292939/LIT_5286_b9ff43.pdf
- Environment Agency (2014) Community Flood Plan template
  https://www.gov.uk/government/publications/community-flood-plan-template
- Environment Agency Personal flood plans
  http://apps.environment-agency.gov.uk/flood/151256.aspx
- Flood Plan UK 'Dry Run' - A Community Flood Planning Guide
  http://www.floodplanuk.org/userfiles/file/AVI10_40%20Floodplan%20Guide.pdf

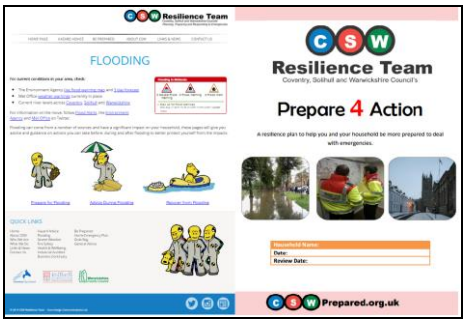
It is recommended that Emergency Planners at Coventry City Council are consulted prior to the production of any emergency flood plan. The Council will help and support the production of any community or individual flood plans when approached, as shown under Objective 4 of the draft Local Flood Risk Management Strategy (LFRMS). Once the emergency flood plan is prepared, it is recommended that it is distributed to Emergency Planners at Coventry City Council and the emergency services. When developing a flood warning and evacuation plan, it is recommended that this links in with any existing parish / community level plan.

[25] NPPF Planning Practice Guidance, Reducing the causes and impacts of flooding Paragraph: 053 Reference ID: 7-053-20140306

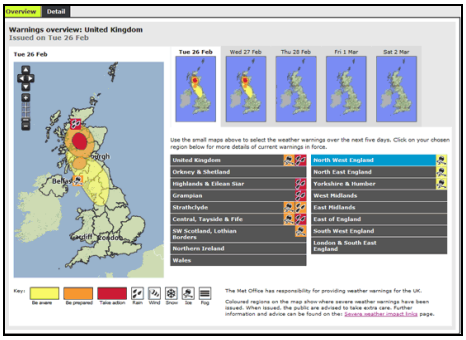
[26] EA and DEFRA (2012) Flood Risk Assesment: Standing Advice: https://www.gov.uk/flood-risk-assessment-standing-advice

10.5.5 Other sources of information

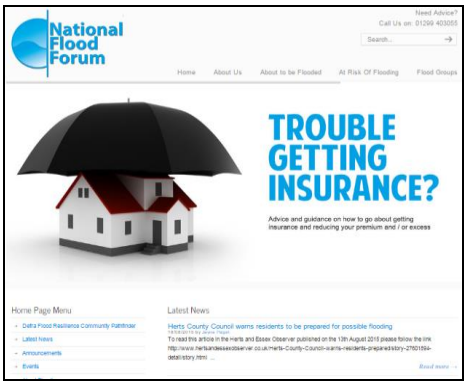
As well as being a **statutory consultee** for new development at risk of flooding, the EA can offer independent technical advice. The EA website contains a breadth of information on flood risk and there are numerous publications and guidance available. For example, the "flooding from groundwater" guide has been produced by the EA and Local Government Association to offer practice advice to reduce the impact of flooding from groundwater and is available to download from the EAs website.



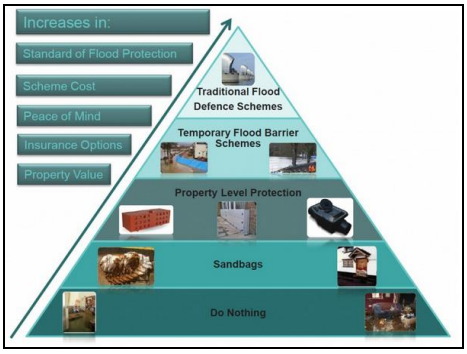
The **CSW Resilience Team** website offers advice regarding hazards in the Coventry area, including flooding. The website has a summary of the EA Flood Alerts and Warnings issued, links to websites to check the current conditions in your area and advice on what to do before, during and recovering from a flood. The CSW has also developed a household emergency plan template, to help inform and prepare residents for emergency situations. The template is called "Prepare 4 Action" and is downloadable from their website.



The Met Office provides a **National Severe Weather Warning Service** about rain, snow, wind, fog and ice. The severity of warning is dependent upon the combination of the **likelihood** of the event happening and the **impact** the conditions may have. In simplistic terms, the warnings mean: Yellow: Be Aware, Amber: Be Prepared, Red: Take Action. This service does not provide flood warnings. The Met Office provide many other services and products. For further information, please visit their website.



The National Flood Forum (NFF) is a **national charity**, set up in 2002 to support those at risk and affected by flooding. The NFF helps people to prepare and recover from flooding as well as campaigning on behalf of flood risk communities, including providing advice on matters such as insurance. The sister website, the Blue Pages Directory, provides a **directory of a range of property flood products and services** which help to reduce the risk of flooding to homes and businesses (the NFF do not endorse any of these products).



Individual property-level protection (PLP) measures are design to help protect homes and businesses from flooding. These include a combination of **flood resistance measures** - trying to prevent water ingress – and **flood resilience measures** - trying to limit the damage and reduce the impact of flooding, should water enter the building. It is important that any measures have the **BSI Kitemark**. This shows that the measure has been tested and ensures that it meets industry standards. Please visit the Government website: "improve your property's flood protection" for more information.

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11 Flood risk management policy considerations

11.1 Overview

The following section set out recommendations for inclusion in Coventry City Council's policy for flood risk management and development control. The policy recommendations are not exhaustive and it is recommended the Council refer to the key policy and management documents outlined in Section 2 to fully inform the development of their flood policies.

11.2 Council-specific policy

A key purpose of a SFRA is to identify and define flood risk management objectives and key policy considerations. It is the responsibility of the Council to formally adopt and implement these policies.

It is recommended that the conditions for new and redevelopment set out by the LLFA should be incorporated during the policy making process and should be used to strengthen and enhance the development control policies recommended in Section 11.3.

In addition to these conditions, the objectives set out in the following paragraphs should also be considered.

11.2.1 Objective One: seek flood risk reduction through spatial planning and site design

- Use the Sequential Test to locate new development in areas of lowest risk, giving priority to locations in Flood Zone One
- Where development cannot be placed wholly in Flood Zone One, the Sequential approach to site layout should be used to locate the most vulnerable elements of a development in the areas of lowest risk
- Identify opportunities to remove development from the floodplain
- Build resilience into a site's design e.g. raised floor levels, flood resistant/resilient design
- Ensure development passes the Exception Test and is 'safe'. For example, by making sure safe access and egress is possible for the 1 in 100-year flood level, plus an allowance for climate change, and emergency vehicular access should be possible during times of flood. Flood risk from surface water should also be included when applying the Exception Test, ensure the development is 'safe' for all type of flood risk.

11.2.2 Objective Two: reduce surface water runoff from development and agricultural land

- SUDS are required on all new developments. Conditions imposed by the LLFA, as set out in their LFRMS, are described in Sections 8 of this SFRA. These conditions should be followed when designing SuDS and surface water management on all developments
- Space should be specifically set aside for SuDS and used to inform the overall site layout
- Promote environmental schemes to reduce soil and water runoff from agricultural land
- Discharge rates should be based on Greenfield runoff for all sites.

11.2.3 Objective Three: to restore and enhance the river corridor

- Development should look for opportunities to undertake river restoration and enhancement to make space for water as well as providing ecological and biodiversity benefits
- When renewing assets, opportunities for enhancement should be investigated, for example de-culverting, weir removal etc). Further information is provided in Section 14.7
- Use conditions imposed by the LLFA to ensure culverts are not built over and to avoid any further culverting
- Using conditions imposed by the LLFA to ensure development is set back at least five metres from Ordinary Watercourses. Development should be set back at least eight metres from Main Rivers as required by the Environment Agency

11.2.4 Objective Four: to protect and promote areas for future flood alleviation schemes

- Protect functional floodplain (Flood Zone 3b) in greenfield areas from future development and reinstate functional floodplain, where possible, in brownfield areas
- Identify sites where developer contributions could be used to fund future flood risk management schemes or reduce flood risk in the surrounding area. Further details on possible areas where this may be implemented are provided in Section 15

11.2.5 Objective Five: to improve flood awareness and emergency planning

- Results from the SFRA should be used to inform the emergency planning process, e.g. by identifying communities at risk and raising awareness
- Encourage householders and businesses to sign up to the Environment Agency's Flood Warning Service (further details on the service are provided in Section 10.5.4
- Ensure evacuation plans are developed for new developments greater than one hectare (future details on safe access and egress and evacuation plans are provided in Section 10.5.2)

11.3 Development control policy

11.3.1 Development in Flood Zone 1

Although, flood risk is not normally a significant constraint to development within Flood Zone 1, developments can still be at risk from surface water flooding which can be a significant constraint on proposed development. Additionally sites may be shown to be in Flood Zone 1 but this may not take into account flood risk from un-modelled ordinary watercourses which also has the potential to constrain development. The Council and developers should look at opportunities to reduce the overall level of risk in the area through layout and design of development.

- A Flood Risk Assessment (FRA) is required for all developments, where necessary, and should be proportionate to the degree of flood risk, as well as the scale, nature and location of the development. FRAs should account for flooding from all sources including rivers, directly from rainfall on the ground surface and rising groundwater, overwhelmed and blocked sewers/drainage systems and from reservoirs, canals and lakes and other artificial sources. The Local Planning Authority and Environment Agency should be consulted to confirm the level of assessment required and to provide any information on any known local issues. Local requirements may be imposed on an FRA. Guidance on the preparation of FRAs is provided in the NPPF Planning Practice Guidance Flood Risk and Coastal Change.
    - If a small watercourse (i.e. catchment area less than 3 km^2) is located within 100m of a site, more detailed assessment of this watercourse should be undertaken so the flood risk from the site can be defined.
    - The Local Planning Authority should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014 when reviewing planning applications for proposed developments at risk of flooding.
- It should be demonstrated, through a Surface Water Drainage Strategy that the proposed drainage scheme, and site layout and design, will prevent properties from flooding from surface water, allowing for climate change effects. They should also show that flood risk elsewhere will not be exacerbated by increased levels of surface runoff. Consideration must also be given to residual risk and maintenance of sustainable drainage and surface water systems.
- Post development runoff volumes and peak flows should be attenuated to the Greenfield Qbar discharge rates with a minimum reduction of 20%. Total volume reduction should be agreed with the LLFA.
- Reference should be made to the Local Flood Risk Management Strategy and consideration given to requirements for the management of local flood risk.

11.3.2 Development in Flood Zone 2

Most development is permitted in Flood Zone 2 with the exception of Highly Vulnerable development. Highly vulnerable development is only permitted if it has passed the Exception Test.

- A Flood Risk Assessment (FRA) is required for all developments and should be proportionate to the degree of flood risk, as well as the scale, nature and location of the development. FRAs should account for flooding from all sources including rivers, directly from rainfall on the ground surface and rising groundwater, overwhelmed and blocked sewers/drainage systems and from reservoirs, canals and lakes and other artificial sources. The Local Planning Authority and Environment Agency should be consulted to confirm the level of assessment required and to provide any information on any known local issues. Local requirements may be imposed on an FRA if there is high risk of flooding from a particular source. Guidance on the preparation of FRAs is provided in the NPPF Planning Practice Guidance Flood Risk and Coastal Change.
    - If a small watercourse (i.e. catchment area less than 3 km^2) is located within 100m of a site, more detailed assessment of this watercourse should be undertaken so the flood risk from the site can be defined.
    - The Local Planning Authority should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014 when reviewing planning applications for proposed developments at risk of flooding.
- Development design should incorporate mitigation measures, to manage any flood risk to the development, including residual risk. Floor levels should be above the 1 in 100-year flood level, plus an allowance for climate change plus a minimum freeboard of 600mm.
- The layout of buildings and access routes should adopt a sequential approach, steering buildings towards areas of lowest risk within the site. Dry pedestrian access to and from the development should be above the 1 in 100-year flood level, plus an allowance for climate change, and emergency vehicular access should be possible during times of flood.
- It should be demonstrated, through a Surface Water Drainage Strategy that the proposed drainage scheme, and site layout and design, will prevent properties from flooding from surface water, allowing for climate change effects. They should also show that flood risk elsewhere will not be exacerbated by increased levels of surface runoff. Consideration must also be given to residual risk and maintenance of sustainable drainage and surface water systems.
- Post development runoff volumes and peak flows should be attenuated to the Greenfield Qbar discharge rates with a minimum reduction of 20%. Total volume reduction should be agreed with the LLFA.

11.3.3 Development in Flood Zone 3a

Development in Flood Zone 3a is significantly constrained by flood risk. Highly Vulnerable development is not permitted within this zone and More Vulnerable development and Essential Infrastructure are only permitted if the Exception Test can be passed.

- A flood risk assessment (FRA) is required for all developments within this zone.
    - It should be demonstrated that flood defences provide an acceptable standard of protection, including an allowance for climate change for the lifetime of the development.
    - Residual risks should be assessed, and the Environment Agency consulted regarding whether there is a need for a breach analysis to map a rapid inundation zone.
- The layout of buildings and access routes should adopt a sequential approach, steering buildings towards areas of lowest risk within the site. Where rapid inundation zones have been identified, development should be avoided in these areas.
- Development should not impede flow routes, reduce floodplain storage or consume flood storage in a 'flood cell' within a defended area. If the development does result in a loss of storage, compensatory floodplain storage should be provided on a 'level for level' and 'volume for volume' basis.
- If existing defences are to be upgraded as part of the development, an assessment should be undertaken to ensure it does not result in an increase in flood risk elsewhere.
- Development design should incorporate mitigation measures, to manage any flood risk to the development, including residual risk for the lifetime of the development. Floor levels should be above the 1 in 100-year flood level, plus an allowance for climate change.
- It is recommended that all types of new development behind flood defences is avoided, where possible, due to the residual risks of breach and overtopping
- Consideration should be given to the type of building that will be permitted, for example single-storey buildings and basements should be avoided. No built development on stilts should be considered in Flood Zone 3a.

11.3.4 Development in Flood Zone 3b (Function Floodplain)

Development is highly constrained within Flood Zone 3b. Only Essential Infrastructure and Water Compatible uses are permitted in this zone, and only if the Exception Test has been passed.

Functional floodplain is vital for the conveyance and storage of floodwater. Development within this zone will potentially impede the flow of floodwater as well as result in a loss of flood storage, increasing flood risk both within the area and further downstream. Consideration should be given to 'rolling back' development in this zone, withdrawing development from the floodplain and allowing it to return back to a natural floodplain. This has an additional benefit of reducing flood risk to communities further downstream.

Where outlines of Flood Zone 3b are not available, Flood Zone 3 should be considered as Flood Zone 3b unless, following further work as part of a detailed site specific flood risk assessment, and in consultation with the Environment Agency, it can be proven as Flood Zone 3a.

Flood Zone 3b

- A flood risk assessment (FRA) is required for all developments within this zone.
- Essential infrastructure should only be allocated in this zone if no reasonable alternative sites are available in areas of lower flood risk.
- A detailed site-specific flood risk assessment (FRA) is required for Essential Infrastructure within this zone and should include evidence to demonstrate the Exception Test has been passed. Should the site pass the Exception Test, it should be designed and constructed to:
    - remain operational and safe for users in times of flood
    - result in no net loss of floodplain storage
    - not impede water flows and not increase flood risk elsewhere
- Development should not impede flow routes or reduce floodplain storage. If the development does result in a loss of storage, compensatory floodplain storage should be provided on a 'level for level' and 'volume for volume' basis.
- Development design should incorporate mitigation measures, to manage any flood risk to the development, including residual risk. Floor levels should be above the 1 in 100-year flood level, plus an allowance for climate change.

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12 Level 1 summary assessment of potential development locations

12.1 Introduction

The potential development locations have been screened against flood risk information to identify the level of risk to each site, including

- the proportion of the site in each Flood Zone;
- whether the site is shown at risk in the uFMfSW and, if so, the lowest return period from which the site is at risk;
- whether the site is within 100m of a canal; and
- whether the site has experienced flooding in the past.

The results of this screening is provided in Table 12-1. An overview of the potential site locations are provided in Figure 12-1.

Inclusion of proposed sites in the SFRA does not mean that development can be permitted without further consideration of the Sequential Test. The required evidence should be prepared as part of a local plan sustainability appraisal or alternatively, it can be demonstrated through a free-standing document, or as part of strategic housing land or employment land availability assessments. NPPF Planning Practice Guidance for Flood Risk and Coastal Change describes how the Sequential Test should be applied in the preparation of a Local Plan (Figure 4-1). The assessments undertaken for this SFRA will assist the Council when they undertake the Sequential Test.

The results of the screening were used to determine which sites were to be taken forward for Level 2 SFRA assessment.

12.2 Guidance on the application of the Sequential Test

The following provides guidance on the application of the Sequential Test to potential development locations to help determine whether they should be taken forward and allocated for development in the Coventry Local Plan.

When allocating land within the potential sites preference should be made for locations outside of Flood Zone 3b, 3a and 2. If development cannot be located in Flood Zone 1, then locations in Flood Zone 2 should be preferred. However, it would need to be demonstrated that there are no suitable alternative sites, both within the potential site or other sites across Coventry. If the proposed development type is highly vulnerable the Exception Test will need to be applied.

Only when it is not possible to allocate land in Flood Zones 1 or 2 should land be allocated in Flood Zone 3. As with development in Flood Zone 2, it would need to be demonstrated that there are no suitable alternative sites, both within the proposed sites or other sites across the Coventry. The Exception Test will also need to be applied.

12.2.1 Step One: Strategic overview of flood risk

Flood risk information provided in this SFRA should be used to identify flood risk issues from all sources of flooding for each site. Table 12-1 provides the basis of this information. Additionally, sites that have the potential to exacerbate flood risk elsewhere should also be identified, as well as sites with potential safe access and egress issues.

12.2.2 Step Two: Identify flood risk issues in Flood Zone 1

Sites that are located in Flood Zone 1 should be assessed to identify if there are any flood risk issues from other sources, for example surface water.

The screening undertaken for this SFRA has identified the following proposed sites within Coventry as being in Flood Zone 1 only and having other flood risk issues:

- Browns Lane grouping of sites
- Whitmore Park in Holbrooks

- Sutton Stop (site A)
- Elms Farm (north and south)
- Allard Way / London Road
- London Road
- Canley Regeneration (Westwood Farm)
- Canley Regeneration (Charter Avenue)
- Canley Regeneration (Mitchell Avenue)

Once other flood risk issues have been identified, the significance of the risk should be assessed in terms of probability of flooding and the potential consequences.

For areas where the significance of the flood risk is low, development should be permitted providing appropriate measures are implemented to mitigate this risk. Sites greater than one hectare in Flood Zone 1 will still require a site-specific FRA. The FRA should include the vulnerability to flooding from other sources, the potential to increase flood risk elsewhere, and a drainage assessment.

12.2.3 Step Three: Sequential Test sites in Flood Zones 2 and 3

Where sites cannot be wholly allocated in Flood Zone 1, they should be sequentially allocated in Flood Zones 2 and 3. The Exception Test will need to be passed depending on the proposed land use and Flood Zone affecting the site.

The screening undertaken for this SFRA has identified the following sites as being located in Flood Zone 2 and Flood Zone 3:

- Canley Regeneration
- Eastern Green Sustainable Urban Extension (SUE)
- Grange Farm
- Keresley SUE
- Sutton Stop (site B)
- Walsgrave Hill Farm (sites A to D)

These sites have been taken forward for assessment in the Level 2 SFRA.

In some cases it may be possible to adjust the boundary of the site to move it outside of the Flood Zones. For example, Walsgrove Hill Farm (Cov3), less than 2% of the site is in the Flood Zones and is confined to a small section of the site at High Bridge. By adjusting the boundary it is possible to remove the site completely from the Flood Zones.

12.2.4 Field drains and small watercourses

Flood Zone information is not available for catchments smaller than 1km^2, for example field drains or smaller Ordinary Watercourses. Although no flooding information is available, it does not necessarily mean there is no flood risk. These watercourses are often too small to show on LIDAR data and may be dry for much of the year. In some cases the watercourse no longer exists, having been filled in or culverted. Where there is a possibility that field drains or smaller Ordinary Watercourses flow through a site, the location and path of the watercourse should be ground-truthed and verified and the risk considered.

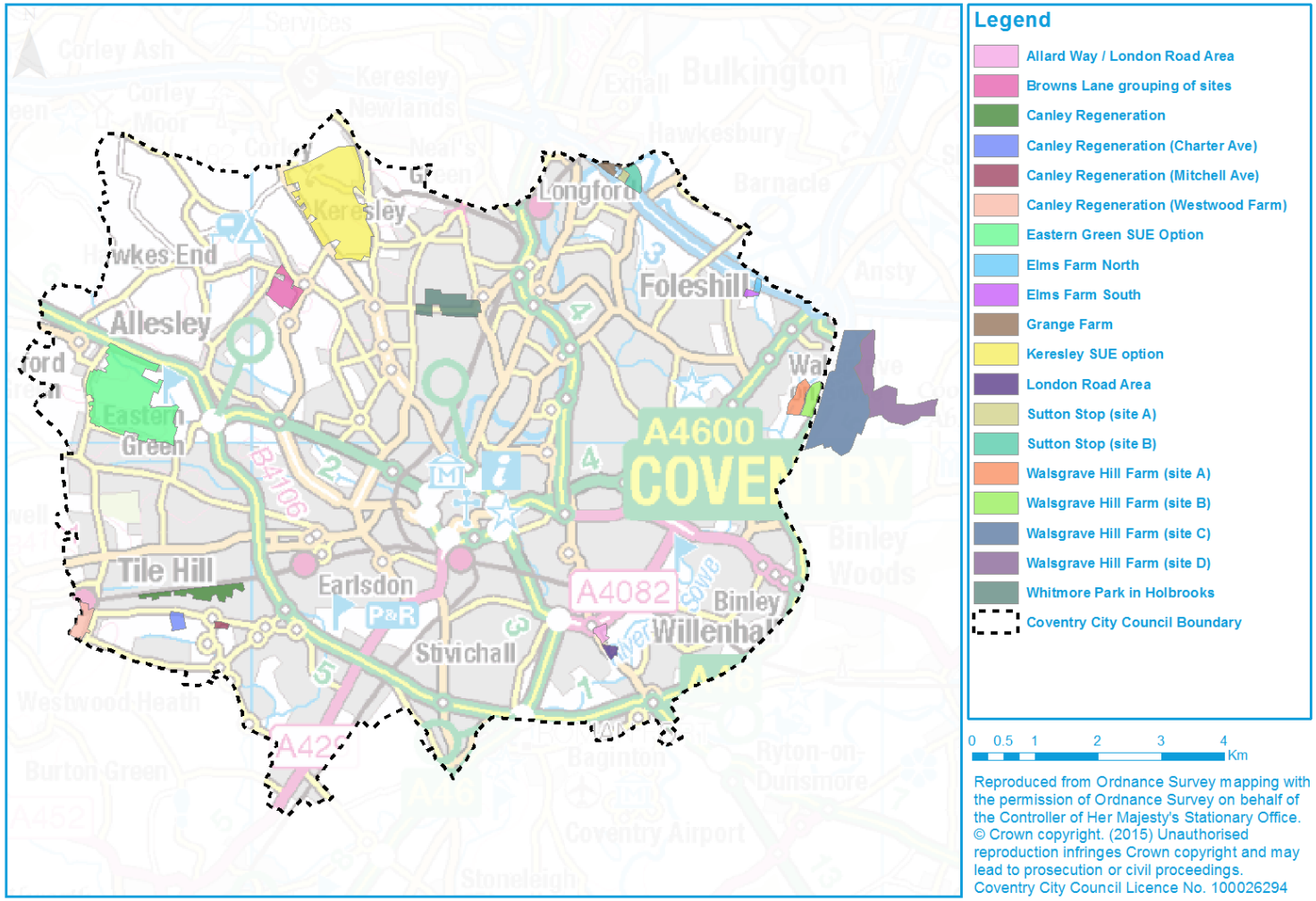
Detailed hydraulic modelling has been undertaken as part of this SFRA to assess the flood risk from some of these watercourses where they are shown to flow through potential development locations; however, there may be some smaller field drains or gulleys for which flood risk information is not available. Ordnance Survey mapping shows smaller field drains of gulleys potentially within the following sites:

- Browns Lane grouping of sites
- Walsgrave Hill Farm (site C)
- Walsgrave Hill Farm (site D)
- Canley regeneration
- Sutton Stop (site B)

Table 12-1: Summary of flood risk to all assessment areas in Coventry City area

Site name	Site Code	Site area (ha)	Proportion of site in Flood Zone 3b	Proportion of site in Flood Zone 3a	Proportion of site in Flood Zone Two	Proportion of site in Flood Zone One	uFMfSW (lowest return period (yr) of risk)	Site within 100m of a canal? (Y/N)	Any historical flooding? (Y/N)
Eastern Green SUE Option	bab70	141.2	1.0%	2%	3%	97%	30	N	Y
Browns Lane grouping of sites	bab8	20.8	0%	0%	0%	100%	30	N	Y
Keresley SUE Option	Cov1	152.0	1%	1%	1%	99%	30	N	Y
Whitmore Park in Holbrook's	Ho10	30.0	0%	0%	0%	100%	30	N	Y
Grange Farm	L16	4.0	0%	0%	0%	100%	30	Y	N
Sutton Stop (Site A)	L33	2.3	0%	0%	0%	100%	30	Y	N
Sutton Stop (Site B)	L30	8.6	0%	1.9%	2.0%	98%	30	Y	Y
Elms Farm North	He8a North	2.1	0%	0%	0%	100%	100	N	N
Elms Farm South	He8b South	2.1	0%	0%	0%	100%	30	N	N
Walsgrave Hill Farm (Site A)	Cov2	10.6	43%	66%	88%	13%	30	N	N
Walsgrave Hill Farm (Site B)	Cov3	10.1	0.5%	1%	2%	98%	30	N	N
Walsgrave Hill Farm (Site C)	Cov4	111.6	0.6%	4%	8%	92%	30	N	N
Walsgrave Hill Farm (Site D)	Cov5	57.8	0.5%	5%	7%	93%	30	N	N
Allard Way / London Road Area	Cov6	4.5	0%	0%	0%	100%	30	N	N
London Road Area	Cov7	3.5	0%	0%	0%	100%	30	N	Y
Canley Regeneration (Westwood Farm)	we28	11.9	0%	0%	0%	100%	30	N	N
Canley Regeneration	Cov8	22.1	6%	8%	12%	88%	30	N	Y
Canley Regeneration (Charter Ave)	we35	6.1	0%	0%	0%	100%	1,000	N	Y
Canley Regeneration (Mitchell Ave)	wa19	2.1	0%	0%	0%	100%	N/A	N	N

Figure 12-1: Overview of proposed development locations



Level Two Strategic Flood Risk Assessment

Photo: Pickford Brook at Allesley Park Golf Club

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13 Level 2 Assessment of Strategic Sites

13.1 Introduction

The SFRA forms an integral part of Coventry City Council's evidence base, in terms of identifying locations for development and preparation of flood risk policies in the Local Plan, with the primary objective being to help inform site allocations so they are in accordance with the NPPF. Potential development locations have been provided by the Council to be assessed in the SFRA. This assessment, as part of a Level 2 SFRA helps to determine variations in flood risk across proposed sites, identifying site-specific flood risk assessment requirements and helping guide local policies to provide sustainable developments as well as reducing flood risk to existing communities.

13.1.1 Level 2 detailed site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites identified in Section 12.2.3. These sites are shown to be at fluvial flood risk with watercourses running either through or along the site boundary. Detailed site summary tables have been produced for these sites to provide further information on flood risk to assist with the strategic application of the Exception Test. As individual developments are brought forward more detailed Flood Risk Assessments should be performed to satisfy the requirements of the Exception Test as the information in the SFRA will not be prepared at the required level of detail. The summary tables are provided in Appendix A. Each table sets out the following information:

- Site area
- Proportion of the site in each Flood Zone
- NPPF and Exception Test guidance
- Mapping including Flood Zones, climate change and surface water
- Depth, hazard and velocity mapping
- A broad scale assessment of suitable SuDS techniques and considerations
- The presence of any flood defences
- Whether the site is covered by a flood warning service
- Whether there are any access and egress issues for the site
- The potential impacts of climate change in the future
- Advice on the preparation of site-specific Flood Risk Assessments and considerations for developers

13.1.2 Important note on Flood Zones within the summary tables

It is important to recognise that for the SFRA a number of different sets of data have been used to clarify the Flood Zones. Mapping shown in the detailed site summary tables in Appendix A may differ to the Environment Agency Flood Zones on the 'Flood Map for Planning' as additional modelling has been undertaken for the SFRA in order to derive Flood Zones for areas not covered by the Environment Agency's Flood Zones.

13.1.3 Assessment of potential SuDS suitability

As part of the Level 2 SFRA assessment the hydraulic and geological characteristics of each potential development location were assessed to determine potential constraining factors for surface water management at the sites. This assessment is designed to help inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments. The results of the assessment are included within the Level 2 SFRA detailed summary tables provided in Appendix A.

The assessment is based on catchment characteristics and additional datasets such as the Areas Susceptible to Ground Water flooding (AStGWF) map and Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site by site basis. Geomatics Group LIDAR was used as a basis for determining the topography and average slope across each potential development location. Other datasets were used to determine over constraining factors on potential SuDS. These datasets include the following:

- Historical landfill sites
- Source Protection Zones
- Groundwater Vulnerability Zones
- Detailed River Network
- Environment Agency Flood Zones
- OS open data on Sites of Special Scientific Interest (SSSI)

The data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups as shown in Table 13-1.

This assessment should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be utilised on a particular development.

Table 13-1: Summary of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Underdrained Swale, Wet Swale

The suitability of each SuDS type for the potential development locations has been displayed using a traffic light colour system in the summary tables. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. The LLFA should be consulted should be consulted at an early stage to ensure SuDS are implemented and designed to overcome site specific constraints.

Suitability	Description
	The SuDS Group and its associated techniques may be unsuitable at the development location based on identified constraints as part of a broad scale assessment.
	The SuDS Group and its associated techniques may be suitable at the development but is likely to require additional engineering works to overcome constraints identified as part of the broad scale assessment. Some techniques from this group may not be suitable for use at the development.
	The SuDS Group and its associated techniques are likely to be suitable at the development location based on the results of this assessment.

14 Green Infrastructure and the Water Framework Directive

14.1 Green Infrastructure

There are multiple definitions of Green Infrastructure (GI); GI can be defined as a strategically planned and managed network of greenspaces and environmental components, which connect and surround the urban built environment and rural settings and consist of

- open spaces – lakes, nature reserves, woodland, parks, wetlands, and formal gardens;
- connections \ linkages – greenways, canals and river corridors, pathways and cycle routes; and/or
- "urban green" networks – green roofs, private gardens, street trees and verges.

The NPPF defines GI as: *"a network of multi-functional green space, urban and rural, which is capable of delivering a wide range of environmental and quality of life benefits for local communities."*[27]

GI is a multi-functional resource; it is capable of proving numerous services and benefits across many different sectors including climate change and sustainable development. It is central to climate change action and is referred to frequently in the planning policy. Identifying and planning for GI is intrinsic to sustainable growth and therefore, merits investment and consideration as much as other socio-economic priorities.

It has been recognised that GI can provide a means of flood mitigation and sustainable drainage, as well as improving water quality. For example, green spaces can be used as flood storage areas, managing storm flows and storing excess flows, to reduce the risk of damage to the built environment. GI can also support urban and rural regeneration and can provide an opportunity for a multi-functional network encompassing major landscape features, biodiversity and extensive habitats.

14.1.1 Coventry Green Infrastructure Study (2008)

The Coventry Green Infrastructure Study was published in 2008. Its aim was to provide high quality Green Infrastructure in Coventry over the next 25-30 years by collating data on existing GI to assess and identify deficiencies, as well as reviewing the need and opportunities for GI, now and in the future. The study presented a long-term vision for GI:

"The overall long-term vision for green infrastructure in Coventry is the provision of a city-wide network of high quality, well-managed and well-connected, multi-functional green space, delivering a wide range of benefits to those living in, working in and visiting the city and improving the attractiveness of the city as a whole."[28]

The Study identified two components of the GI network in Coventry:

- Nodes: features or clusters of features of value that may be important habitat complexes, characteristic landscape features, public parks or a combination of these or other uses. Identified nodes relating to waterbodies include
  - Coombe Pool and Country Park; and
  - Pickford Brook Meadows.
- Corridors: linkages the connect nodes into coherent, city-wide networks that deliver greater value then the nodes in isolation. Identified corridors relating to waterbodies include
  - River Sowe;
  - Coventry Canal;
  - Oxford Canal;
  - Sowe Valley; and

27 NPPF (2012) National Planning Policy Framework: Annex 2: Glossary, page 50.

28 Faber Maunsell (2008) Coventry Green Infrastructure Study, Chapter 10, reference para: 10.1.

- Smite Brook.

The 2008 study also identified locations in Coventry that were deficient in corridors or that had corridors that had been broken. The Study recommended a number of additional connections to address these shortfalls. Of the recommendations, three related to watercourses within Coventry:

- River Sherbourne East
- River Sherbourne West
- Pickford Brook

14.1.2 Sub-regional Green Infrastructure Strategy

The Warwickshire, Coventry & Solihull sub-regional GI Strategy aims to provide evidence for the preparation of plans, policies and strategies relating to GI. The strategy recognises the multifunctional character of GI, incorporating cultural, landscape and ecological assets / habitats, sustainable water and resource management, the use of river corridors and floodplains for amenity greenspace and biodiversity and benefits to human health and mental wellbeing.

A vision for GI is provided across three disciplines - landscape, biodiversity and accessibility and the assessments seek to identify GI assets in each of these disciplines. The strategy provides recommendations for GI across the three disciplines and outlines how these recommendations are to be implemented. The strategy identifies a series of sub-regional GI assets in Coventry which include but are not limited to

- Coventry North West Green Belt;
- Coventry Southern Green Belt;
- Coventry West Green Belt (including War Memorial Park);
- London Road Cemetery, Coventry;
- Coombe Abbey; and
- Linear assets including Coventry Way and the Coventry Canal.

14.1.3 Local Flood Risk Management Strategy

The Coventry LFRMS discusses the provision of GI and blue corridors, designed to convey water and are located adjacent to watercourse or flow routes. Coventry City Council are consulting with key partners regarding land-use planning and the progressive reinstatement of green open spaces and the introduction of wetlands and woodlands to help reduce flood risk and satisfy requirements of the WFD (see section 14.3).

The LFRMS stresses the

- the maintenance and operation of flood risk assets and watercourses is not restricted;
- reinstatement of floodplain in conjunction with green and blue infrastructure as part of new and redevelopment; and
- SuDS are integrated with green and blue infrastructure.

14.2 Using this SFRA to support GI plans and strategies

The evidence base provided in this SFRA should be used to help inform any Green Infrastructure Plans or Strategies in Coventry. River corridors identified as functional floodplain can provide flood storage during a flood event. The council GI strategies should also incorporate any areas identified within the urban environment or upstream of a critical surface water flood area. Creating flood storage areas or flow paths areas and improving accessibility to this land can help protect current and future property.

Potential development site locations, as identified by the Council, which have watercourses flowing through them, provide an opportunity to use the land as green infrastructure by adopting the Sequential design to locate development away from watercourses and Flood Zones, and by the use of SuDS. This can provide multiple benefits across a number of disciplines including flood risk and biodiversity / ecology and may provide opportunities to use the land for an amenity and recreational purposes.

Run-off from green space can cause flooding in developed areas and this should be considered in the Surface Water Management Plan proposed for Coventry.

14.3 The Water Framework Directive

The EU Water Framework Directive (WFD) seeks to integrate and enhance the way in which water bodies are managed throughout Europe by the preservation, restoration and improvement of the water environment. On 23 October 2000 the European Commission established the WFD Directive (WFD) requiring each Member State of the European Union to satisfy the environmental objectives set by the Directive and implement the legislation. This was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. In England, the Environment Agency (EA) is responsible for the delivery of the WFD objectives.

The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Ecological Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies) by a defined date. These Environmental Objectives are listed below:

- Prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters
- Aim to achieve at least good status/potential for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status/potential by 2021 or 2027
- Meet the requirements of Water Framework Directive Protected Areas
- Promote sustainable use of water as a natural resource
- Conserve habitats and species that depend directly on water
- Progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment
- Progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants
- Contribute to mitigating the effects of floods and droughts

The WFD requires the production of Management Plans for each River Basin District. Each District is composed of a group of catchments termed river basins to which all water bodies are assigned. Coventry City is located within the Severn River Basin District.

The EA has produced River Basin Management Plans (RBMP) which sets statutory objectives for water bodies and describe how the measures will achieve them. The RBMP for the Severn River Basin District sets out the chemical and the ecological objectives for each water body and a deadline by which the objectives need to be met. The target is for all waterbodies have to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by 2015. GEP is the best ecological improvements that can be achieved for a water body while still enabling Flood and Coastal Erosion Risk Management (FCERM) works to be undertaken to protect people and property from flooding. The RBMP for the Severn River Basin District states that the GES and GEP status cannot be achieved for 65% of water bodies by that deadline and outlines three management cycles (2009-2015, 2015-2021 and 2021-2027) which seeks to achieve this target by 2027.

The WFD defines the flow, shape and physical characteristics of a watercourse as its 'hydromorphology.'. Any in-channel works can impact upon the shape of a watercourse and the natural processes that occur within it, including

- flow patterns;
- width and depth of a channel;
- features such as pools, riffles, bars and bank slopes;
- sediment availability/transport;
- interaction between a channel and its floodplain; and
- ecology and biology (i.e. habitats which support plants and animals)

Any adverse impacts can cause a waterbody's ecology to deteriorate and prevent environmental improvements from being undertaken. Nevertheless, in-channel works can also be beneficial if they can be designed to help achieve environmental improvements included in the RBMP, thus enhancing the water environment for plants and animals.

14.4 Preventing Deterioration in Status

Any activity which has the potential to have an impact on the ecology of a waterbody will need consideration in terms of whether it could cause deterioration in its Ecological Status or Potential.

For each waterbody, three different status objectives are identified. These are the overall status objective, the ecological status or potential objective and the chemical status objective. A default objective for all water bodies is to prevent the deterioration in the Ecological Status (or Ecological Potential for Heavily Modified and Artificial Water Bodies) of the waterbody.

The Ecological Status of a waterbody is determined through analysis of its constituent biological Quality Elements (listed below). These elements are in turn supported by a series of physio-chemical and hydromorphological Quality Elements. These Quality Elements are taken from Annex V of the Directive and are listed below. The overall Ecological Status is determined by the lowest element status.

Biological Quality Elements

- Fish
- Invertebrates
- Macrophytes
- Phytobenthos

Any activity that has the potential to have an impact upon any of the Quality Elements will need consideration in terms of whether it could cause a deterioration in the status of a waterbody. The activity will also need to be considered in terms of whether it will compromise the ability of the waterbody to reach Good Ecological Status or Good Ecological Potential by the date specified in the RBMP.

Whilst good ecological status is defined as a slight variation from undisturbed natural conditions in natural water bodies, artificial and heavily modified water bodies are unable to achieve natural conditions. Instead, artificial and heavily modified water bodies have a target to achieve Good Ecological Potential, which recognises their important uses, whilst making sure ecology is protected as far as possible. Ecological potential is also measured on the scale high, good, moderate, poor and bad. The chemical status of these water bodies is measured in the same way as for natural water bodies.

Specific mitigation measures have been identified for each Artificial and Heavily Modified Waterbody and are listed in the RBMP. These mitigation measures are necessary to reduce the existing hydromorphological impacts on the waterbody and all measures need to be in place in order for the waterbody to achieve Good Ecological Status or Potential.

A ruling of the Court of Justice of the EU on the EU on the Weser dredging case (C-461/13) defining deterioration under the WFD was published on 1st July 2015. Whilst many of the Court's findings reflect the approach already adopted in the UK, some of the points of detail clarified by the ruling nonetheless have potentially important implications for anyone proposing an activity or development that could affect the ecological or chemical status of a waterbody.

The main conclusions of the Court are that

- Member States are required – unless a derogation is granted – to refuse authorisation for an individual project where it may cause a deterioration of the status of a body of surface water or where it jeopardises the attainment of good surface water status or of good ecological potential and good surface water chemical status by the date laid down by the directive; and
- the concept of 'deterioration of the status' must be interpreted as meaning that there is deterioration as soon as the status of at least one of the quality elements, within the meaning of Annex V to the directive, falls by one class, even if that fall does not result in a fall in classification of the body of surface water as a whole. However, if the quality element concerned is already in the lowest class, any deterioration of that element constitutes 'a deterioration of the status' of a body of surface water.

14.5 Artificial or Heavily Modified Water Bodies

Whilst good ecological status is defined as a slight variation from undisturbed natural conditions in natural water bodies, artificial and heavily modified water bodies are unable to achieve natural conditions. Instead, artificial and heavily modified have a target to reach Good Ecological Potential, which recognises their important uses, whilst making sure ecology is protected as far as possible. Ecological potential is also measured on the scale high, good, moderate, poor and bad. The chemical status of these water bodies is measured in the same way for natural water bodies.

Specific mitigation measures have been identified for each Artificial and Heavily Modified Waterbody and are listed in the RBMP. These mitigation measures are necessary to reduce the existing hydromorphological impacts on the waterbody and all measures need to be in place in order for the waterbody to achieve Good Ecological Status or Potential.

14.6 WFD Assessments

A detailed assessment should be undertaken to determine the effects that any proposed works within or adjacent to a watercourse could have upon Quality Elements. Any impacts identified should then be considered in relation to the Ecological, Hydromorphological and Chemical Status of the waterbody and the status objectives.

The following assessment objectives should then be used to determine whether the proposed works comply with the overarching objectives of the WFD. These objectives were therefore derived from the Environmental Objectives of the Directive:

- Objective 1: The proposed scheme does not cause deterioration in the Status of the Biological Elements of the waterbody
- Objective 2: The proposed scheme does not compromise the ability of the waterbody to achieve its WFD status objectives
- Objective 3: The proposed scheme does not cause a permanent exclusion or compromised achievement of the WFD objectives in other bodies of water within the same RBD
- Objective 4: The proposed scheme contributes to the delivery of the WFD objectives

In order to establish whether the strategy complies with the WFD it is necessary to ascertain whether the preferred options have the potential to result in

- failure of a water body to achieve good ecological status or potential; or
- failure to prevent a deterioration in the ecological status or potential of a water body.

If the answer to these questions is ‘no’ the strategy can be considered WFD compliant. If either of these failures is identified, further assessment may be required to identify if the strategy meets all of the conditions set out by the WFD Legislation.

A map showing the 2009 overall status of the main water bodies in Coventry City Council administrative area is provided in Appendix E. Note, not all the watercourses in the Council District are shown on this map. Three watercourses are classed as ‘Poor’ or ‘Poor Potential’ – River Sowe (confluence of Smite Brook to confluence of River Avon and confluence of Beach Brook to confluence of Withy Brook), Smite Brook (source to confluence of River Sowe) and River Sherbourne (source to confluence of River Sowe). Three watercourses are classed as ‘Moderate’ – River Sowe (confluence of the Withy Brook to the Smite Brook), Finham Brook (confluence of Canley Brook to confluence of River Sowe) and Canley Brook (source to confluence with FInham Brook). Three watercourses are classed as ‘Good’ or ‘Good Potential’ - the Coventry and Ashby Canal, Withy Brook (source to confluence of River Sowe) and Coombe Pool. Future development should ensure there is no adverse impact on the quality of watercourses within the Council District. Opportunities to improve the status of watercourses should also be considered.

14.7 Example Restoration Options and assessments

14.7.1 Structure Removal and / or modification (e.g. Weirs)

Structures, both within watercourses and adjacent to them can have significant impacts upon rivers including, alterations to the geomorphology and hydraulics of the channel through water impoundment and altering sediment transfer regime, which over time can significantly impact the channel profile including bed and bank levels, alterations to flow regime and interruption of biological connectivity, including the passage of fish and invertebrates.

Many artificial in-channel structures (examples include weirs and culverts) are often redundant and / or serve little purpose and opportunities exist to remove them where feasible. The need to do this is heightened by climate change, for which restoring natural river processes, habitats and connectivity are vital adaptation measures. However, it also must be recognised that some artificial structures may have important functions or historical/cultural associations, which need to be considered carefully when planning and designing restoration work.

In the case of weirs, whilst weir removal should be investigated in the first instance, in some cases it may be necessary to modify a weir rather than remove it. For example by lowering the weir crest level or adding a fish pass. This will allow more natural water level variations upstream of the weir and remove a barrier to fish migration.

There are a number of structures within Coventry, some of which may be redundant or may benefit from de-culverting. The 2008 Green Infrastructure study identified the regeneration of Coventry City Centre as a potential opportunity to re-open sections of the River Sherbourne which is currently culverted along much of its length where it passes through the city centre.

A detailed assessment would need to be undertaken to gain a greater understanding of the restoration response, including erosion and flood risk analysis to ensure that the post removal and / or modification scenario does not increase flood risk at the site and up and downstream of the site.

14.7.2 Re-naturalisation

There is potential to re-naturalise a watercourse by re-profiling the channel, removing hard defences, re-connecting the channel with its floodplain and introducing a more natural morphology (particularly in instances where a watercourse has historically been modified through hard bed modification). Detailed assessments and planning would need to be undertaken to gain a greater understanding of the response to any proposed channel modification.

A number of watercourses in Coventry have been modified in the past; development should look for opportunities to re-naturalise channels where possible.

15 Strategic Flood Risk Solutions

15.1 Introduction

Strategic flood risk solutions may offer a potential opportunity to reduce flood risk in Coventry. As described in Section 2.8 Coventry has been assigned Policy 5 under the River Severn CFMP which means further actions can be taken to reduce flood risk. Of the actions identified in the CFMP two are applicable to strategic flood risk solutions in Coventry.

The first relates to ensuring floodplains are not inappropriately developed; the guidance for planners and developers set out within this document and by Coventry City Council should ensure this action is followed.

The second relates to encouraging compatibility between urban open spaces and their ability to make space for rivers to expand and flood flows occur. Use of flood storage schemes and floodplain restoration can help towards achieving this action. Further details are provided in the following sections.

15.2 Flood defences

There are currently no formal flood defence schemes in Coventry.

Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas. If defences are constructed to protect a development site, it will need be demonstrated that the defences will not have a resulting negative impact on flood risk elsewhere, and that there is no net loss in floodplain storage.

15.3 Flood storage schemes

Flood storage schemes aim to reduce the flows passed downriver to mitigate downstream flooding. Development increases the impermeable area within a catchment, creating additional and faster runoff into watercourses. Flood storage schemes aim to detain this additional runoff, releasing it downstream at a slower rate, to avoid any increase in flood depths and/or frequency downstream. Methods to provide these schemes include[29]

- enlarging the river channel;
- raising the riverbanks; and/or
- constructing flood banks set back from the river.

Flood storage schemes have the advantage that they generally benefit areas downstream, not just the local area.

The construction of new upstream storage schemes as part of upstream catchment-based approaches on a number of watercourses within Coventry would provide one potential strategic solution to flood risk. Watercourses which are rural in their upper reaches but have high levels of flood risk to urban areas in the downstream reaches are potential candidates, as the open land in the upper reaches can potentially provide the space for an attenuation area, providing benefit to the urban area downstream.

Essentially, opportunities to work with natural processes to reduce flood and erosion risk, benefit the natural environment and reduce costs of schemes should be sought, requiring integrated catchment management and involving those who use and shape the land. It also requires partnership working with neighbouring authorities, organisations and water management bodies.

Conventional flood prevention schemes listed above will likely still be preferred, but consideration of 're-wilding' rivers upstream could provide cost efficiencies as well as considering multiple sources of flood risk; for example, reducing peak flows upstream such as through felling trees into streams or building earth banks to capture runoff, could be cheaper and smaller-scale measures than implementing flood walls for example.

Possible locations for potential flood storage schemes have been identified on a high-level basis using hydraulic modelling results developed for the SFRA and other datasets such as the

[29] http://evidence.environment-agency.gov.uk/FCERM/en/FluvialDesignGuide/Chapter10.aspx?pagenum=2

uFMfSW. The assessment has looked at the areas of flood risk within Coventry in relation to proposed development locations. Where proposed development locations are located upstream of areas of known flood risk, and where space is potentially available for upstream storage, these have been highlighted as possible locations to provide a starting point for further investigation of feasibility. No additional modelling was conducted to test the validity of the suggestions in the SFRA. If options are to be taken forward, they should be tested using the most up to date modelling and data to ensure they are suitable and provide a benefit downstream.

The upper reaches of the Hall Brook, Pickford Brook and Wyblynd Brook (tributary of the Hall Brook) are three watercourses where there is potential to investigate storage schemes. The Hall Brook is a tributary of the River Sowe and the Pickford Brook is a tributary of the River Sherbourne. Storage schemes may not only reduce flood risk from the watercourses further downstream, but may also reduce flood risk from the River Sherbourne and River Sowe elsewhere in Coventry. Coventry City Council have identified the predominantly greenfield land in the upper reaches of both watercourses as potential areas for development; feasibility of flood storage schemes should be considered as part of development proposals.

15.4 Floodplain restoration

Compared to flood defences and flood storage, floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state.

However, the urban nature of Coventry means restoration of floodplain is difficult as in previously developed areas development cannot be rolled back. However, the following measures should be adopted

- return existing and future brownfield sites that are adjacent to watercourses (for example, if adjacent to the River Sowe) back to floodplain, rather than allowing new development;
- removal of redundant structures to reconnect the river and the floodplain; and
- apply the Sequential Approach to avoid new development within currently undefended floodplain

Many of the possible development locations identified by the Council are located in rural areas or on the rural fringe of Coventry, therefore the opportunity to restore floodplain in previously developed areas is limited. However, by using the Sequential approach and by locating development away from these watercourses it will ensure the watercourse retains connectivity to its floodplain. This is particularly important for the possible sites in the upper reaches of the Wyblynd, Hall, Pickford and Withy Brooks as these are located on the fringe on Coventry. Loss of floodplain connectivity in the upper reaches of watercourses flowing through Coventry could potentially increase flooding within the city. This will also negate any need to build flood defences within the possible site options.

15.5 Proposed measures in the draft Severn Flood Risk Management Plan

The Severn Flood Risk Management Plan sets out a series of measures to manage flood risk across the River Severn Catchment. Coventry falls within the Warwickshire Avon catchment in the plan; the measures for the Warwickshire Avon that are relevant to Coventry are:

- Address flooding from the River Sherbourne which occurs in Butt lane, Coventry – possible property level protection and localised highway raising
- Minimise the negative impacts of flooding to designated nature conservation sites and heritage assets
- WFD objective to de-culvert, endeavour to undertake riparian enhancement etc
- Promote flood awareness and local actions while investigating potential flood mitigation measures at
    - Broad lane – possible culvert capacity issues
    - Flood risk from the Withybrook and sewers – possible solutions are to increase the size of culverts and sewers and/or provide storage capacity or alter a pumping station

15.6 Further implementation of the 'Ripple Effect' Options

The Ripple Effect[30] is a report exploring the impacts of climate change on urban water systems and proposes methods for identifying ways to build resilience and incorporate water sensitive design in a cost efficient manner. The document was commissioned by UK Technology Strategy Board and Defra and carried out by AECOM and Severn Trent Water in collaboration with Birmingham City Council and Coventry City Council. The report highlights the following key opportunities for flood storage and flood plain restoration within Coventry Centre which link to the information in Section 15.3 and 15.4:

- Naul's and Swanswell Park: opportunity to daylight two culverted tributaries of the River Sherbourne and provide additional flood storage upstream of the City Centre.
- River Sherbourne at Burges: opportunity to daylight the Sherbourne, allowing additional storage and improving the quality of the water already in or entering the Sherbourne.
- River Sherbourne at Butts Road: At this high risk area there are opportunities to further improve flood storage and take advantage of the existing green space, improving access to the river and creating opportunities for recreation in the process.

Additionally the document highlights a number of other measures which could be implemented which primarily focus on dealing with minimising runoff. These include the following:

- Installing water features and rain gardens in the city centre to capture and harvest rainwater for reuse in neighbouring buildings. Key buildings could also incorporate green roofs to improve urban cooling and reduce runoff further. Such measures would reduce dependence of water mains but also reduce the amount of runoff generated within the City Centre.
- Creating green streets where SuDS can be retrofitted. This includes streets such as Friar's Road, New Union Street, Stoney Road and Park Roads. This would incorporate raingardens and tree pits slow and treat to reduce pressure on drains. This would improve urban biodiversity as well as improving the quality of the surrounding area.
- Similar to the point above, the Greyfriars Green area in the vicinity of the train station offers the opportunity to capture, treat and store runoff from the surrounding roads.

15.7 Engaging with key stakeholders

Flood risk to an area or development can often be attributed to a number of sources such as fluvial, surface water or groundwater. In rural areas the definition between each type of flood risk is more distinguished; however, within urban areas flooding from multiple sources can become intertwined. Where complex flood risk issues are highlighted it is important that all stakeholders are actively encouraged to work together to identify issues and provide suitable solutions.

Engagement with riparian owners is also important to ensure they understand their rights and responsibilities including

- maintaining river beds and banks;
- allowing the flow of water to pass without obstruction; and
- controlling invasive alien species e.g. Japanese knotweed.

More information about riparian owner responsibilities can be found in the Environment Agency publication 'Living on the Edge' (2012)[31].

[30] 'The Ripple Effect': http://www.aecom.com/deployedfiles/Internet/Capabilities/Design%20and%20Planning/Sustainability/SuDS/The%20Ripple%20Effect.pdf

[31] Living on the edge: a guide to your rights and responsibilities of riverside ownership (Environment Agency, 2014)

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Summary and recommendations

Photo: River Sowe at Willenhall Bridge

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16 Summary

16.1 Level 1 SFRA

16.1.1 Sources of flood risk

Flood history shows that Coventry City has been subject to flooding from several sources of flood risk. Flooding records show the principle risk is from fluvial flood risk in the vicinity of Main Rivers and Ordinary Watercourse located throughout Coventry City. Additionally, surface water and sewer flooding are well recorded throughout the study area in the central and south-east regions of Coventry.

The principal watercourses flowing through the study are the River Sowe, River Sherbourne, Canley Brook and Withy Brook. The majority of recorded fluvial flood events are associated with these watercourses. In addition, flooding can occur from a number of small Ordinary Watercourses and drains as well as where watercourses converge and interact. This is clearly apparent on Ordinary Watercourses which in part pass through the existing sewer network, such as the Hall Brook and Wyblynd Brook.

Coventry City has significant surface water flood issues with the SWMP identifying approximately 10,600 properties at risk. The majority of surface water flood records are clustered within central Coventry or along Radford Road (B4098). There are shown to be a number of flood records in the south-western portion of the Coventry City administrative area which would appear to correlate with the location of the Brookstay Brook and the Canley Brook. It is likely that surface water is likely to originate from the interaction of the sewer network and the watercourse to which they outfall.

There are limited records of groundwater flooding within Coventry City. However, there are records indicating elevated groundwater levels in Keresley. Coventry City has reports that the elevated groundwater levels are a result of the closure of the coal mining operation and associated pumping in 1991. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted with elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas

In relation to artificial sources of flooding, there are no records of flooding from reservoirs impacting properties inside the study area. There is one record of a canal breach happening on 15th December 1978 at Bishopgate Green. This was the result of excavation works on a construction site at the time. The flood extent extended a significant distance through Coventry impacting both industrial and residential properties.

With regards to assessment methods, fluvial flood risk has been analysed using a combination of results from hydraulic models provided by the Environment Agency and newly commissioned 1D-2D hydraulic models developed for this SFRA to understand flood risk at potential development locations for which Flood Zones do not already exist. Surface water flood risk has been analysed using the updated Flood Map for Surface Water published online by the Environment Agency. A number of other data sources have been drawn upon as an evidence base, such as sewer data from Severn Trent Water and historical flooding information from Coventry City Council.

16.1.2 Key policies

There are a number of regional and local key policies which have been considered within the SFRA. The regional policies include the River Severn CFMP (2009) and the Severn River Basin Management Plan (2009). Key local policies documents include the following:

- **Coventry City Coventry PFRA (2011):** The PFRA assesses past and future flood risk from all sources to flooding. The document highlights a number of Flood Risk Areas based on critical infrastructure/access routes, sewer/surface water problems and areas prone to flooding.
- **Coventry City Coventry Draft LFRMS (2015):** The LFRMS is used as a means by which the LLFA (Coventry City Council) co-ordinates Flood Risk Management on a day to day basis. The Strategy also sets measures to manage local flood risk i.e. flood risk from surface water, groundwater and Ordinary Watercourses. The Strategy sets out an action place of how the LLFA intends to achieve high level objectives relating to flood

risk. The LLFA provides a number of conditions relating to new and re-development to reduce the flood risk from development and ensure that future development is resilient to flooding and is sustainable.

- **Coventry City Coventry Draft SWMP (2015):** Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. The Coventry SWMP outlines the main areas of flood risk and sets out further actions the Council will implement in the management of surface water.
- **Water Cycle Study (2015):** Water Cycle Studies assist Local Authorities to select and develop sustainable development allocations so that there is minimal impact on the environment, water quality, water resources, and infrastructure and flood risk. Coventry City Council is currently preparing the Water Cycle Study which is expected to be published in 2015.
- **Severn Flood Risk Management Plan (draft 2015):** The Severn Flood Risk Management Plans have been produced by the Environment Agency (and Natural Resources Wales) to identify the risk from flooding and to set out objectives and measures for managing flood risk.

16.1.3 Cumulative flooding and cross-boundary issues

A high level assessment has been undertaken of the potential cumulative impact of development in Coventry. The location of the potential development locations has been assessed against the Environment Agency's Flood Zones, the outlines derived by the modelling undertaken for this SFRA and the uFMfSW to undertake a broad scale assessment of areas where there is currently flood risk issues and where the cumulative impact of development has potential to make flood risk worse if preventative measures are not put in place.

Many of the potential development sites have watercourses flowing through them or alongside their boundaries which go on to flow through Coventry and join the River Sowe or River Sherbourne (a tributary of the River Sowe). Depending on the location, size and nature of development within the possible sites, there is the potential for loss of storage and floodplain connectivity in the upper reaches of these watercourses which could potentially increase flood risk downstream. This is an issue which is highlighted by conditions set out by the LLFA.

In regards to cross boundary issues, neighbouring authorities were contacted and, where possible, Local Plans and SFRAs were reviewed to assess whether there are any proposed large-scale developments that may affect flood risk in the SFRA area. Assessment showed that the majority of developments in neighbouring boroughs would not impact flood risk within Coventry. Any potential issues should be mitigated against by adopting appropriate drainage on site.

16.1.4 Development and flood risk

All development and redevelopment within the City Council administrative area shall require a flood risk assessment (FRA), where necessary, appropriate to the scale of the development and to the scope agreed with the LLFA. The FRA must be produced to the current national and local standards and include information on all current and future flood risk. These documents should utilise the SWMP, PFRA and SFRA for Coventry City as sources of information. FRAs should consider flood risk from all sources including residual risk, along with promotion of SuDS to create a conceptual drainage strategy and safe access/egress at the development in the event of a flood.

Site-specific FRA should include assessment of mitigation measures required to safely manage flood risk from all sources (including surface water) along with the promotion of SuDS to create a conceptual drainage strategy and safe access/ egress at the development in the event of a flood. The LLFA has set a number of conditions which should be implemented within new or re-developments.

16.1.5 Flood warning and emergency planning

The Environment Agency (EA) is the lead organisation for providing warnings of fluvial flooding (for watercourses classed as *main rivers*). The EA supplies Flood Warnings via the Floodline Warnings Direct (FWD) service, to homes and business within Flood Zones 2 and 3. Currently there are two Flood Alert Areas and eight Flood Warning Areas (FWAs) covering significant parts of Coventry. In regards to development NPPF sets out where new development is appropriate

based on vulnerability of different property types. NPPF also sets out guidance on how developers can provide safe access and egress and development evacuation plans for developments at risk.

16.1.6 Initial screening

The potential development sites within the study area were screened to identify sites where additional modelling would be required as part of the Level 2 assessment, for example, sites where there is a watercourse that is not included in the Environment Agency's Flood Zone coverage, or where Flood Zones exist but further modelling was required to identify Flood Zone 3b and climate change as well as depth, velocity and hazard information. New 1D-2D hydraulic models were commissioned as part of this study to understand flood risk at these sites.

On completion of the modelling, the sites were screened again to provide a summary of risk to each site including: the proportion of the site in each Flood Zone; whether the site is shown at risk in the uFMfSW and, if so, the lowest return period from which the site is at risk; and whether the site is within, or partially within, the Environment Agency's Historical Flood Map. Where sites are shown to be in Flood Zones, flood risk to the potential development sites has been assessed and summarised in more detail in a series of summary tables as part of the Level 2 SFRA, provided in Appendix A. There were nine potential development sites which required summary tables.

16.2 Level 2 SFRA

16.2.1 Assessment methods

As part of the Level 2 SFRA, detailed site summary tables have been produced for each the nine potential development sites taken forward from the Level 1 assessment. These sites are ones which are shown to be at risk of fluvial flood risk from watercourses running either through or adjacent to the site.

The summary tables set out the flood risk to each site, including maps of extent, depth and velocity of flooding as well as hazard mapping. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific Flood Risk Assessments. A broadscale assessment of suitable SuDS options has also been provided giving an indication where there may be constraints to certain sets of SuDS techniques. This assessment is indicative and more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. It may be possible that those SuDS techniques highlighted as possibly not being suitable can be designed to overcome identified constraints.

A number of sites did not have existing flood risk information, therefore hydraulic models were commissioned as part of the study to provide the relevant data. 1D-2D ESTRY-TUFLOW hydraulic models were developed to represent flood risk for the Hall Brook, Wyblynd Brook, Pickford (& tributary) and two unnamed Ordinary Watercourses allowing the representation of Flood Zones and the impact of climate change on the potential development sites.

Although detailed modelled was conducted, this was only for selected watercourses. Flood Zone information is not available for catchments smaller than 3km^2, for example field drains or smaller Ordinary Watercourses. Although no flooding information is available, it does not necessarily mean there is no flood risk. These watercourses are often too small to show on LIDAR data and may be dry for much of the year. In some cases the watercourse no longer exists, having been filled in or culverted. Where there is a possibility that field drains or smaller Ordinary Watercourses flow through a site, the location and path of the watercourse should be ground-truthed and verified and the risk considered.

It is important to recognise that for the SFRA a number of different sets of data have been used to clarify the Flood Zones. Mapping shown in the detailed site summary tables in Appendix A may differ to the Environment Agency Flood Zones and 'Flood Map for Planning' as the flood risk from Ordinary Watercourses flowing through potential development sites, modelled as part of the SFRA, has been included.

16.2.2 Key site issues

- For all sites, with the exception of Walsgrave Hill Farm – Site A (Cov2), the majority of the land within the potential development sites is situated within Fluvial Flood Zone 1
- Walsgrave Hill Farm – Site A (Cov2) is shown to highly susceptible to fluvial flooding with approximately 88% of the site is located with Flood Zone 2. Consideration is needed on how the site should be developed so that the flood risk is not increased further downstream. It is unlikely that the necessary floodplain compensation could be provided for any development in FZ3, making only a small proportion of the site available for development. The high proportion of the site which is located within the Flood Zones also poses constraints on the implementation of SuDS given that these should be located outside of the 100-year plus climate change flood extent
- The majority of sites do not show major issues regarding surface water flood risk. The only site which is significantly impacted is Walsgrave Hill Farm – Site A (Cov2)
- The following sites are located in groundwater vulnerability zones:
    - Eastern Green SUE Option (bab70)
    - Keresley SUE Option (Cov1)

  This means that special consideration needs to be taken with SuDS. A suitable level of treatment should be ensured prior to discharging, along with establishing an understanding of constraints to sites and how SuDS can be designed to overcome these from relevant bodies (e.g. LLFA)
- Walsgrave Hill Farm – Site C (Cov4) is the only site which has areas within it designated by the Environment Agency as being landfill. For this, site ground investigation will be required to determine the extent of the contamination and the impact this may have on SuDS
- Walsgrave Hill Farm – Site B (Cov3) and Sutton Stop – Site B (L30) are show to border Environment Agency designated landfill sites. For this, site ground investigation will be required to determine the extent of the contamination and the impact this may have on SuDS
- None of the sites specified benefit from formal flood defences. Flood mitigation measures should only be considered if, after a sequential approach, potential development sites cannot be located further away from high risk areas
- A number of potential development sites are shown to have concerns with safe access and egress to the site. These sites are listed below:
    - Canley Regeneration (Cov8): Concerns regarding surface water potentially impacting access and egress to the site. Isolated areas of roads are shown to have potential to be affected by the Canley Brook.
    - Walsgrave Hill Farm – Site A (Cov2): Significant fluvial flood risk concerns which has significant implications on the feasibility of providing safe access and egress for the site. A large proportion of the site is located in FZ3b (43% and FZa (66%).

  Consideration is need to ensure that safe access and egress can be provided to these sites in times of flood from either fluvial flooding or surface water flooding
- Potential upstream storage should be investigated on the following sites:
    - Eastern Green SUE Option (bab70)
    - Keresley SUE Option (Cov1)
    - Walsgrave Hill Farm – Site C (Cov4)
    - Walsgrave Hill Farm – Site D (Cov4)

  Storage options within these sites have the potential to reduce flood risk downstream from numerous Ordinary Watercourses. This will also attenuation flows from watercourse that contribute to the River Sowe and River Sherbourne, providing protection to other areas of Coventry. This is particular important on the Pickford Brook and Hall Brook which have flow through urban areas which existing flood risk issues
- Pickford Brook requires detailed hydraulic model of the upper reaches to improve the representation of flood risk through the potential development site

- When accessing flood risk to Grange Farm (L16) consideration is need of the influence a pond upstream of the site has on flood risk. The pond was represented in the detailed hydraulic model of the unnamed watercourse using the currently available information. However, with a site specific FRA this feature should be investigated
- Assessment of flood risk from the Coventry Canal is shown to be required for Grange Farm (L16) which is adjacent to a perched reach. Additionally Sutton Stop – Site B (L30) should also consider the implications of a canal breach given that the motorway embankment

16.2.3 Green Infrastructure

The Coventry Green Infrastructure Study was published in 2008 and aims to provide high quality Green Infrastructure in Coventry over the next 25-30-years, assessing deficiencies and identifying needs and opportunities for GI now and in the future.

The study identifies important locations based on nodes (e.g. features or clusters of features of value) or corridors (e.g. linkages that connect nodes and typically city wide networks).

The 2008 study also identified locations in Coventry that were deficient in corridors or that had corridors that had been broken. The Study recommended a number of additional connections to address these shortfalls. Of the recommendations, three related to watercourses within Coventry:

- River Sherbourne East
- River Sherbourne West
- Pickford Brook

Other regional GI policies in the area include the Warwickshire, Coventry & Solihull sub-regional GI Strategy which aims to provide evidence for the preparation of plans, policies and strategies relating to GI. Within the strategy a vision for GI is provided across three disciplines - landscape, biodiversity and accessibility and the assessments seek to identify GI assets in each of these disciplines.

Finally, the Coventry LFRMS discusses the provision of GI and blue corridors, designed to convey water and are located adjacent to watercourse or flow routes.

The LFRMS stresses

- the maintenance and operation of flood risk assets and watercourses is not restricted;
- reinstatement of floodplain in conjunction with green and blue infrastructure as part of new and redevelopment; and
- SuDS are integrated with green and blue infrastructure.

16.2.4 Water Framework Directive

In England, the Environment Agency (EA) is responsible for the delivery of the WFD objectives, and has therefore produced River Basin Management Plans describing how the WFD will be achieved. All waterbodies have to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline.

A map showing the 2009 overall status of the main water bodies in Coventry City Council administrative area is provided in Appendix E. Not all the watercourses in the Council District are shown on this map. The following classifications apply to the assessed watercourses in Coventry:

- **Poor / Poor Potential:** River Sowe (confluence of Smite Brook to confluence of River Avon and confluence of Beach Brook to confluence of Withy Brook), Smite Brook (source to confluence of River Sowe) and River Sherbourne (source to confluence of River Sowe)
- **Moderate:** River Sowe (confluence of the Withy Brook to the Smite Brook), Finham Brook (confluence of Canley Brook to confluence of River Sowe) and Canley Brook (source to confluence with Finham Brook)
- **Good / Good Potential:** The Coventry and Ashby Canal, Withy Brook (source to confluence of River Sowe) and Coombe Pool

Future development should ensure there is no adverse impact on the quality of watercourses within the Council District. Opportunities to improve the status of watercourses should also be considered. Example restoration options which could be considered in Coventry City are:

- **structure removal and/ or modification**: There are a number of structures within Coventry, some of which may be redundant or may benefit from de-culverting. The 2008 Green Infrastructure study identified the regeneration of Coventry City Centre as a potential opportunity to re-open sections of the River Sherbourne which is currently culverted along much of its length where it passes through the city centre; and
- **re-naturalisation**: A number of watercourses in Coventry have been modified in the past; development should look for opportunities to renaturalise channels where possible.

16.2.5 Strategic flood risk solutions

- There are currently no formal flood defences schemes in Coventry. Flood mitigation measures should only be considered if, after application of the Sequential Approach, development sites cannot be located away from higher risk areas and need to demonstrate that flood risk will not be increased elsewhere
- There are three opportunities for flood storage schemes highlighted in the upper reaches of the Hall Brook, Pickford Brook and Wyblynd Brook. Storage schemes may not only reduce flood risk from the watercourses further downstream, but may also reduce flood risk from the River Sowe and River Sherbourne elsewhere in Coventry
- Floodplain restoration represents the most sustainable form of strategic flood risk solution, by allowing watercourses to return to a more naturalised state. This may involve measures such as
    - return existing and future brownfield sites that are adjacent to watercourses (for example, if adjacent to the River Sowe) back to floodplain, rather than allowing new development;
    - removal of redundant structures to reconnect the river and the floodplain; and
    - apply the Sequential Approach to avoid new development within currently undefended floodplain.

  Many of the possible site options identified by the Council are located in rural areas or on the rural fringe of Coventry, therefore the opportunity to restore floodplain in previously developed areas is limited. However, by using the Sequential approach and by locating development away from these watercourses it will ensure the watercourse retains connectivity to its floodplain
- Where complex flood risk issues are highlighted it is important that all stakeholders are actively encouraged to work together to identify issues and provide suitable solutions. Engagement with riparian owners is also important to ensure they understand their rights and responsibilities including:
    - maintaining river beds and banks;
    - allowing the flow of water to pass without obstruction; and
    - controlling invasive alien species e.g. Japanese knotweed.

17 Recommendations

A review of national and local policies has been conducted against the information collated on flood risk in this SFRA, along with assessment of the Specified Sites brought forward into the Level 2 assessment, documented in the Appendix A Summary Tables. Following this, several recommendations have been made for the Council to consider as part of their planning policy and flood risk management. These have been summarised below.

17.1 Site allocations

It is recommended that the outputs from this study are used as an evidence base for the allocation of potential development areas, directing new development to areas of lowest risk. The Council should use the information provided within this SFRA to apply the Sequential Test to their potential site allocations.

The Level 2 detailed site summary tables provided in Appendix A should be used by the Council to apply the Exception Test. In order to pass the Exception Test, a number of criteria will need to be met:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk
- It must be demonstrated that the development will be safe, without increasing flood risk elsewhere, and where possible, reduce flood risk overall.

These tables also provide information and guidance for developers at the detailed flood risk assessment and planning application stage.

17.2 Policy

17.2.1 Future development

The Council should consult the Environment Agency's 'Flood Risk Standing Advice (FRSA) for Local Planning Authorities', published in March 2014, when reviewing planning applications for proposed developments at risk of flooding. Planning permission for development affecting watercourses should normally only be granted where

- the natural watercourse system which provides drainage of land is not adversely affected;
- a minimum 8m width access strip is provided adjacent to the top of both banks of any Main River (5m for Ordinary Watercourses) for maintenance purposes and is appropriately landscaped for open space and biodiversity benefits;
- it would not result in the loss of open water features through draining, culverting or enclosure by other means and culverts are opened up where ever possible;
- surface water drainage is delivered by SUDS;
- betterment in the surface water runoff regime is ensured; with any residual risk of flooding, from drainage features either on or off site not placing people and property at unacceptable risk; and
- the application is compliant with the conditions set out by the LLFA.

At the planning application stage, developers need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent, inform development zoning within the site and prove, if required, whether the Exception Test can be passed. The assessment should also identify the risk of existing flooding to adjacent land and properties to establish whether there is a requirement to secure land to implement strategic flood risk management measures to alleviate existing and future flood risk.

17.2.2 Surface water management

Planners should be aware of the conditions set by the LLFA for surface water management and ensure development proposals and applications are compliant with the Council's policy. These policies should also be incorporated into the Local Plan.

17.2.3 Access

Safe access and egress will need to be demonstrated at development sites. Consideration of alternative access and egress routes should be made in the event that access/ egress routes are inundated with flood water.

17.2.4 Green Infrastructure and WFD

Opportunities to enhance green infrastructure and reduce flood risk by making space for water should be sought. In addition, opportunities where it may be possible to improve the WFD status of watercourses, for example by daylighting culverts, weir removal, and river restoration, should be considered.

17.2.5 Strategic solutions

The information provided in the SFRA should be used as a base for investigating potential strategic flood risk solutions within Coventry. Opportunities to incorporate strategic flood risk solutions, such as storage areas and attenuation ponds, should be investigated as part of potential development proposals. Potential locations which merit further investigation include the upper reaches of the Pickford, Hall and Wyblynd Brooks.

17.3 Use of SFRA data and future updates

It is important to recognise that the SFRA has been developed using the best available information at the time of preparation. This relates both to the current risk of flooding from rivers, and the potential impacts of future climate change.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment.

The SFRA should be **periodically updated** when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by Coventry City Council, the Highways Authority, Canal and River Trust, Severn Trent Water and the Environment Agency. It is recommended that the SFRA is reviewed internally on an annual basis, allowing a cycle of review, by checking with the above bodies for any new information to allow a periodic update.

Note on the Environment Agency Flood Map for Planning

Where outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km^2. For this reason, the Flood Map for Planning is not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. Accordingly for site specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue. Where the Flood Map for Planning is based on generalised modelling, developers should undertake a more detailed analysis and assessment of the flood risk at the planning application stage.

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Appendices

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A Level 2 SFRA detailed site summary tables

Summary table structure

Summary tables have been produced for all possible site options identified by the Council. Each table sets out the following information:

- Site area.
- Proportion of the site in each flood zone.
- NPPF and Exception Test guidance.
- Mapping including Flood Zones, climate change and surface water.
- Depth, hazard and velocity mapping.
- A broad scale assessment of suitable SuDS techniques and considerations (see below).
- The presence of any flood defences.
- Whether the site is within 100m of a canal.
- Whether the site is covered by a flood warning service.
- Whether there are any access and egress issues for the site.
- The potential impacts of climate change in the future.
- Advice on the preparation of site-specific flood risk assessments and considerations for developers.

SuDs suitability

The hydraulic and geological characteristics of each development site were assessed to determine the constraining factors for surface water management at the proposed development sites. This assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

From catchment characteristics and additional datasets (areas susceptible to groundwater flooding map, Soil map of England and Wales, Environment Agency 'What's in your Backyard' online mapping) a broad criterion for the applicability of SuDS techniques was determined. These criteria were then used to carry out a simple assessment of the likely feasibility of different types of SuDS techniques at each of the proposed development sites. SuDS techniques were categorized into 5 main groups as follows.

Table A-1: Summary of SuDS Categories

SuDS Type	Technique
Source Controls	Green Roof, Rainwater Harvesting, Pervious Pavements, Rain Gardens
Infiltration	Infiltration Trench, Infiltration Basin, Soakaway
Detention	Pond, Wetland, Subsurface Storage, Shallow Wetland, Extended Detention Wetland, Pocket Wetland, Submerged Gravel Wetland, Wetland Channel, Detention Basin
Filtration	Surface Sand filter, Sub-Surface Sand Filter, Perimeter Sand Filter, Bioretention, Filter Strip, Filter Trench
Conveyance	Dry Swale, Underdrained Swale, Wet Swale

The suitability of each SuDS type for the proposed developments has been displayed using a traffic light colour system in the summary tables. The assessment of suitability is broad scale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS.

Suitability	Description
	The SuDS Group and its associated techniques are unlikely to be suitable at the development site based on the results of this assessment.
	The SuDS Group and its associated techniques may be suitable at the development but is likely to require additional engineering works. Some techniques from this group may not be suitable for use at the development.
	The SuDS Group and its associated techniques are likely to be suitable at the development site based on the results of this assessment.

B Watercourses in Coventry City

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C Flood Zone mapping

The flood zone maps show the extents of Flood Zones 1, 2 3a and 3b in Coventry City. The flood zones are defined as follows:

Zone 1: Comprised of land having a less than 1 in 1,000 annual probability of river or sea flooding in any year.

Zone 2: Comprised of land having between a 1 in 100 and a 1 in 1,000 annual probability of river flooding or 1 in 200 and 1 in 1,000 annual probability of sea flooding in any year.

Zone 3a: Comprised of land assessed as having a greater than 1 in 100 annual probability of river flooding or a greater than 1 in 200 annual probability of flooding from the sea in any year.

Zone 3b: Comprised of land where water has to flow or be stored in times of flood (the functional floodplain). The SFRA identified this Flood Zone as land which would flood with an annual probability of 1 in 20 years, where detailed hydraulic modelling exists. In the absence of detailed hydraulic model information, a precautionary approach was adopted with the assumption that the extent of Flood Zone 3b would be equal to Flood Zone 3a. If development is shown to be in Flood Zone 3a, further work should be undertaken as part of a detailed site specific flood risk assessment to define the extent of Flood Zone 3b.

Note: the Flood Zones presented in Appendix C will differ from the Environment Agency's flood map for planning because flood zones for the Hall Brook, Pickford Brook, and two unnamed watercourses have been defined from detailed modelling for the purposes of this study. The Flood Map for Planning does not contain Flood Zones for these watercourses.

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D Climate change mapping

The climate change maps show the potential impacts that climate change may have on river flows and, subsequently, on flood events. Where models exist in Coventry, a change factor of 20% has been applied to the 1 in 100 year flows.

Where modelling output is not available, the Environment Agency's flood zones can provide some indication of areas where rare, more extreme flows might affect the floodplain extents, by comparing Flood Zone 3a with Flood Zone 2. For the purposes of this study, a precautionary approach has been adopted where Flood Zone 2 has been used as a guide to provide an indication of the likely increase in extent of Flood Zone 3 with climate change (hatched area).

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E WFD status of watercourses

The 2009 WFD status of watercourses in Coventry is shown in Appendix E. The watercourses are colour-coded according to their current overall status.

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F Surface water mapping

The updated Flood Map for Surface Water (uFMfSW) maps show the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which: (a) is on the surface of the ground (whether or not it is moving), and

(b) has not yet entered a watercourse, drainage system or public sewer.

The uFMfSW will pick out natural drainage channels, rivers, low areas in the floodplain and flow paths between buildings but it will only indicate flooding caused by local rainfall.

The uFMfSW shows predictions of flooded area but does not show whether individual properties will be affected by surface water flooding or have been affected in the past. The uFMfSW should not be used to predict if individual properties will flood.

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G Groundwater mapping

The Areas Susceptible to Groundwater Flooding (AStGWF) maps are a set of strategic maps which show groundwater flood areas on a 1km square grid. The data was produced to annotate indicative Flood Risk Areas for Preliminary Flood Risk Assessment (PFRA) studies and allow the Lead Local Flood Authorities (LLFAs) to determine whether there may be a risk of flooding from groundwater.

This data shows the proportion of each 1km grid square where geological and hydrogeological condition show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. It does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of ground water flooding.

The AStGWF data should only be used in combination with other information, for example local data or historical data. It should not be used as sole evidence for any specific flood risk management, land use planning or other decisions at any scale. However, the data can help to identify areas for assessment at a local scale where finer resolution datasets exist.

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H Flood warning coverage

Flood Warning and Flood Alert coverage maps are shown in Appendix H for Coventry City. Flood Alerts are used to warn people of the possibility of flooding and encourage them to be alert, stay vigilant and make early preparations. It is issued earlier than a flood warning, to give customers advance notice of the possibility of flooding, but before we are fully confident that flooding in Flood Warning Areas is expected.

Flood Warnings warn people of expected flooding and encourage them to take action to protect themselves and their property.

Some areas may be covered by more than one flood warning area as they may be at risk of flooding from more than one watercourse.

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I Technical Summary

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Registered Office
South Barn
Broughton Hall
SKIPTON
North Yorkshire
BD23 3AE

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England
3246693

Visit our website
www.jbaconsulting.com