Southern Staffordshire Councils Level 1 Strategic Flood Risk Assessment

Final Report

August 2019

www.jbaconsulting.com

Southern Staffordshire Councils

Tamworth Borough Council

South Staffordshire Council

Stafford Borough Council

Cannock Chase Council

Lichfield district council

This page is intentionally left blank

JBA Project Manager

Joanne Chillingworth
The Library
St Philips Courtyard
Church Hill
Coleshill
Warwickshire
B46 3AD

Revision History

Revision Ref/Date	Amendments	Issued to
Draft report v1.0 08/05/2019	Draft Report	Andrew Lindop Strategic Planning Assistant – South Staffordshire District Council
Final report v1.0 22/08/2019	Updated with stakeholder comments and cumulative impact assessment	Andrew Lindop Strategic Planning Assistant – South Staffordshire District Council

Contract

This report describes work commissioned by Andrew Lindop on behalf of the Southern Staffordshire Councils by an email dated the 7th December 2018. Lucy Finch of JBA Consulting carried out this work.

Prepared by ..... Lucy Finch BSc
Analyst

Reviewed by ..... Joanne Chillingworth BSc MSC MCIWEM C.WEM
Principal Analyst

..... Hannah Coogan BSc MCIWEM C.WEM
Technical Director

Purpose

This document has been prepared as a Final Report for the Southern Staffordshire Councils. 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 Southern Staffordshire Councils.

Acknowledgements

We would like to acknowledge the assistance of:

- Stafford Borough Council;
- South Staffordshire District Council;
- Lichfield District Council;
- Cannock Chase District Council;
- Tamworth Borough Council;
- Staffordshire County Council;
- Environment Agency;
- Severn Trent Water;
- The Canal and Rivers Trust; and,
- Planners at the neighbouring authorities

Copyright

Carbon Footprint

A printed copy of the main text in this document will result in a carbon footprint of 495g if 100% post-consumer recycled paper is used and 630g if primary-source paper is used. These figures assume the report is printed in black and white on A4 paper and in duplex.

JBA is aiming to reduce its per capita carbon emissions.

Executive summary

Introduction

The Level 1 Strategic Flood Risk Assessment (SFRA) 2019 document was created with the purpose of supporting the production of the Local Plan for each of the Southern Staffordshire Councils. The study area comprises South Staffordshire District Council, Cannock Chase District Council, Lichfield District Council, Stafford Borough Council and Tamworth Borough Council; the combined authorities will be referred to throughout this document as the Southern Staffordshire Councils (SSCs), and the whole study area as Southern Staffordshire. The Level 1 SFRA provides an understanding of the risk from all types of flooding across Southern Staffordshire and presents clear and robust evidence. It also provides useful information to inform future Infrastructure Planning and Neighbourhood Plans.

Strategic Flood Risk Assessment Objectives

The key objectives of the Level 1 Strategic Flood Risk Assessment are to:

- Inform the SSCs Local Plans by assessing flood risk from all sources, current and future.
- Identify which locations are most and least vulnerable to flooding from all relevant sources.
- Produce a comprehensive set of maps presenting flood risk from all sources that can be used as evidence base for flood management purposes.
- Provide sufficient detail to enable the Sequential Test to be applied to inform allocations of land for development.
- Provide clear advice for developers undertaking site-specific flood risk assessments.
- Assess or identify existing and proposed flood defences and the maintenance requirements of these defences.
- Summarise the role that the Lead Local Flood Authority will play in the management of flood risk.
- Consider outputs from the Preliminary Flood Risk Assessment and any local flood risk strategies.
- Take into account climate change.
- Assess the cumulative impact that development will have on flood risk.

SFRA outputs

The following outputs are available:

- Identification of **policy and technical updates**.
- 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.
- Assessment of the potential increase in **flood risk due to climate change**.
- Review of **historic flooding incidents**.
- Appraisal of **all potential sources of flooding**, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- **Mapping** showing distribution of flood risk across all flood zones from all sources of flooding including climate change allowances.
- Reporting on the **standard of protection** provided by existing flood risk management infrastructure.
- Assessment of **strategic flood risk solutions** that can be implemented to reduce risks.

- **Flood Risk Assessment guidance for developers**.
- Guidance for developers on the use of **Sustainable Drainage Systems**.

Summary of flood risk in Southern Staffordshire

Parts of Southern Staffordshire are at risk from the following sources: fluvial, surface water, groundwater, sewers, reservoir inundation and canal overtopping/breaches. This study has shown that the most significant sources of flood risk in Southern Staffordshire are fluvial and surface water.

- *Fluvial flooding*: The primary fluvial flood risk is along the River Trent, River Sow, River Penk, River Tame, River Anker, the Smestow Brook and the tributaries of these watercourses. These present fluvial flood risk to rural communities as well as some of the main urban centres, including, but not limited to Stafford, Tamworth, Rugeley, Stone and Penkridge. More recent significant flooding events across Southern Staffordshire occurred in July 2007, Summer 2012, Winter 2013/2014 and June 2016.
- *Surface water:* Surface water flooding is most likely caused by intense rainfall. There are many areas at high risk of surface water flooding in Southern Staffordshire. Staffordshire County Council's Local Flood Risk Management Strategy highlights that Cannock, Tamworth, Lichfield, Rugeley, Stafford, Burntwood, Perton, Armitage, Gnosall, Whittington and Brewood are in the Top 10 urban and rural areas at risk of surface water flooding in the County.
- *Sewer*: The sewers in Southern Staffordshire are managed by Severn Trent Water. Severn Trent Water provided their Hydraulic Flood Risk Register which denotes 602 properties at risk of sewer flooding in Southern Staffordshire, with the areas of highest risk/most historical incidents of sewer flooding in Cheslyn Hay, Great Wyrley and Stafford.
- *Groundwater:* The Areas Susceptible to Groundwater Flooding map shows that in general, the majority of Southern Staffordshire has a low risk of groundwater flooding. Parts of the study area including along the River Trent, the River Tame, Tamworth and Stafford have a higher risk of groundwater flooding. The Local Flood Risk Management Strategy states that historically, information on groundwater flooding has been sparse and there is currently no evidence to suggest that this is a major problem within Southern Staffordshire. Based on this, it is anticipated that groundwater flooding issues are likely to be localised in their nature, affecting only a small number of properties.
- *Canals*: There are eight canals in Southern Staffordshire; the Shropshire Union Canal, Birmingham and Fazeley Canal, Trent and Mersey Canal, Staffordshire and Worcestershire Canal, Coventry Canal, Wyrley and Essington Canal, Cannock Extension Canal and Stourbridge Canal. These have the potential to interact with other watercourses and become flow paths during flood events or in a breach scenario. There have been incidences of breach and overtopping on the Trent and Mersey, Shropshire Union, Staffordshire and Worcestershire and Birmingham and Fazeley Canals, affecting areas in Stafford Borough, South Staffordshire District and Lichfield District. The most recent incident of overtopping was on the Trent and Mersey Canal in Weston (Stafford Borough) in January 2013.
- *Reservoirs:* There is a potential risk of flooding from reservoirs both within Southern Staffordshire and those outside. There is one record of flooding from reservoirs in the study area, from Chasewater in 1799 (after which the reservoir embankment was rebuilt, and further major works have been undertaken since to reduce the risk). The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from the reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this should be considered in any site-specific Flood Risk Assessments (where relevant).

How to use this report

Planners

The SFRA provides **recommendations** regarding **all sources of flood risk** in Southern Staffordshire which can be used to inform policy on flood risk within the Local Plan. This includes how the cumulative impact of development should be considered and how new development could bring wider flood risk benefits to existing communities

It provides the latest flood risk data and guidance to **inform the Sequential Test** and provides guidance on **how to apply the Exception Test**. The Southern Staffordshire Councils (SSCs) will use this information to apply the Sequential Test to strategic allocations and identify where the Exception Test will also be needed.

The SFRA provides **guidance for developers**, which can be used by Development Management staff to assess whether site-specific Flood Risk Assessments meet the required quality standard.

Developers

For sites that are not strategic allocations, developers will need to use the information in this SFRA to help apply the Sequential Test. For all sites, whether strategic allocations or windfall sites, developers will need to apply the Exception Test and use information in a site-specific Flood Risk Assessment to inform this test at planning application stage.

When assessing sites not identified in the Local Plan (windfall sites), developers should use evidence provided in this SFRA to apply the **Sequential Test** and provide evidence to show that they have adequately considered reasonably available sites at lower flood risk.

This is a strategic assessment and does not replace the need for site-specific Flood Risk Assessments where a development is either within Flood Zones 2 or 3 or greater than a hectare in Flood Zone 1. In addition, a Surface Water Drainage Strategy will be needed for all major developments in any Flood Zone to satisfy Staffordshire County Council (the Lead Local Flood Authority (LLFA) for the area).

Developers can use the information in this SFRA, alongside site-specific research to help to scope out what additional work will be needed in a detailed Flood Risk Assessment. To do this they should refer to **Chapter 5** Understanding flood in Southern Staffordshire and the **flood maps in the appendices**.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (**including applying the latest climate change allowances**, due to be updated by the Environment Agency in 2019), inform master planning and prove, if required, whether the Exception Test can be passed.

Developers need to ensure that new development does not increase surface water runoff from a site. **Chapter 9** provides information on the surface water drainage requirements of Staffordshire County Council as LLFA. Sustainable Drainage Systems should be considered at the earliest stages that a site is developed, which will help to minimise costs and overcome any site-specific constraints.

Flood Risk Assessments will need to identify how flood risk will be mitigated to ensure the development is safe from flooding. In high risk areas, the Flood Risk Assessment will also need to consider emergency arrangements, including how there will be safe access and egress from the site.

Developers should contribute to the wider strategic vision for flood risk management and drainage in an area where possible. Any developments located within an area protected by **flood defences**, where the condition of those defences is 'fair' or 'poor', where the future maintenance is uncertain and where the standard of protection is not of the required standard (either now or in the future) should be identified and the use of developer contributions considered to fund improvements.

This page is intentionally left blank

Contents

Appendices

List of Figures

List of Tables

Abbreviations and glossary

Term	Definition
1D model	One-dimensional hydraulic model
2D model	Two-dimensional hydraulic model
AEP	Annual Exceedance Probability – The probability (expressed as a percentage) of a flood event occurring in any given year.
AStGWf	Areas Susceptible to Groundwater flooding
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) can cause flooding.
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.
Design flood	This is a flood event of a given annual flood probability, which is generally taken as: fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or; tidal flooding with a 0.5% annual probability (1 in 200 chance each year), against which the suitability of a proposed development is assessed and mitigation measures, if any, are designed.
DTM	Digital Terrain Model
EA	Environment Agency
EU	European Union
Exception Test	Set out in the NPPF, the Exception Test is used to demonstrate that flood risk to people and property will be managed appropriately, where alternative sites at a lower flood risk are not available. The Exception Test is applied following the Sequential Test.
FCERM	Flood and Coastal Erosion Risk Management
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 Map for Planning	The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.
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.
Flood 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.
FWA	Flood Warning Area
Fluvial Flooding	Flooding resulting from water levels exceeding the bank level of a 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
FRMP	Flood Risk Management Plan
FSA	Flood Storage Area
FWMA	Flood and Water Management Act
FWS	Flood Warning System
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
IDB	Internal Drainage Board
Flood Risk Area	Nationally identified flood risk areas based on a definition of 'significant' flood risk set by the Minster. Relates to assessments under the EU Floods Directive.
JBA	Jeremy Benn Associates
Jflow	2D generalised hydrodynamic modelling software.
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
m AOD	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
NFM	Natural Flood Management
NPPF	National Planning Policy Framework
PPG	Planning Practice Guidance
NRD	National Receptor Database
NRIM	National Reservoir Inundation Mapping
NVZs	Nitrate Vulnerability Zones
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 for maintenance.
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.
PPS25	Planning Policy Statement 25: Development and Flood Risk – superseded by the NPPF and PPG
RBMP	River Basin Management Plan
RFCC's	Regional Flood and Coastal Committee
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.
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.
Riparian owner	A riparian landowner, in a water context, owns land or property, next to a river, stream or ditch.
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.
Risk Management Authority	Operating authorities who's remit and responsibilities concern flood and/or coastal risk management.
RoFfSW	Risk of Flooding from Surface Water (formerly known as the Updated Flood Map for Surface Water (uFMfSW))
Sequential Test	Set out in the NPPF, the Sequential Test is a method used to steer new development to areas with the lowest probability of flooding.
Sewer flooding	Flooding caused by a blockage or overflowing in a sewer or urban drainage system.
SFRA	Strategic Flood Risk Assessment
SMP	Shoreline Management Plan
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.
SPD	Supplementary Planning Document
SPZ	(Groundwater) Source Protection Zone
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.
SSCs	Southern Staffordshire Councils (South Staffordshire District, Stafford Borough, Cannock Chase District, Lichfield District and Tamworth Borough).

SWMP	Surface Water Management Plan - A SWMP outlines the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner.
WFD	Water Framework Directive – Under the WFD, all waterbodies have a target to achieve Good Ecological Status (GES) or Good Ecological Potential (GEP) by a set deadline. River Basin Management Plans (RBMPs) set out the ecological objectives for each water body and give deadlines by when objectives need to be met.

This page is intentionally left blank

1 Introduction

1.1 Purpose of the Strategic Flood Risk Assessment

JBA Consulting were commissioned by the Southern Staffordshire Councils (SSCs) to prepare a Strategic Flood Risk Assessment (SFRA). This study provides a comprehensive and robust evidence base to support the production of the Local Plans. It replaces the 2014 Joint Level 1 Strategic Flood Risk Assessment (SFRA) for South Staffordshire, Cannock Chase, Lichfield and Stafford, and the 2009 Tamworth Level 1 SFRA.

The combined authorities will be referred to throughout this document as the Southern Staffordshire Councils (SSCs), and the whole study area as Southern Staffordshire.

The 2019 SFRA will be used to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

1.2 Local Plan

The current Local Plans for the Southern Staffordshire Councils can be found at the links below. This SFRA will help to inform any further Local Plans or reviews for the Councils. The aim of the Local Plan is to establish a planning framework for future development, identifying how much land is available and where such land should be provided for new homes and employment, alongside associated infrastructure.

- **South Staffordshire District Council**
- **Stafford Borough Council**
- **Tamworth Borough Council**
- **Lichfield District Council**
- **Cannock Chase District Council**

1.3 Levels of SFRA

The Planning Practice Guidance identifies the following two levels of SFRA:

- Level 1: where flooding is not a major issue in relation to potential site allocations and where development pressures are low. The assessment should be of sufficient detail to enable application of the Sequential Test.
- Level 2: where land outside Flood Zones 2 and 3 cannot appropriately accommodate all 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.

This Level 1 SFRA is intended to aid the Southern Staffordshire Councils in applying the Sequential Test for their site allocations and identify where the application of the Exception Test may be required via a Level 2 SFRA.

1.4 SFRA objectives

The key objectives of the Level 1 Strategic Flood Risk Assessment are to:

- Inform the SSCs Local Plans by assessing flood risk from all sources, current and future.
- Identify which locations are most and least vulnerable to flooding from all relevant sources.
- Produce a comprehensive set of maps presenting flood risk from all sources that can be used as an evidence base for flood management purposes.
- Provide sufficient detail to enable the Sequential Test to be applied to inform allocations of land for development.

- Provide clear advice for developers undertaking site-specific Flood Risk Assessments.
- Assess or identify existing and proposed flood defences and the maintenance requirements of these defences.
- Summarise the role that the Lead Local Flood Authority will play in the management of flood risk.
- Consider outputs from the Preliminary Flood Risk Assessment and any local flood risk strategies.
- Take into account climate change.
- Assess the cumulative impact that development will have on flood risk.

1.5 SFRA study area

This SFRA covers the administrative areas of Cannock Chase, Lichfield, South Staffordshire, Stafford and Tamworth.

The area covered by this study is approximately 1,447km^2 and the combined population of these administrative areas is approximately 516,600, with Stafford Borough having the largest population of approximately 130,900.

The SFRA study area is bordered by Newcastle-under-Lyme, Stoke-on-Trent, Staffordshire Moorlands, East Staffordshire, South Derbyshire, North West Leicestershire, North Warwickshire, Birmingham, Walsall, Wolverhampton, Dudley, Bromsgrove, Redditch, Wyre Forest, Shropshire and Telford and Wrekin District/Borough Councils. An overview of the study area is shown in Figure 1-1.

The main rivers in the study area are the River Trent, River Tame, River Sow and River Penk with many of the smaller watercourses draining into these rivers. Other main watercourses in the individual areas are listed below:

Lichfield: River Tame, River Trent, River Blithe, River Mease, Moreton Brook

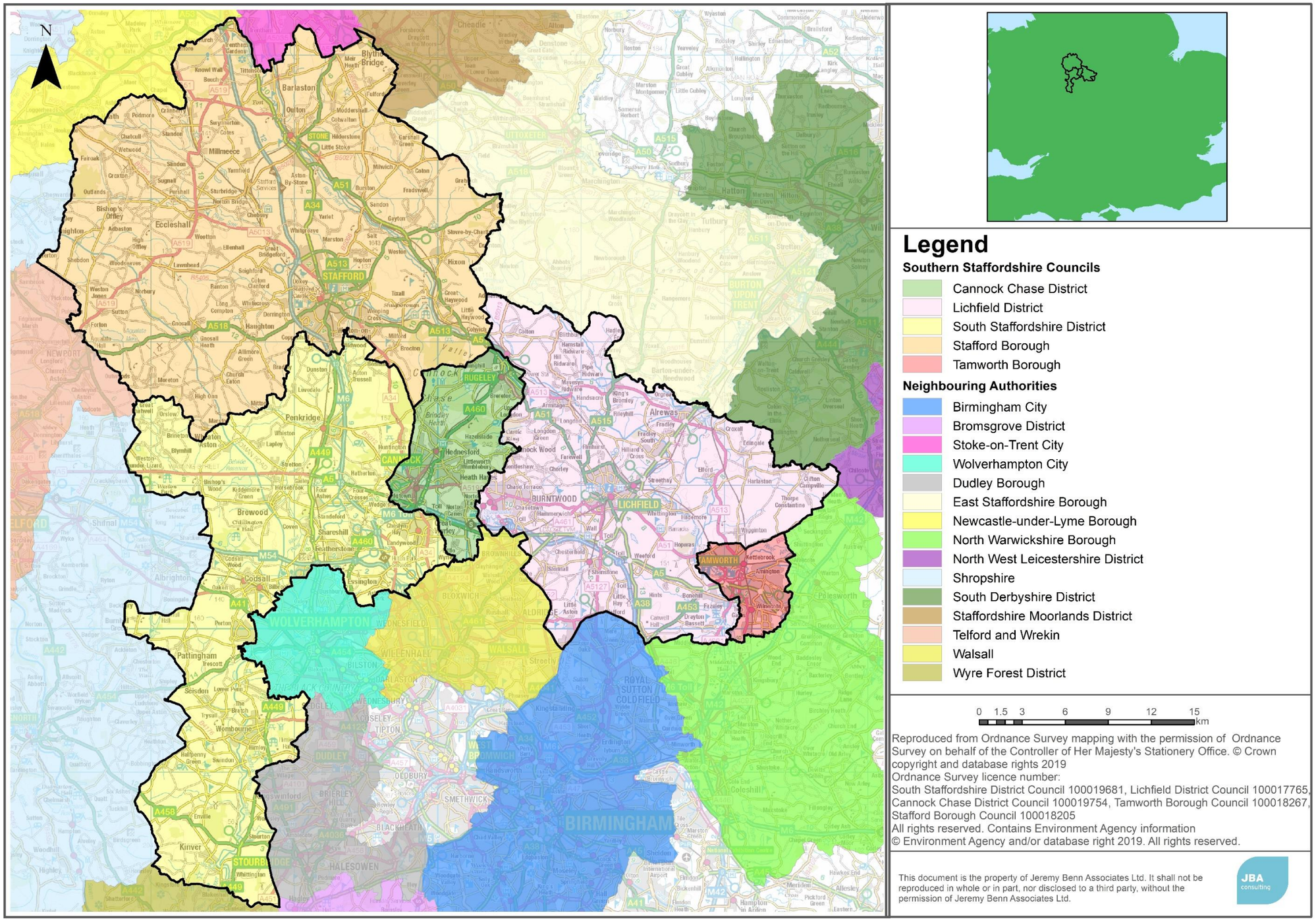
Cannock Chase: River Trent**,** Rising Brook**,** Ridings Brook**,** Saredon Brook

South Staffordshire: River Penk**,** Smestow Brook**,** River Stour

Stafford: River Trent**,** Scotch Brook**,** River Sow**,** Sandyford Brook**,** Kingston Brook**,** Meece Brook**,** Doxey Brook

Tamworth: River Tame, River Anker**,** Kettle Brook

Figure 1-1 Study Area



1.6 Consultation

The following parties (external to the SSCs) were consulted to inform the SFRA:

- Environment Agency
- Staffordshire County Council
- Canal & River Trust
- Severn Trent Water
- Neighbouring authorities including:
  - Newcastle-under-Lyme Borough Council
  - Stoke on Trent City Council
  - Staffordshire Moorlands District Council
  - East Staffordshire Borough Council
  - South Derbyshire District Council
  - North West Leicestershire District Council
  - North Warwickshire Borough Council
  - Birmingham City Council
  - Walsall Council
  - City of Wolverhampton Council
  - Dudley Metropolitan Borough Council
  - Bromsgrove District Council
  - Redditch Borough Council
  - Wyre Forest District Council
  - Shropshire Council
  - Telford and Wrekin Council

1.7 Use of SFRA data

Level 1 SFRAs are high-level strategic documents and do not go into detail on an individual site-specific basis. The primary purpose is to provide an evidence base to inform the Local Plan and any future flood risk policies.

Developers will still be required to undertake site-specific Flood Risk Assessments to support Planning Applications. Developers will be able to use the information in the SFRA to scope out the sources of flood risk that will need to be explored in more detail at site level.

Hyperlinks to external guidance documents/websites are provided in **green** throughout the SFRA.

Advice to users has been highlighted in **amber** boxes throughout the document.

On the date of publication, the SFRA contains the latest flood risk information. Over time, new information will become available to inform planning decisions, such as updated hydraulic models (which then update the Flood Map for Planning), flood event information, new defence schemes and updates to policy and legislation. Developers should check the **online Flood Map for Planning** in the first instance to identify any major changes to the Flood Zones.

1.8 Structure of this report

Section	Contents
Executive Summary	Focuses on how the SFRA can be used by planners, developers and neighbourhood planners.
1. Introduction	Provides a background to the study, the Local Plan stage the SFRA informs, the study area, the roles and responsibilities for the organisations involved in flood management and how they were involved in the SFRA. Provides a short introduction to how flood risk is assessed and the importance of considering all sources. Includes this table of the contents of the SFRA.
2. Flood risk policy and strategy	Sets out the relevant legislation, policy and strategy for flood risk management at a national, regional and local level.
3. Planning policy for flood risk management	Provides an overview of both national and existing Local Plan policy on flood risk management. This includes the Flood Zones, application of the Sequential Approach and Sequential/Exception Test process. Provides guidance for the Council and Developers on the application of the Sequential and Exception Test for both allocations and windfall sites, at allocation and planning application stages.
4. The impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA. Sets out how developers should apply the guidance to inform site-specific Flood Risk Assessments.
5. Understanding flood risk in Southern Staffordshire	Provides an overview of the characteristics of flooding affecting the study area and key risks including historical flooding incidents, flood risk from all sources and flood warning arrangements.
6. Flood alleviation schemes and assets	Provides a summary of current flood defences and asset management and future planned schemes. Introduces actual and residual flood risk.
7. Cumulative impact of development and strategic solutions	This section provides a summary of the catchments with the highest flood risk and development pressures, considers opportunities for strategic flood risk solutions and makes recommendations for local planning policy based on these.
8. Guidance for developers	Guidance for developers on Flood Risk Assessments, considering flood risk from all sources.
9. Surface water management and Sustainable Drainage	An overview of Sustainable Drainage Systems, Guidance for developers on Surface Water Drainage Strategies, considering any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority.

Systems	
10. Summary and recommendations	Summarises sources of flood risk in the study area and outlines planning policy recommendations.

Appendices:

- Appendix A: Interactive flood risk maps
- Appendix B: Data sources used in the SFRA
- Appendix C: Detailed information on Flood Alert and Flood Warning Areas
- Appendix D1: South Staffordshire Flood Risk Summary Table
- Appendix D2: Cannock Chase Flood Risk Summary Table
- Appendix D3: Lichfield Flood Risk Summary Table
- Appendix D4: Stafford Flood Risk Summary Table
- Appendix D5: Tamworth Flood Risk Summary Table
- Appendix E: Models used in the SFRA
- Appendix F: Flood management assets
- Appendix G: Cumulative impact assessment methodology

1.9 Understanding flood risk

1.9.1 Sources of flooding

Flooding is a natural process and can happen at any time in a wide variety of locations. It constitutes a temporary covering of land not normally covered by water and presents a risk when people and human or environmental assets are present in the area that floods. Assets at risk from flooding can include housing, transport and public service infrastructure, commercial and industrial enterprises, agricultural land and environmental and cultural heritage. Flooding can occur from many different and combined sources and in many different ways. Major sources of flooding include:

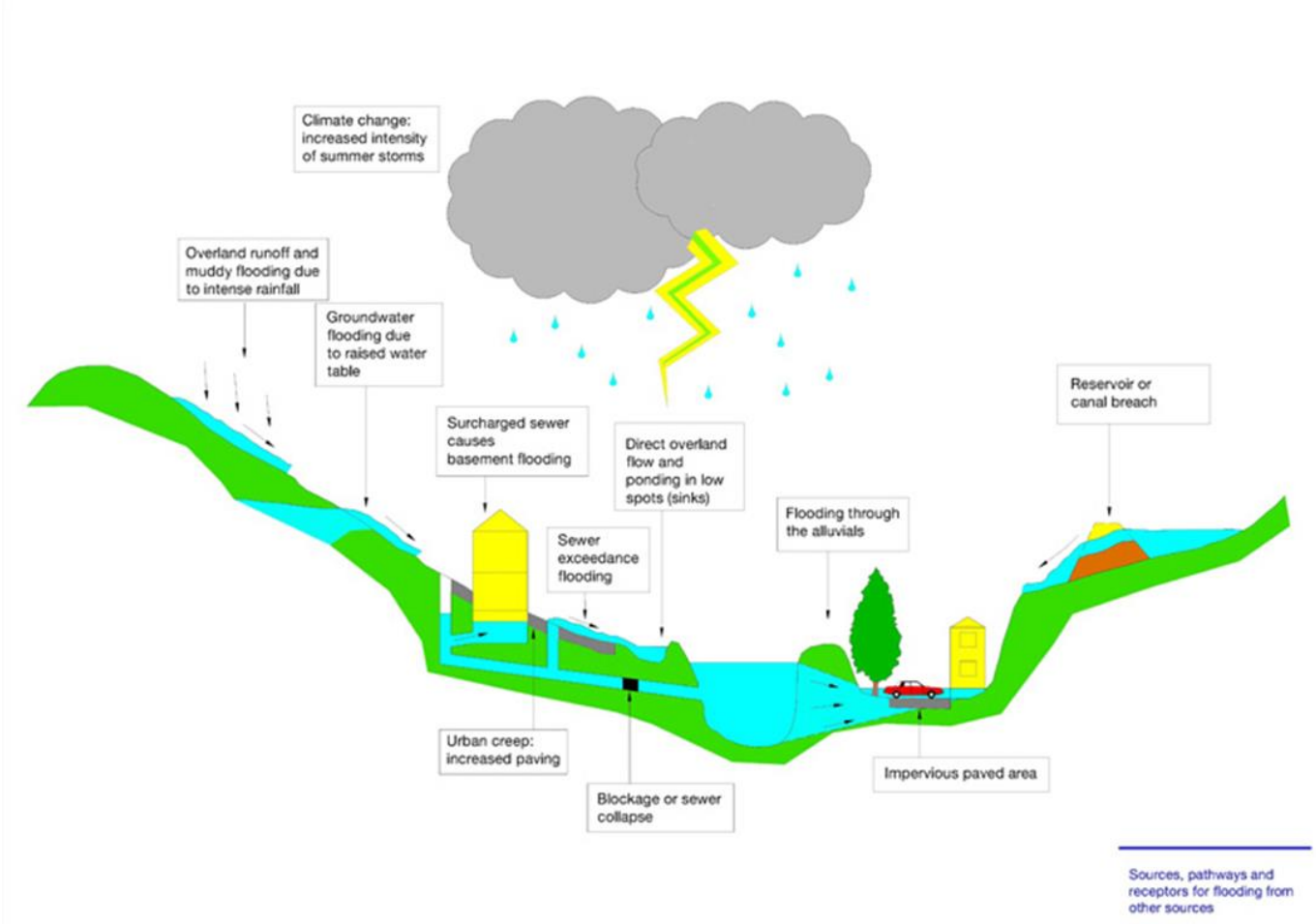
- Fluvial (rivers) - inundation of floodplains from rivers and watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors.
- Surface water - surface water flooding covers two main sources including direct run-off from adjacent land (pluvial) and surcharging of piped drainage systems (public sewers, highway drains, etc.)
- Groundwater - water table rising after prolonged rainfall to emerge above ground level remote from a watercourse; most likely to occur in low-lying

areas underlain by permeable rock (aquifers); groundwater recovery after pumping for mining or industry has ceased.

- Infrastructure failure - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Different types and forms of flooding present a range of different risks and the flood hazards of speed of inundation, depth and duration of flooding can vary greatly. With climate change, the frequency, pattern and severity of flooding are expected to change and become more damaging. A summary of the different sources of flooding is shown in Figure 1-2.

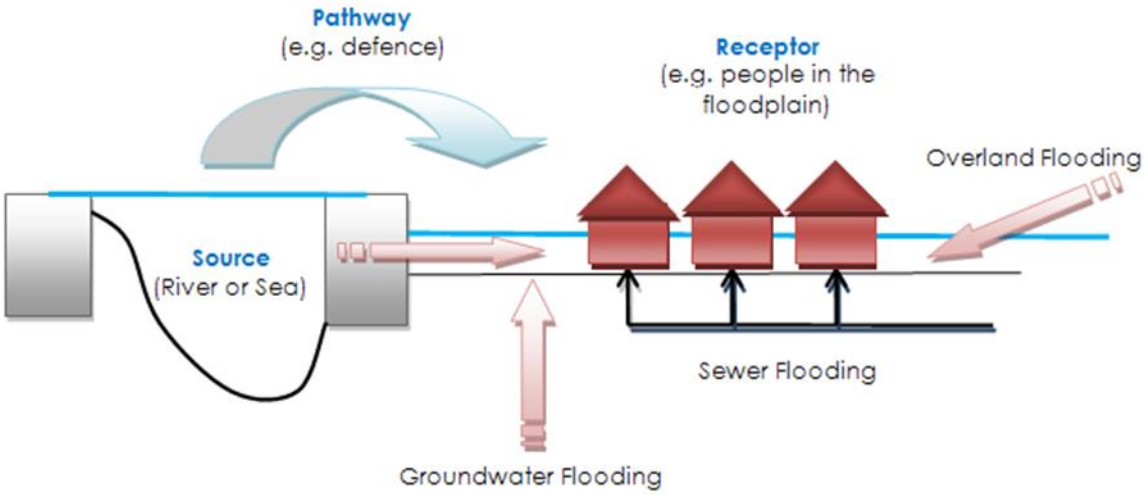
Figure 1-2 Flooding from all sources



1.10 Likelihood and consequence

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 1-3 below. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

Figure 1-3 Source-Pathway-Receptor Model



The principal sources are rainfall, snowmelt and high groundwater levels and the most common pathways are rivers, drains, sewers, overland flow and river and coastal floodplains and their defence assets. The receptors can include people, their property and the environment. All these elements must be present for flood risk to arise. Mitigation measures have little or no effect on sources of flooding, but they can block or impede pathways or increase the resilience of receptors.

The planning process is primarily concerned with the location of receptors, taking appropriate account of potential sources and pathways that might put those receptors at risk. It is therefore important to define the components of flood risk in order to apply this guidance in a consistent manner.

1.10.1 Likelihood

Likelihood of flooding is expressed as the percentage probability based on the average frequency measured or extrapolated from records over a large number of years. A 1% probability indicates the flood level that is expected to be reached on average once in a hundred years, i.e. it has a 1% chance of occurring in any one year, not that it will only occur once every hundred years.

Considered over the lifetime of development, such an apparently low frequency or rare flood has a significant probability of occurring. For example:

- A 1% flood has a 26% (1 in 4) chance of occurring at least once in a 30-year period - the period of a typical residential mortgage;
- And a 49% (1 in 2) chance of occurring in a 70-year period - a typical human lifetime.

1.10.2 Consequence

The consequences of flooding include fatalities, property damage, disruption to lives and businesses, with severe implications for people (e.g. financial loss, emotional distress, health problems). Consequences of flooding depend on the hazards caused by flooding (depth of water, speed of flow, rate of onset, duration, wave-action effects, water quality) and the vulnerability of receptors (type of development, nature, e.g. age-structure, of the population, presence and reliability of mitigation measures etc). Flood risk is then expressed in terms of the following relationship:

Flood risk = Probability of flooding x Consequences of flooding

1.11 Risk

Flood risk is not static; it cannot be described simply as a fixed water level that will occur if a river overtops its banks or the intensity of a rainfall event that will trigger surface water flooding. It is therefore important to consider the continuum of risk carefully. Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above.

2 Flood risk policy and strategy

This section sets out the flood risk management roles and responsibilities for different organisations and relevant legislation, policy and strategy.

2.1 Roles and responsibilities for Flood Risk Management in Southern Staffordshire

There are different organisations that cover Southern Staffordshire that have responsibilities for flood risk management, known as Risk Management Authorities (RMAs). These are shown on Table 2-1, with a summary of their responsibilities.

It is important to note that land and property owners are responsible for the maintenance of watercourses either on or next to their properties. Property owners are also responsible for the protection of their properties from flooding as well as other management activities, for example by maintaining riverbeds/banks, controlling invasive species and allowing the flow of water to pass without obstruction. More information can be found in the Environment Agency publication **'Owning a Watercourse' (2018)**.

Table 2-1 Roles and responsibilities for flood risk management within Southern Staffordshire

Risk Management Authority	Strategic Level	Operational Level	Planning role
Environment Agency	Strategic overview for all sources of flooding National Strategy Reporting and general supervision	Main rivers (e.g. River Trent, River Tame, River Sow) Reservoirs	Statutory consultee for development in Flood Zones 2 and 3
Staffordshire County Council as Lead Local Flood Authority (LLFA)	Preliminary Flood Risk Assessment Local Flood Risk Management Strategy	Surface Water Groundwater Ordinary Watercourses (consenting and enforcement) Ordinary Watercourses (works)	Statutory consultee for major developments
The Southern Staffordshire Councils (SSCs) as Local Planning Authorities	Local Plans as Local Planning Authorities	Determination of Planning Applications as Local Planning Authorities Managing open spaces under District/Borough Council ownership	As left
Water Companies: Severn Trent Water	Asset Management Plans, supported by Periodic Reviews (business cases)	Public sewers	Non-statutory consultee

	Develop Drainage and Wastewater management plans		
Internal Drainage Board: Sow and Penk IDB	Water Level Management Plans	Ordinary Watercourses within Internal Drainage Districts	Non-statutory consultee
Highways Authorities: *Highways Agency (motorways and trunk roads)* *Staffordshire County Council (other adopted roads)*	Highway drainage policy and planning	Highway drainage	Internal planning consultee regarding highways design standards and adoptions

2.2 Relevant legislation

The following legislation is relevant to development and flood risk in Southern Staffordshire:

- **Flood Risk Regulations (2009)** transpose the EU Floods Directive (2000) into UK law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments (PFRAs) and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan is produced. This is a six-year cycle of work and the second cycle started in 2017.
- **Town and County Planning Act (1990)**, **Water Industry Act (1991)**, **Land Drainage Act (1991)**, Environment Act (2005) and **Flood and Water Management Act (2010)** – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have a role in FRM.
- **Land Drainage Act (1991)** and **Environmental Permitting Regulations (2016)** also set out where developers will need to apply for additional permission (as well as Planning Permission) to undertake works to an ordinary watercourse or Main River.
- **Water Environment Regulations (2017)** transpose the European Water Framework Directive (2000) into law and require the Environment Agency to produce River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reach 'good status'.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014) and Strategic Environmental Assessment Directive (2001) also apply as appropriate to strategic and site-specific developments to guard against environmental damage.

2.3 Relevant flood risk policy and strategy documents

Table 2-2 summarises relevant national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. Hyperlinks are provided to external documents. These documents may:

- Provide useful and specific local information to inform Flood Risk Assessments within the Southern Staffordshire area.
- Set the strategic policy and direction for Flood Risk Management (FRM) and drainage – they may contain policies and action plans that set out what future flood mitigation and climate change adaptation plans may affect a development site. A developer should seek to contribute in all instances to the strategic vision for FRM and drainage in Southern Staffordshire.
- Provide guidance and/or standards that informs how a developer should assess flood risk and/or design flood mitigation and SuDS.

Table 2-2: National, regional and local flood risk policy and strategy documents

	Document, lead author and date	Information	Policy and measures	Development design requirements	Next update due (if known)
National	**Flood and Coastal Management Strategy** (Environment Agency) 2011	No	Yes	No	2019
	National Planning Policy Framework and Guidance (MCHLG) 2018/2015	No	No	Yes	2019 updates to PPG
	Building Regulations Part H (MCHLG) 2010	No	No	Yes	-
Regional	**River Trent Catchment Flood Management Plan** (Environment Agency) 2009	Yes	Yes	No	-
	Humber Flood Risk Management Plan (Environment Agency) 2015	Yes	Yes	No	2021
	Severn Flood Risk Management Plan (Environment Agency) 2015	Yes	Yes	No	2021
	Humber River Basin Management Plan (Environment Agency) 2015	No	Yes	No	2021
	Severn River Basin Management Plan (Environment Agency) 2015	No	Yes	No	2021
	Climate Change guidance for development and flood risk (Environment Agency) 2016	No	No	Yes	2019
Local	**Local Flood Risk Management Strategy** (Staffordshire County Council) 2015	Yes	Yes	No	2021
	SuDS Handbook (Staffordshire County Council) 2017	Yes	No	Yes	-
	Drainage and Wastewater Management Plan (Severn Trent Water) due 2023	Yes	Yes	No	-
	Surface Water Management Plan Phase 1 (SSCs) 2010	Yes	Yes	Yes	-

	Surface Water Management Plan Phase 2, Lichfield City (Lichfield District Council and Staffordshire County Council) 2011	Yes	Yes	No	-
	Surface Water Management Plan Phase 2, Stafford (Stafford Borough Council and Staffordshire County Council) 2011	Yes	Yes	No	-
	Surface Water Management Plan Phase 2, Penkridge (South Staffordshire Council, Staffordshire County Council) 2011	Yes	Yes	No	-
	Surface Water Management Plan Phase 2, Cannock (Cannock Chase District Council, Staffordshire County Council) 2011	Yes	Yes	No	-
	Surface Water Management Plan Phase 2, Tamworth (Tamworth Borough Council, Staffordshire County Council) 2011	Yes	Yes	No	-
	Policy Statement on Flood Protection and Water Level Management (Sow and Penk IDB) 2011	Yes	Yes	No	-

2.4 Key national, regional and local policy documents and strategies

2.4.1 The National Flood and Coastal Erosion Risk Management Strategy for England (2011)

The National Flood and Coastal Erosion Risk Management Strategy for England provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. It was prepared by the Environment Agency with input from Defra.

The Strategy builds on existing approaches to flood and coastal risk management and promotes the use of a wide range of measures to manage risk. It describes how risk should be managed in a co-ordinated way within catchments and along the coast and balance the needs of communities, the economy and the environment.

The Strategy encourages more effective risk management by enabling people, communities, business, infrastructure operators and the public sector to work together to:

- ensure a clear understanding of the risks of flooding and coastal erosion, nationally and locally, so that investment in risk management can be prioritised more effectively;
- set out clear and consistent plans for risk management so that communities and businesses can make informed decisions about the management of the remaining risk;
- manage flood and coastal erosion risks in an appropriate way, taking account of the needs of communities and the environment;
- ensure that emergency plans and responses to flood incidents are effective and that communities are able to respond effectively to flood forecasts, warnings and advice;
- help communities to recover more quickly and effectively after incidents.

The Strategy is currently being updated and was **published for consultation** in May 2019.

2.4.2 River Basin Management Plans

The **Humber and Severn River Basin District River Basin Management Plans** (RBMPs), managed by the EA, have been updated since the first cycle in 2009. The latest versions were published in December 2015. Water quality and flood risk can go hand in hand in that flood risk management activities can help to deliver habitat restoration techniques. The Humber RBMP includes such examples whereby land management techniques have been designed to reduce flood risk whilst also reducing sediment loss and improving water quality. The plans include an assessment of river basin characteristics, a review of the impact on human activity, statuses of water bodies, and an economic analysis of water use and progress since the first plan in 2009. The Plans are currently being reviewed and the Environment Agency are currently planning for the 3rd cycle of RBMPs from 2021-2027.

2.4.3 Flood Risk Management Plans

Flood Risk Management Plans (FRMPs) are part of the six-year cycle of assessment, mapping and planning required under the Flood Risk Regulations. The Environment Agency led the development of the **Humber and Severn FRMPs**, which were published in 2015. The FRMPs summarise the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations. The FRMPs draw on policies and actions identified in Catchment Flood Management Plans and Local Flood Risk Management Strategies. The Plans will be

updated as part of the new cycle of the Flood Risk Regulations and are due to be published in December 2021, the Environment Agency are now planning for this 2nd cycle of FRMPs from 2021-2027.

2.4.4 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. When the first cycle of FRMPs was being developed, much of the information the CFMPs included and many of the actions were translated into measures for FRMPs. The Environment Agency and Defra are currently considering what the future of CFMPs is, and this may be subject to public consultation in future.

Southern Staffordshire is covered by the **River Severn CFMP (2009)** and the **River Trent CFMP (2009)**. Within these CFMPs, Southern Staffordshire is covered by four policy units:

- West Staffordshire (including Stafford and Cannock) is covered by Policy Option 4 – Areas of low, moderate or high flood risk where the flood risk is currently being managed effectively but where further action may be needed to keep pace with climate change.
- Mid Staffordshire and Lower Tame (including Tamworth, Lichfield and Rugeley) is covered by Policy Option 6 – Areas of low to moderate flood risk where action will be taken to store water or manage run-off in locations that provide overall flood risk reduction or environmental benefits.
- Telford, Black Country, Bromsgrove and Kidderminster (including Wombourne and the Smestow Brook) is covered by Policy Option 5 – Areas of moderate to high flood risk where further action can generally be taken to reduce flood risk.
- Shropshire Tributaries (covering a small, rural area in the west of South Staffordshire, including Weston-under-Lizard) is covered by Policy Option 2 – Areas of low to moderate flood risk where existing flood management actions can be reduced.

In these Policy Options, there are specific 'actions' to manage flood risk in the area. Those most relevant to Southern Staffordshire are:

- Provide a more accurate and community focussed flood warning service.
- Complete a strategy for the River Tame, focussing on opportunities to naturalise the river in rural areas and to reduce flood risk in Tamworth.
- Carry out a feasibility study to identify and assess locations for river restoration or improvements.
- Work with aggregate companies and mineral and waste authorities to prepare a plan identifying current and future opportunities to create restoration that benefits wildlife and flood risk management.
- Identify problem coal mining sites within Staffordshire where discharge during flood events causes pollution and damages habitat/species in receiving watercourses.
- Review current land drainage, flood defence and water level management practices in the Sow and Penk catchments.
- Work with the 'Farming Floodplains for the Future' project to influence and share findings and policies that support flood risk management. This was a pilot

project led by Staffordshire Wildlife Trust that explored land management techniques that could reduce flood risk downstream.

- Produce and implement an Integrated Urban Drainage Strategy through Stafford.
- Encourage close liaison with planners and developers to ensure future urban growth is appropriate and helps manage flood risk.
- Investigate the opportunities for and the feasibility of broad scale SuDS and encourage them to be implemented, where practical.
- Ensure floodplains are not inappropriately developed. Follow the 'sequential approach' of Planning Policy Statement 25 (which is now superseded but the principles of the approach are embedded into the 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. One example of a flood-compatible use is 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, especially major operators of infrastructure, allowing them to be better prepared. Encourage them all to increase the resilience and resistance of vulnerable buildings, infrastructure and businesses.
- Encourage rural and urban best practices in land-use and in land-management to restore more sustainable natural floodplains and to reduce run-off.

2.4.5 Staffordshire County Council Local Flood Risk Management Strategy (2015)

Staffordshire County Council are responsible for developing, maintaining, applying and monitoring a Local Flood Risk Management Strategy (LFRMS). The **most recent strategy** was published in 2015 in conjunction with Shropshire County Council and is used as a means by which the LLFA co-ordinates Flood Risk Management on a daily basis.

The seven high-level objectives proposed in the strategy for managing flood risk include:

- Develop a strategic understanding of flood risk from all sources.
    - Continue to gather information on different sources of flood risk and provide better historic flooding records through investigating the cause of flood events. Flooding information will be risk based with areas shown at risk to be analysed in more detail.
- Promote effective management of drainage and flood defence systems.
    - Aim to raise awareness of the responsibilities of drainage systems by publicity information, public engagement, designation of features and consenting works.
- Support communities to understand flood risk and become more resilient to flooding.
    - Aim to provide local communities with improved flood risk information as it becomes available so that they can increase their understanding and allow them to make informed decisions on how to protect themselves.
- Manage local flood risk and new development in a sustainable manner.

- Aim to manage flood risk and drainage associated with new development such that no new flood risk is created and ensure that where possible, opportunities to reduce flood risk are taken through early engagement with developers.

- Achieve results through partnership and collaboration.
  - Shropshire Council and Staffordshire County Council will continue to work in partnership to enhance resource capabilities for the better management of local flood risk. Partnerships with RMAs, other organisations, landowners and community groups will be strengthened.
- Be better prepared for flood events.
  - The improved information on flood risk will be used to ensure that emergency responders, partner organisations and communities better understand the nature of local flood risk and can use this information to improve their preparedness for flood events.
- Secure and manage funding for flood risk management in a challenging financial climate.
  - Funding for flood risk management will be directed to areas most at need and where solutions will be most effective. Where local flood alleviation schemes are identified, communities will be engaged in the project process to influence the design and maximise the schemes potential.

2.4.6 LLFAs, surface water and SuDS

The2019 National Planning Policy Framework (NPPF) states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 165). When considering planning applications, local planning authorities should consult the LLFA 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.

Staffordshire County Council's requirements for new developers on SuDS are set out on their **website**, alongside supporting documents. At the time of writing this SFRA, documents and policies relevant to SuDS and surface water in Southern Staffordshire are:

- **SuDS Handbook** (Staffordshire County Council, 2017);
- **Standing Advice** (Staffordshire County Council, 2015);
- Surface Water Management Plan Phase 1 (SSCs and Staffordshire County Council 2010);
- Surface Water Management Plan Phase 2, for Lichfield, Stafford, Cannock, Tamworth and Penkridge (SSCs and Staffordshire County Council 2011);
- **Tamworth Borough Council Local Plan** Policy SU4;
- **Stafford Borough Council Local Plan** Policy N2;
- **South Staffordshire Council Core Strategy** Core Policy 3, Policy EQ7, Policy EQ11, Policy EQ12.

2.4.7 Water Cycle Studies

Water Cycle Studies (WCS) – both scoping, outline and detailed – assist Councils to select and develop sustainable development allocations in locations where there is minimal impact on the environment, water quality, water resources, infrastructure, and

flood risk. WCS provide the required evidence, and an agreed strategy, to ensure that planned growth occurs within environmental constraints (and where possible contributes to environmental improvements), with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable. This is undertaken by identifying areas where there may be conflict between any proposed development, the requirements of the environment and by recommending potential solutions to these conflicts. At the time of writing this SFRA, a WCS for the SSCs was being prepared alongside the study.

2.4.8 Surface Water Management Plans

A Surface Water Management Plan (SWMP) is a study to understand the flood risks that arise from local flooding, which is defined by the Flood and Water Management Act 2010 as flooding from risk from surface runoff, groundwater, and ordinary watercourses. SWMPs are led by a partnership of flood risk management authorities who have responsibilities for aspects of local flooding, including the LLFA, Local Authority, Sewerage Undertaker and other relevant authorities. The purpose of a SWMP is to identify what the local flood risk issues are, what options there may be to prevent them or the damage they cause and who should take these options forward. This is then presented in an Action Plan that the stakeholders and partners agree. A Phase 1 **SWMP for the SSCs** was produced in 2010 and an **addendum** published in 2011. The Phase 1 SWMP identifies settlements with a high overall risk of surface water flooding, along with five key settlements which were highlighted as "red" with regards to overall surface water flooding and were taken forward to a Phase 2 SWMP study for further investigation:

- **Stafford Phase 2 SWMP**
- **Cannock Phase 2 SWMP**
- **Lichfield Phase 2 SWMP**
- **Penkridge Phase 2 SWMP**
- **Tamworth Phase 2 SWMP**

The Phase 2 SWMPs identified a number of key strategies including:

- All information contained within the SWMP should be considered when site-specific FRAs are undertaken for developments within the area. It is noted that the Risk Management Authorities should consider that the Risk of Flooding from Surface Water mapping has now superseded the mapping produced for the SWMPs.
- Installation of SuDS in all new developments, with the aim to reduce runoff below greenfield rate in the key drainage areas upstream of the towns.
- Retrofitting of SuDS in existing developments where feasible.
- Investigation into dual use of residential roads as flow pathways, and reduction in private gardens/driveway paving where possible.

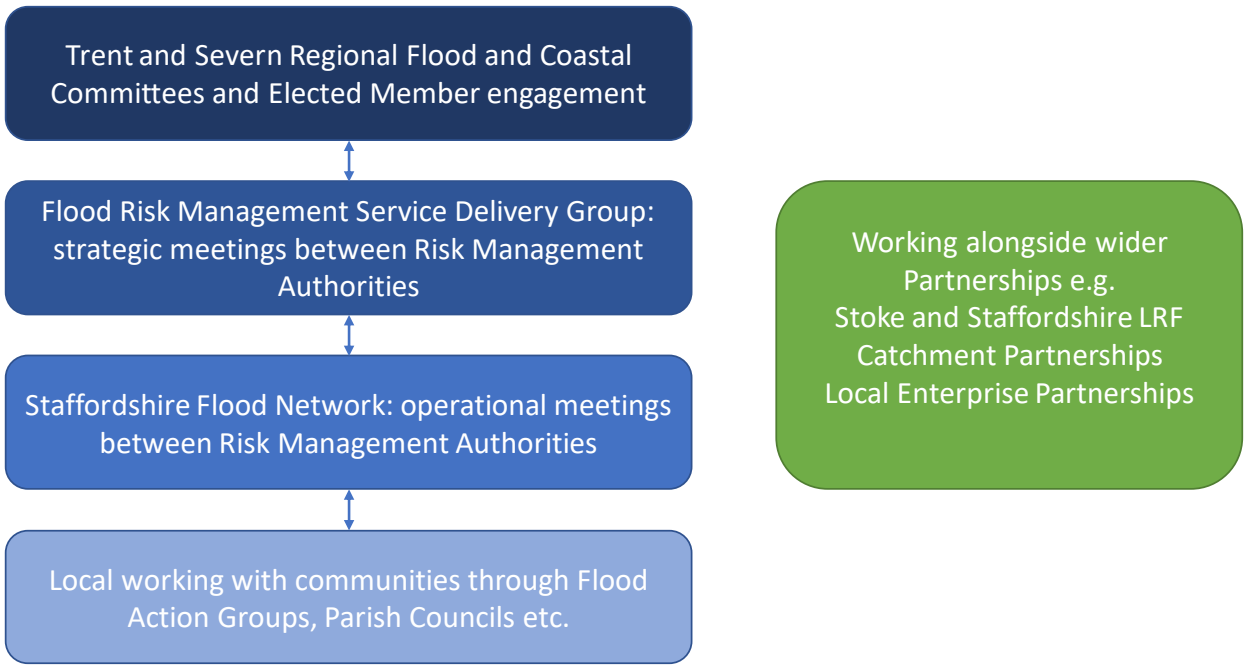
2.4.9 Sow and Penk Internal Drainage Board (IDB) Policy Statement on Flood Protection and Water Level Management

The **policy statement** provides a statement of the IDB's approach to its management of flood risk and water levels in its area. The statement outlines how the IDB will deliver the Government's policy aim and objectives for flood and coastal defence.

2.4.10 Partnership working in Staffordshire

Figure 2-1 shows how partnership working between Risk Management Authorities is structured in Staffordshire.

Figure 2-1 Partnership working in Staffordshire



This page is intentionally left blank

3 Planning policy for flood risk management

This section summarises national planning policy for development and flood risk.

3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (NPPF) was published in July 2018 and updated in February 2019, replacing the 2012 version. The NPPF sets out Government's planning policies for England. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF states that:

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards".

Planning Practice Guidance on flood risk was published in March 2014 and sets out how the policy should be implemented. **Diagram 1 in the PPG** sets out how flood risk should be considered in the preparation of Local Plans.

3.2 The risk-based approach

The NPPF takes a risk-based approach to development in flood risk areas.

3.2.1 The Flood Zones

The definition of the Flood Zones is provided below. The Flood Zones do not take into account defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

The Flood Zones do not take into account surface water, sewer or groundwater flooding or the impacts of canal or reservoir failure. They do not consider climate change, hence there could still be a risk of flooding from other sources and the level of flood risk will change over time during the lifetime of a development.

The Flood Zones are:

- Flood Zone 1: Low probability: less than a 0.1% chance of river and sea flooding in any given year.
- Flood Zone 2: Medium probability: between a 1% and 0.1% chance of river flooding in any given year or 0.5% and 0.1% chance of sea flooding in any given year.
- Flood Zone 3a: High probability: greater or equal to a 1% chance of river flooding in any given year or greater than a 0.5% chance of sea flooding in any given year. Excludes Flood Zone 3b.
- Flood Zone 3b: Functional Floodplain: land where water has to flow or be stored in times of flood. SFRAs identify this Flood Zone in discussion with the LPA and the Environment Agency. The identification of functional floodplain takes 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.

The Flood Zones in the Appendix A Geo-PDFs are the same as those shown on the Environment Agency's 'Flood Map for Planning'.

The Environment Agency Flood Zones do not cover all catchments or ordinary watercourses if the catchment is <3km^2. As a result, whilst the Environment Agency Flood Zones may show an area is in Flood Zone 1, there may be a flood risk from smaller watercourses not shown in the Flood Zones.

Functional floodplain (Flood Zone 3b) is land which would flood with an annual probability of 1 in 20 years. Where detailed modelling exists, the 1 in 20-year flood extent (provided by the Environment Agency) has been used to represent Flood Zone 3b. For areas outside of the detailed model coverage, this is represented by Flood Zone 3a (indicative Flood Zone 3b) as a conservative indication. Further work should be undertaken as part of a detailed site-specific Flood Risk Assessment to define the extent of Flood Zone 3b where no detailed modelling exists.

3.2.2 The Sequential Test

Firstly, land at the lowest risk of flooding from all sources should be considered for development. To do this, a test is applied, called the 'Sequential Test'. Figure 3-1 summarises the Sequential Test; the LPA will apply the Sequential Test to strategic allocations. For all other developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test.

The LPA should work with the Environment Agency to define a suitable area of search for the consideration of alternative sites in the Sequential Test. 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.

Whether any further work is needed to decide if the land is suitable for development will depend on both the vulnerability of the development and the Flood Zone it is proposed for. Table 2 of the PPG defines the vulnerability of different development types to flooding. Table 3 of the PPG shows whether, having applied the Sequential Test first, that vulnerability of development is suitable for that Flood Zone and where further work is needed.

Figure 3-1 The Sequential Test

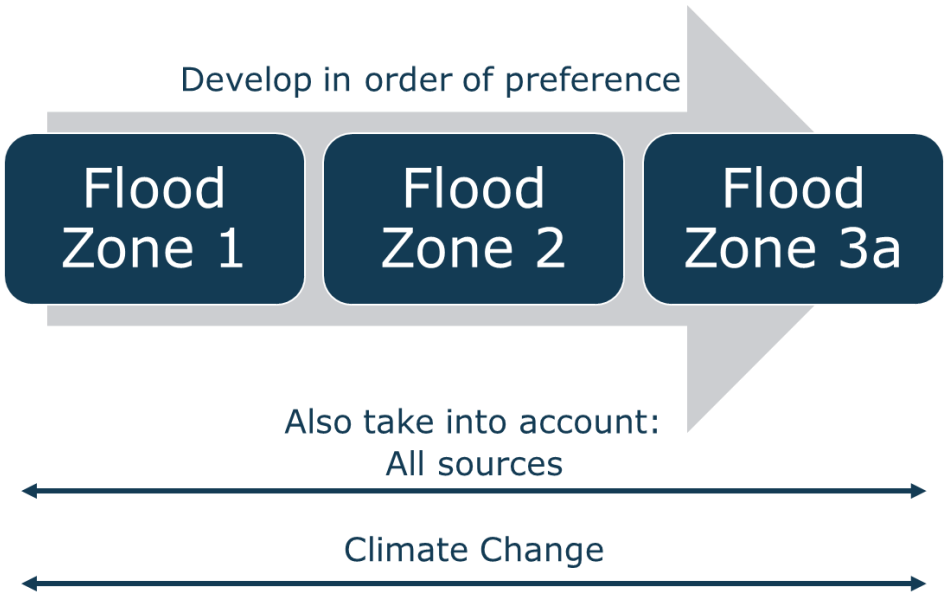
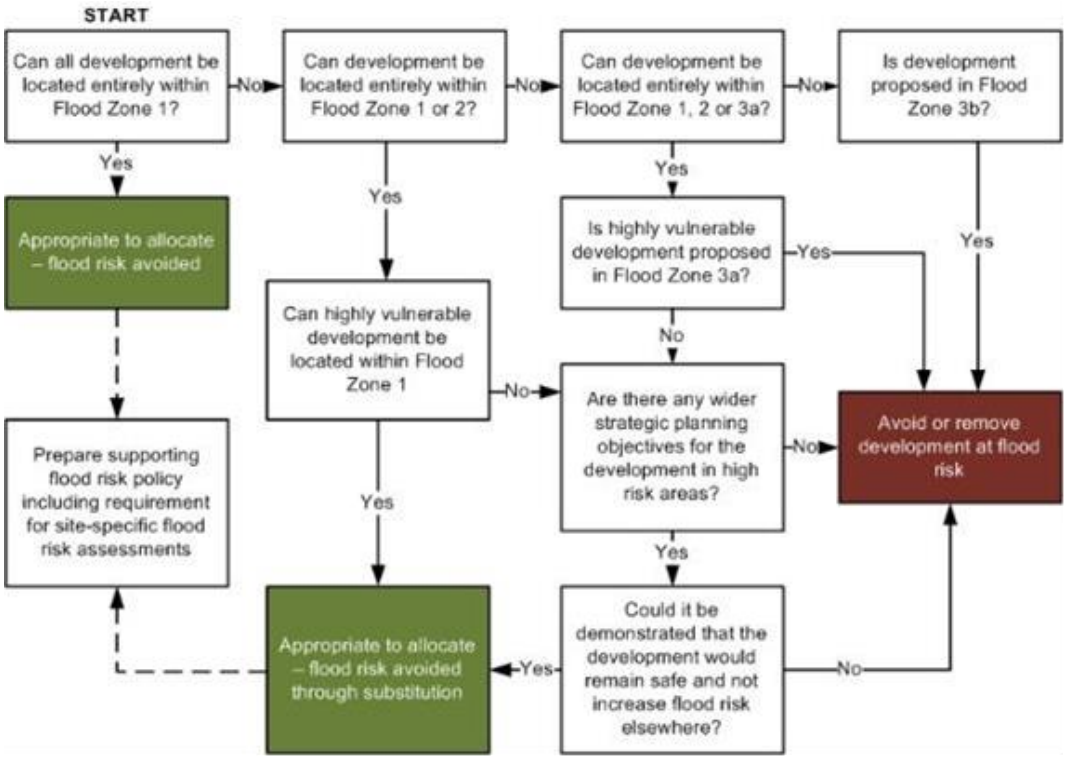


Figure 3-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning Flood Zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used and are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded.

In addition, the risk of flooding from other sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

Figure 3-2 Local Plan sequential approach to site allocation



3.2.3 The Exception Test

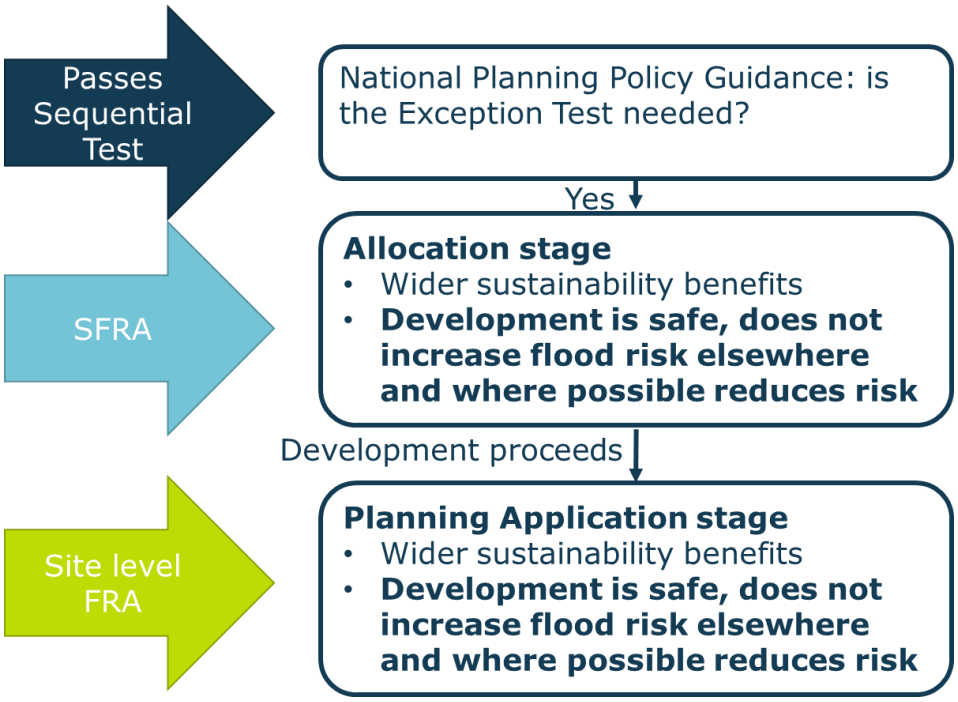
It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required.

The Exception Test should only be applied following the application of the Sequential Test. It applies in the following instances as set out in Table 3 of the PPG:

- More vulnerable in Flood Zone 3a
- Essential infrastructure in Flood Zone 3a or 3b
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)

Figure 3-3 summarises the Exception Test. An LPA should apply the Exception Test to strategic allocations. For all developments, developers must supply evidence to the LPA, with a Planning Application, that the development has passed the test. This is because when a site-specific Flood Risk Assessment is done, more information on the exact measures that can manage the risk is available.

Figure 3-3 The Exception Test



3.3 Using the SFRA to apply the Sequential and Exception Tests to the Local Plan

This SFRA provides the main evidence required on flood risk to carry out the Sequential Test. This process also enables those sites that have passed the Sequential Test, and may require the Exception Test, to be identified. A Local Plan Sustainability Appraisal should be used to support any decision to locate development in higher flood risk areas in terms of wider strategic planning objectives.

It is recommended that planners use the information in this report to apply the Sequential Test alongside wider strategic planning objectives as follows:

1 Using the information on the Flood Zones, can development be allocated into the lowest flood risk areas?

2 Using the information on other sources of flooding, can development be allocated into the lowest flood risk areas?

3 Using the information on climate change, is there likely to be a significant increase in flood risk due to climate change? They should form a judgement based on the likely lifetime of a development (e.g. 100 years for residential) as to whether the site is likely to become at unacceptable risk of flooding over time.

Where there are flood defences (shown on the maps in Appendix A), the results of the climate change modelling will not be directly comparable with the Flood Map for Planning, because it does not take the defences into account. Should a site rely heavily on defences for protection, a Level 2 SFRA is recommended that can explore in greater detail what the impact of climate change on flood hazard, depth and velocity over the lifetime of a development to inform the Exception Test, should this be required.

Having applied this analysis, should there be any sites allocated in areas of high flood risk, Table 3 of the PPG should be consulted to see if the Exception Test would apply, with reference to the flood risk vulnerability of the development. If so, it is recommended that these sites proceed to a Level 2 SFRA to further advise on the likelihood of the allocation passing the Exception Test. In addition, sites that are at high risk of flooding from other sources and/or where there may be significant impacts due to climate change would benefit from Level 2 SFRA.

Once the process has been completed, the LPA should then be able to allocate appropriate development sites through the Local Plan as well as prepare flood risk policy including the requirement to prepare site-specific FRAs for all allocated sites that remain at risk of flooding.

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

3.4.1 The Sequential Test

The SSCs, with advice from the Environment Agency, are responsible for considering the extent to which Sequential Test considerations have been satisfied.

Developers are required to apply the Sequential Test to all development sites, unless the site is:

- A strategic allocation and the test have already been carried out by the LPA, or
- A change of use (except to a more vulnerable use), or
- A minor development (householder development, small non-residential extensions with a footprint of less than 250m^2), or
- A development in Flood Zone 1 unless there are other flooding issues in the area of the development (i.e. surface water, ground water, sewer flooding).

The SFRA contains information on all sources of flooding and taking into account the impact of climate change. This should be considered when a developer undertakes the Sequential Test, including the consideration of reasonably available sites at lower flood risk.

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 relates to the catchment area for the type of development being proposed. For some sites this may be clear e.g. school catchments, in other cases it may be identified by other Local Plan policies. For some sites e.g. regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans

- Sites with Planning Permission but not yet built out
- Strategic Housing and Economic Land Availability Assessments (SHELAAs)/five-year land supply/annual monitoring reports
- Locally listed sites for sale

It may be that a number of smaller sites or part of a larger site at lower flood risk form a suitable alternative to a development site at high flood risk.

Ownership or landowner agreement in itself is not acceptable as a reason not to consider alternatives.

3.4.2 The Exception Test

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 required (as set out in Table 3 of the PPG). Developers are required to apply the Exception Test to all applicable sites (including strategic allocations).

The applicant will need to provide information that the application can pass both parts of the Exception Test:

- *Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk*

  Applicants should refer to wider sustainability objectives in Local Plan Sustainability Appraisals. These generally consider matters such as biodiversity, green infrastructure, historic environment, climate change adaptation, flood risk, green energy, pollution, health, transport etc.

  Applicants should detail the suitability issues that the development will address and how doing so will outweigh the flood risk concerns for the site e.g. by facilitating wider regeneration of an area, providing community facilities, infrastructure that benefits the wider area etc.

- *Demonstrating 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 FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:

  - 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, including whether the developer would increase the pressure on emergency services to rescue people during a flood event.
  - Any funding arrangements required for implementing measures.

3.5 Existing Local Plan policy on development and flood risk

The policies relevant to flood risk in Southern Staffordshire from each Council's current Local Plan are outlined below.

South Staffordshire District

Below are some of the policies and principles in **South Staffordshire District's Core Strategy** that are relevant to flood risk:

- Core Policy 3: Sustainable Development and Climate Change states that development should be guided away from known areas of flood risk as identified in the SFRA, SWMP and consistent with the NPPF, and that SuDS should be used in all new development and retrofitting SuDS should be promoted where possible.
- Policy EQ13: Development Contributions identifies that developers should contribute to flood protection measures and SuDS and the long-term maintenance of these features.

Stafford Borough

Below are some of the policies and principles in **Stafford Borough's Local Plan** that are relevant to flood risk:

- Spatial Principle 7 (SP7) states that settlement boundaries will not be located in areas of flood risk or contribute to flood risk on neighbouring areas.
- Policies for Stafford (Policy Stafford 2 – North of Stafford, Policy Stafford 3 – West of Stafford, Policy Stafford 4 – East of Stafford) identifies that drainage schemes will be delivered to enable development of the Strategic Development Locations which will include measures to alleviate flooding downstream on the Marston Brook, Sandyford Brook, Doxey Brook, River Sow and tributaries of the River Sow.
- Policies for Stone (Policy Stone 1 – Stone Town, Policy Stone 2 – West and South of Stone) states that development must deliver measures to alleviate flooding and surface water management on sites and reduce associated implications for the Trent Valley corridor through necessary works and SuDS.
- Policy N2 – Climate Change states that all new development will be expected to incorporate sustainable design features to mitigate against the impact of climate change. The policy lists how development should incorporate SuDS.

Tamworth Borough

Below are some of the policies and principles in **Tamworth Borough's Local Plan** that are relevant to flood risk:

- SU4 – Flood Risk and Water Management sets out criteria for development with regards to flood risk, including applying a Sequential Approach to development, incorporating SuDS and not increasing flood risk elsewhere.

Lichfield District

Below are some of the policies and principles in **Lichfield District's Local Plan** that are relevant to flood risk:

- Core Policy 3: Delivering Sustainable Development states that development should be guided away from areas of known flood risk identified in the SFRA and SWMP.
- Policies for a number of urban areas within Lichfield District states that development should be delivered with the provision and maintenance of SuDS and flood mitigation measures.

Cannock Chase District

Below are some of the policies and principles in **Cannock Chase District's Local Plan** that are relevant to flood risk:

- Policy CP16 – Climate Change and Sustainable Resource Use identifies that proposed development should appropriately account for both current and future potential level of flood risk, and that development should be guided away from areas of flood risk.

4 Impact of Climate Change

The NPPF sets out that flood risk should be managed over the lifetime of a development, taking climate change into account. This section sets out how the impact of climate change should be taken into account.

Climate change projections show an increased chance of warmer, wetter winters and hotter, drier summers with a higher likelihood of more frequent and intense rainfall. This is likely to make severe flooding happen more often.

4.1 Revised Climate Change Guidance

The Environment Agency published **updated climate change guidance** in 2016 on how allowances for climate change should be included in both strategic and site-specific FRAs. The guidance adopts a risk-based approach considering the vulnerability of the development.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency are currently using these to update their climate change guidance for new developments. Developers should check on the government website for the latest guidance before undertaking a detailed Flood Risk Assessment. At the time of writing this report, this was due in late 2019.

The UKCP18 contains high resolution mapping with peak river flow allowances at 1km grid scale that will be released in late 2019. The regional peak river flow allowances in the 2016 guidance may not change but planners and developers may need to consider the finer resolution data where it shows a significant difference to the regional averages.

The UKCP18 high resolution (daily and sub daily) rainfall projections are due to be published in late 2019. Following this, the Environment Agency may update the recommended peak rainfall allowances in their guidance for planners and developers.

4.2 Applying the climate change guidance

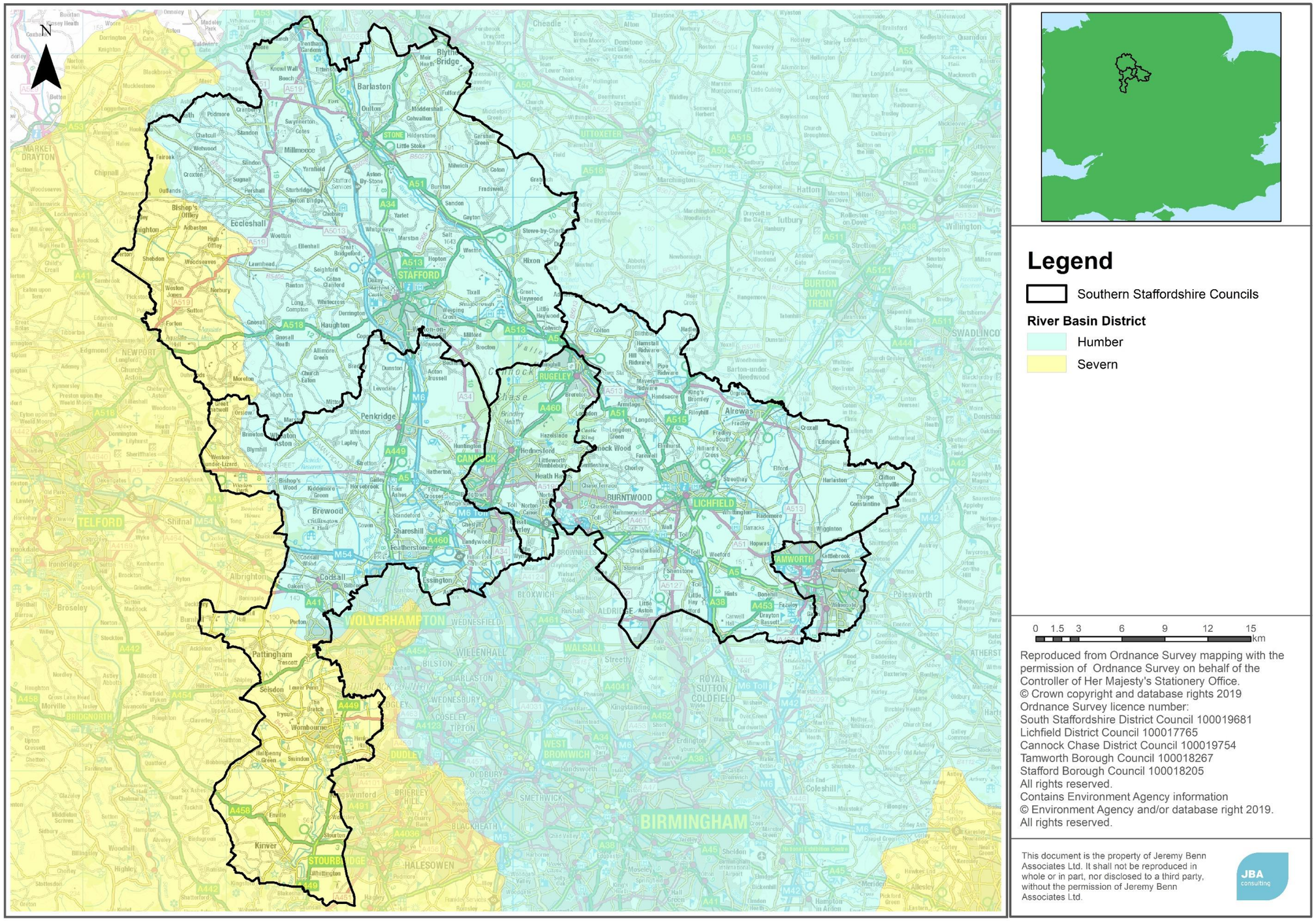
To apply the climate change guidance, the following information needs to be known:

The vulnerability of the development – see the **PPG**.

When deciding which range of scenarios are appropriate, developers should consider:

- The likely lifetime of the development – in general 60 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA.
- The River Basin that the site is in – Southern Staffordshire sits largely within the Humber River Basin District, with the western edge of Stafford Borough and part of South Staffordshire District falling within the Severn River Basin District as shown in Figure 4-1.
- The likely depth, speed and extent of flooding for each allowance of climate change over time considering the allowances for the relevant epoch (2020s, 2050s and 2080s).
- The vulnerability of the development to flooding – see the **PPG**.
- 'Built in' resilience measures used, for example, raised floor levels.
- The capacity or space in the development to include additional resilience measures in the future, using a 'managed adaptive' approach.

Figure 4-1 River Basin Districts in Southern Staffordshire



4.3 Relevant allowances for Southern Staffordshire

Table 4-1 and 4-2 shows the peak river flow allowances that apply in Southern Staffordshire.

Table 4-1 Peak river flow allowances for the Humber river basin district

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	20%	30%	50%
Higher central	15%	20%	30%
Central	10%	15%	20%

Table 4-2 Peak river flow allowances for the Severn river basin district

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	25%	40%	70%
Higher central	15%	25%	35%
Central	10%	20%	25%

Table 4-3 shows the peak rainfall intensity allowances that apply in Southern Staffordshire. Both the central and upper end allowances should be considered to understand the range of impact.

Table 4-3 Peak rainfall intensity allowances for small urban catchments

Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

4.4 Climate change modelling for the 2019 SFRA

Important note on Climate Change Mapping in this SFRA

For this SFRA update, the existing hydraulic models provided by the Environment Agency were re-run for climate change scenarios to account for the 2016 climate change guidance (Aston Chase Brook, Scotch Brook, Bell Brook, Otherton Brook, Ridings Brook, Rising Brook (Rugeley), Rising Brook (Stafford), Kingston Brook, River Anker, River Penk, River Sow, River Tame, River Trent, Smestow Brook, Warstones Brook and Wom Brook).

It should be noted that different mapping techniques have been applied, depending on the type of hydraulic model (e.g. 1D-2D or 1D-only). LIDAR ground levels will have updated in some places along with newer model software versions since some of the much older models were originally run, and hence mapped outputs may differ slightly in some areas when compared against the original studies.

The majority of Southern Staffordshire lies within the Humber River Basin District and the models were run with the three scenarios to reflect the three climate change allowances for the '2080s' timeframe in the Humber River Basin District, therefore the 100-year plus 20%, 30% and 50% flows. The Smestow Brook model falls within the Severn River Basin District and therefore this was run with the three scenarios to reflect the three climate change allowances for the '2080s' timeframe in the Severn River Basin District, therefore the 100-year plus 25%, 35% and 70% flows. The climate change mapping reflects the defended scenario.

This modelling was undertaken to assist the SSCs with the preparation of their Local Plans. Developers will need to undertake a more detailed assessment of climate change as part of the planning application process when preparing FRAs. Where no detailed hydraulic models are present, Flood Zone 2 has been used as a proxy (termed 'Indicative Climate Change Extent' on the mapping). More detailed hydraulic modelling in these areas may be required at site-specific Flood Risk Assessment stage to confirm flood risk and climate change impacts.

Climate change mapping has been provided in Appendix A: Geo-PDFs. The Indicative Climate Change Extent layer provided under the climate change sub-heading should be viewed in conjunction with the modelled climate change outlines. The Indicative Climate Change extent has been provided where climate change models are not available or could not be run, to serve as an indication of possible extents.

An overview of the models provided and used in this SFRA are shown in Appendix E.

It is recommended that the impact of climate change on a proposed site is considered as part of a detailed Flood Risk Assessment, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development as described in Chapter 4. The Environment Agency should be consulted to provide further advice for developers on how best to apply the 2019 climate change guidance, when this becomes available.

4.4.1 Sensitivity to climate change

The modelled climate change extents increase in comparison to Flood Zone 3 as expected; however, there are notable cases where the modelled extents indicate sensitivities to an increase in flows due to climate change:

- The Rising Brook through Rugeley shows sensitivity to increasing flows, as the Hagley Fields flood defence is overtopped in the upper end climate change scenario, resulting in significant overland flow routes.

- The River Trent through Stone shows sensitivity to increasing flows affecting Westbridge sports centre, Simeon Way and surrounding areas.
- An overland flow path of Bell Brook in Penkridge is present between the Staffordshire and Worcestershire Canal and Teddesley Road (where the watercourse is culverted) in the upper end climate change scenario.
- The Smestow Brook and its tributaries show large increases in flood extents in the upper end climate change scenario; however, as the upper end model had to be run and mapped as a 1D-only model (see Appendix E), the upper end flood extent is likely to be less accurate and should be investigated in further detail in site-specific assessments.
- The River Tame shows sensitivity to increasing flows from climate change, most notably around Elford, Fisherwick and at the confluence with the River Anker in Tamworth.

4.5 Requirements for site-specific Flood Risk Assessments

When undertaking a site-specific FRA, developers should:

- Confirm which national guidance on climate change and new development applies by visiting GOV.UK.
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.
- Chapter 8 provides further details on climate change for developers, as part of the FRA Guidance.

4.5.1 Adapting to climate change

The PPG sections on climate change contain information and guidance for how to identify suitable mitigation and adaptation measures in the planning process to address the impacts of climate change. Examples of adapting to climate change include:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses.
- Identifying no or low-cost responses to climate risks that also deliver other benefits, such as green infrastructure that improves adaptation, biodiversity and amenity, for example by leaving areas shown to be at risk of flooding as public open space.

5 Understanding flood risk in Southern Staffordshire

This chapter explores the key sources of flooding in Southern Staffordshire and the factors that affect flooding including topography, soils and geology. The main sources of flooding are from watercourses, surface water, sewers and culvert blockages.

This is a strategic summary of the risk. Developers should use this chapter to scope out the flood risk issues they need to consider in greater detail in a site-specific Flood Risk Assessment to support a Planning Application.

Appendix B contains a list of the sources of data used in the SFRA.

5.1 Historical flooding

Southern Staffordshire has a history of documented flood events, with the main sources being fluvial and surface water. Significant historic flood events are highlighted in Table 5-1.

Figure 5-1 shows historic flooding events recorded by Staffordshire County Council. For confidentiality reasons this data has been provided on a postcode basis identifying the number of recorded flood events per postcode. Information regarding the nature, source or impact of flooding has not been provided. It can be seen that there are notable clusters of flooding around the main urban areas of Stafford, Tamworth and Rugeley, however, historic flooding is widespread throughout the study area.

Figure 5-1 Staffordshire County Council historic flooding

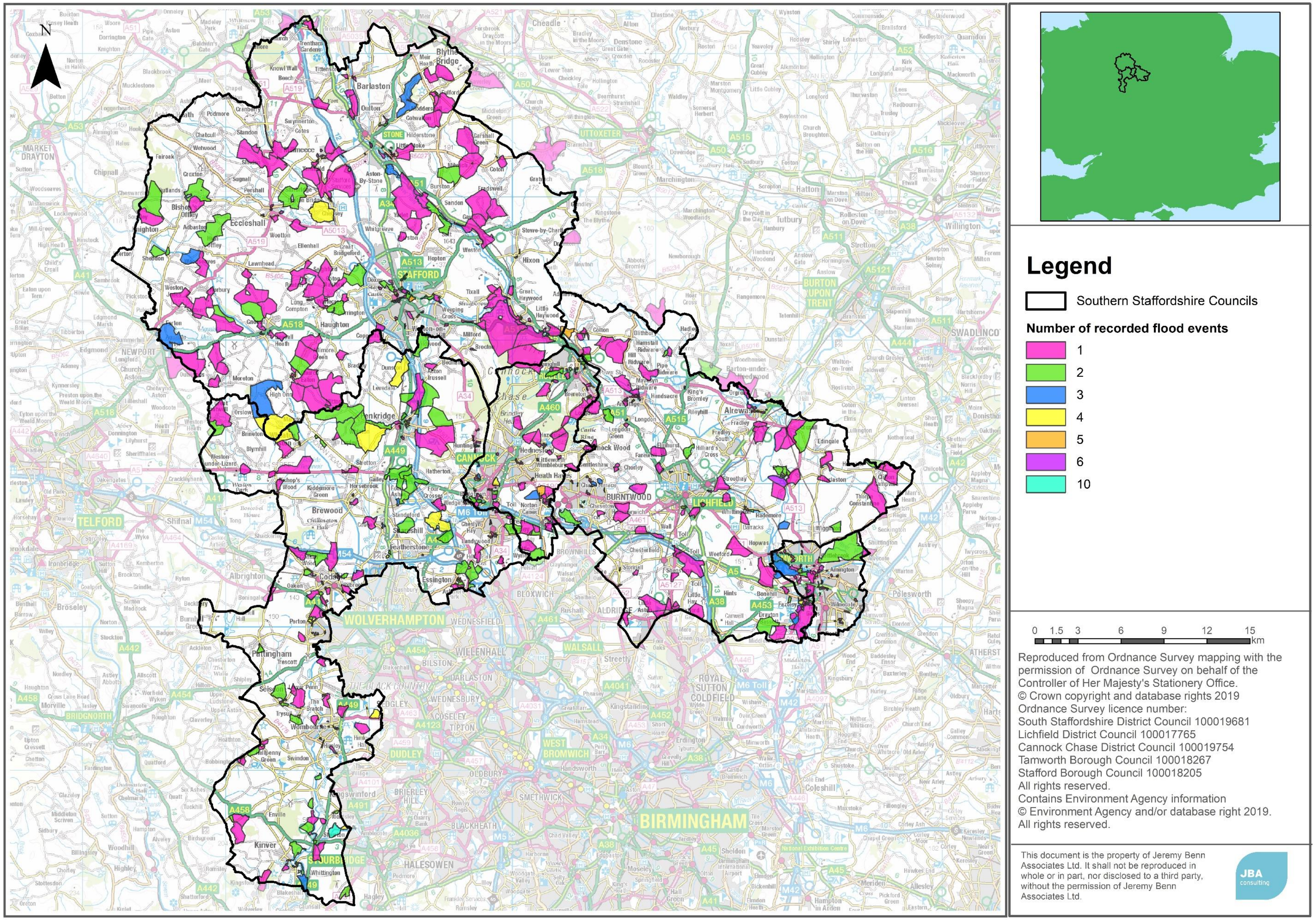


Table 5-1 Historic flooding

Council	Location	Date	Record source	Additional information
All	Multiple locations across the study area	July 2007	Multiple	Intense rainfall caused severe fluvial and pluvial flooding across the study area.
		Summer 2012	Multiple	Intense rainfall caused widespread flooding.
		Winter 2013/14	2014 SFRA	Intense rainfall events causing flooding across the study area.
		June 2016	**Staffs CC flood investigation report**	Intense rainfall between the 8th and 17th of June caused pluvial and fluvial flooding across the County. The worst affected areas included Bishops Wood, Kinver and Wheaton Aston in South Staffordshire; Cannock; Stafford; and Shenstone, Harlaston and Clifton Campville in Lichfield.
Cannock Chase District	South-west of the District	September 1994	2014 SFRA	Flooding as a result of multiple storms affecting many areas including the A34, A5, and Rumer Hill Road.
	South of Mill Green Balancing Ponds	July 1999	2014 SFRA	Flooding from the Ridings Brook.
	A5 at Cannock	November 2000	2014 SFRA	Heavy rainfall causing minor flooding at Eternit and Finnings factories on the A5.
	Rugeley	Multiple incidents	Multiple	Rugeley has a history of flooding from the Rising Brook which flows culverted through the town. Flooding occurs when the culvert is full, and from overtopping upstream of Hagley playing fields causing water to back up and flow overland through the town.
Lichfield District	Hamstall Ridware	August 1987	Recorded flood outlines	Fluvial flooding from the River Blithe.
	Fazeley and north-east of the District	December 1992	Recorded flood outlines	Fluvial flooding from the River Tame, River Mease and River Trent affecting Fazeley and the east of the District.
	Multiple	Autumn 2000	2014 SFRA	Fluvial flooding along the River Tame. Elford and Colton areas were particularly affected.
	Fazeley	Summer 2007	Multiple	Major flooding from the River Tame and the Bourne Brook causing damage to at least 150 properties.
	Shenstone	June 2009	2014 SFRA	Pluvial flooding due to damage of gullies and outlets. Sewer flooding recorded in Lichfield.
	Multiple locations in Lichfield	September 2009	2014 SFRA	Pluvial flooding due to failure of highways drainage capacity along Tamworth Road, Cappers Lane and Thomas Green Way.
	Alrewas	November 2009	2014 SFRA	Failure of public highways and sewer networks caused flooding along the A513 and the main road in Alrewas. Roads and footpaths damaged, and external areas of public property were flooded.

Council	Location	Date	Record source	Additional information
	Clifton Campville	September 2010	2014 SFRA	The main street in Clifton Campville was flooded from failure of public sewer and highways drain. External areas of residential properties were flooded.
	Alrewas	October 2010	2014 SFRA	Pluvial flooding along the main road.
	Multiple locations in Lichfield	July 2013	2014 SFRA	Sandford Street, Wheel Lane and Birmingham Road flooded from intense rainfall.
South Staffordshire	Penkridge	1958	2014 SFRA	Fluvial flooding from the River Penk and the Bell and Otherton Brooks.
	Saredon Brook	February 1976	Recorded flood outlines	Fluvial flooding along the Saredon Brook from Cannock to Standeford.
	River Penk catchment	Autumn 2000	2014 SFRA	Flash flooding to large areas of agricultural land.
	Penkridge	October 2004	2014 SFRA	Flooding at multiple locations including Crown Bridge, Pinfold Lane, Penkridge Market, and floodplain to the north and south of Cuttlestone Bridge.
	Kinver	November 2006	**BBC News**	Flooding from runoff from nearby hills.
	Coven	November 2009	2014 SFRA	Intense rainfall causing external flooding of the culvert under St Pauls school.
	Gilberts Cross and Orton	January 2010	2014 SFRA	Pluvial flooding closing roads and footpaths.
	Coven/Coven Heath	Summer 2010	2014 SFRA	Pluvial flooding to Ball Lane, Stafford Road and School Lane.
	Multiple locations	June 2012	2014 SFRA	Intense rainfall causing pluvial flooding in Huntington, Essington and Great Wyrley from overland flow. Groundwater flooding in Essington.
	Multiple locations	Summer 2012	2014 SFRA	Fluvial, pluvial and highways flooding in Bilbrook, Brewood, Codsall, Essington, Great Wyrley, Huntington, Lower Penn and Perton.
	Coven	May 2018	Staffordshire County Council	Intense rainfall causing external flooding of the culvert under St Pauls school.
	Great Wyrley			Pluvial flooding from intense summer storms causing flooding to >5 properties.
	Perton	May 2019	Staffordshire County Council	Surface water flooding to 4 properties.
	Cheslyn Hay			Pluvial flooding to >5 properties, pending S19 report.
Stafford Borough	Stafford	February 1946	Recorded flood outlines	Fluvial flooding from the River Sow and surrounding drains.
	Stafford	November 2000	2014 SFRA	Flooding from intense rainfall, most notably affecting properties on Newport Road and Bridge Street.
	Stafford	September 2008	2014 SFRA	Sewer flooding from public sewer capacity failure flooding external areas of residential properties.
	Meirheath and Oulton	Summer 2009	2014 SFRA	Flooding to residential gardens in Anthony Grove (Meirheath) and Church Lane (Oulton) due to build-up of surface water along the roads.

Council	Location	Date	Record source	Additional information
	Forton and Barlaston	November 2009	2014 SFRA	Surface water flooding after prolonged rainfall causing flooding to external residential properties.
	Ranton	October 2010	2014 SFRA	Surface water flooding caused damage to rail and road infrastructure.
	Borough-wide	Summer 2012	2014 SFRA	Intense rainfall in July 2012 caused Borough-wide flooding.
Tamworth Borough	Tamworth	June 1955	Recorded flood outlines	Fluvial flooding from the River Anker and River Tame.
	Tamworth	December 1992	Recorded flood outlines	Fluvial flooding from the River Tame and River Anker.

5.2 Topography, geology, soils and hydrology

The topography, geology and soil are all important in influencing the way the catchment responds to a rainfall event. The degree to which a material allows water to percolate through it (the permeability) affects the amount of surface water run-off reaching the watercourse. Steep slopes or clay rich (low permeability) soils cause rapid surface runoff, whereas more permeable rock such as limestone and sandstone can mean a catchment takes longer to respond to rainfall.

Topography

Notable areas of high topography in Southern Staffordshire are around Cannock District, to the north of Stafford Borough and the west of South Staffordshire District. The areas of lowest topography are in Lichfield District and Tamworth Borough.

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 underlying geology in Southern Staffordshire is predominantly mudstone, sandstone and siltstone which make up the Triassic Rocks and Warwickshire Group. Figure 5-3 shows the bedrock geology in Southern Staffordshire.

The superficial geology in the study area is predominantly till (diamicton) and river terrace deposits from historical flood events. Figure 5-4 shows the superficial deposits in Southern Staffordshire.

There are a mix of slowly permeable and freely permeable soils within Southern Staffordshire. These are a mix of very acidic, slightly acidic, loamy, clayey and sandy soils. Notable areas of soils with impeded drainage include south and east of Cannock, north-west Tamworth, Stafford, Stone and large areas of South Staffordshire District.

Figure 5-2 Topography of Southern Staffordshire

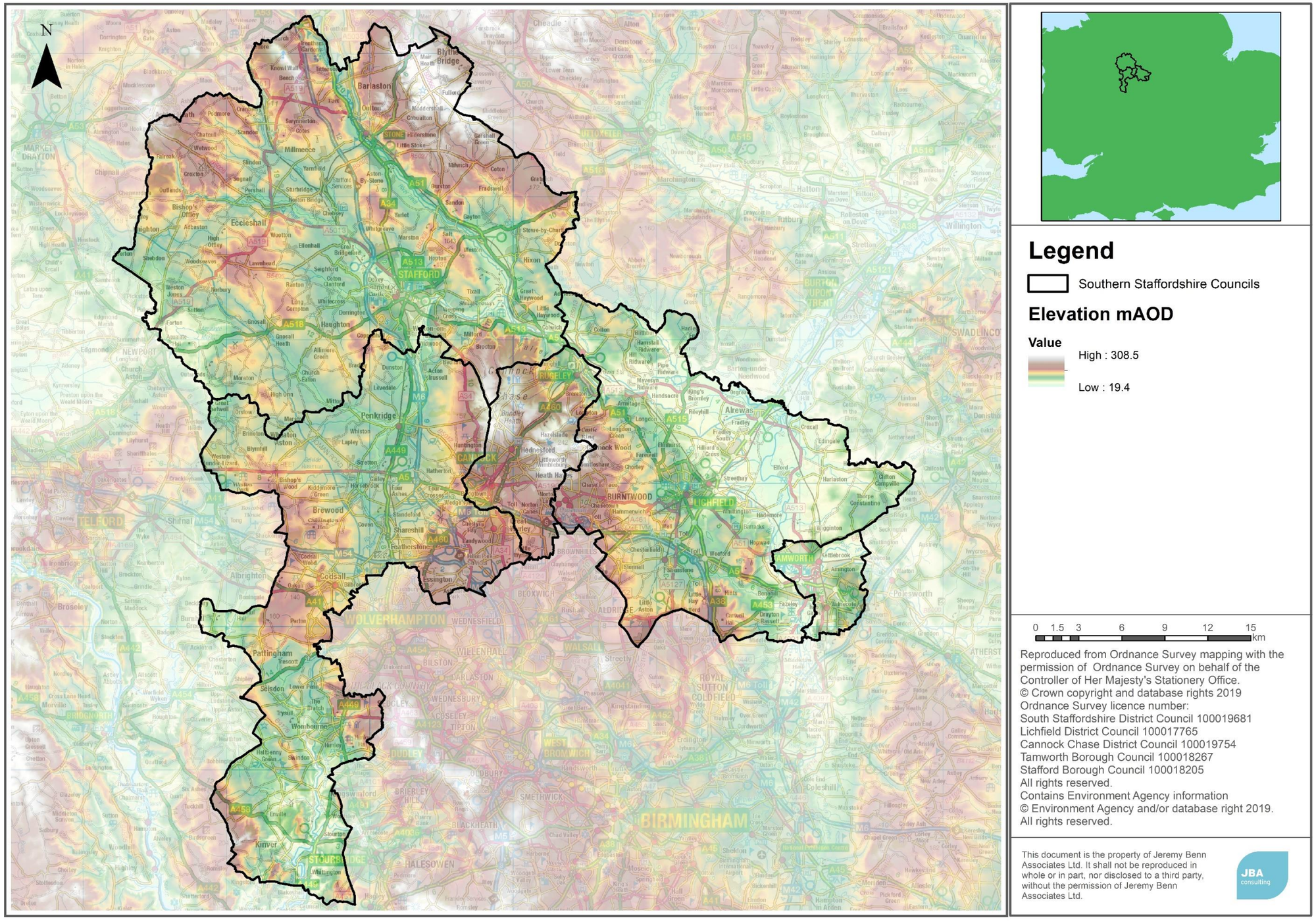


Figure 5-3 Bedrock geology in Southern Staffordshire

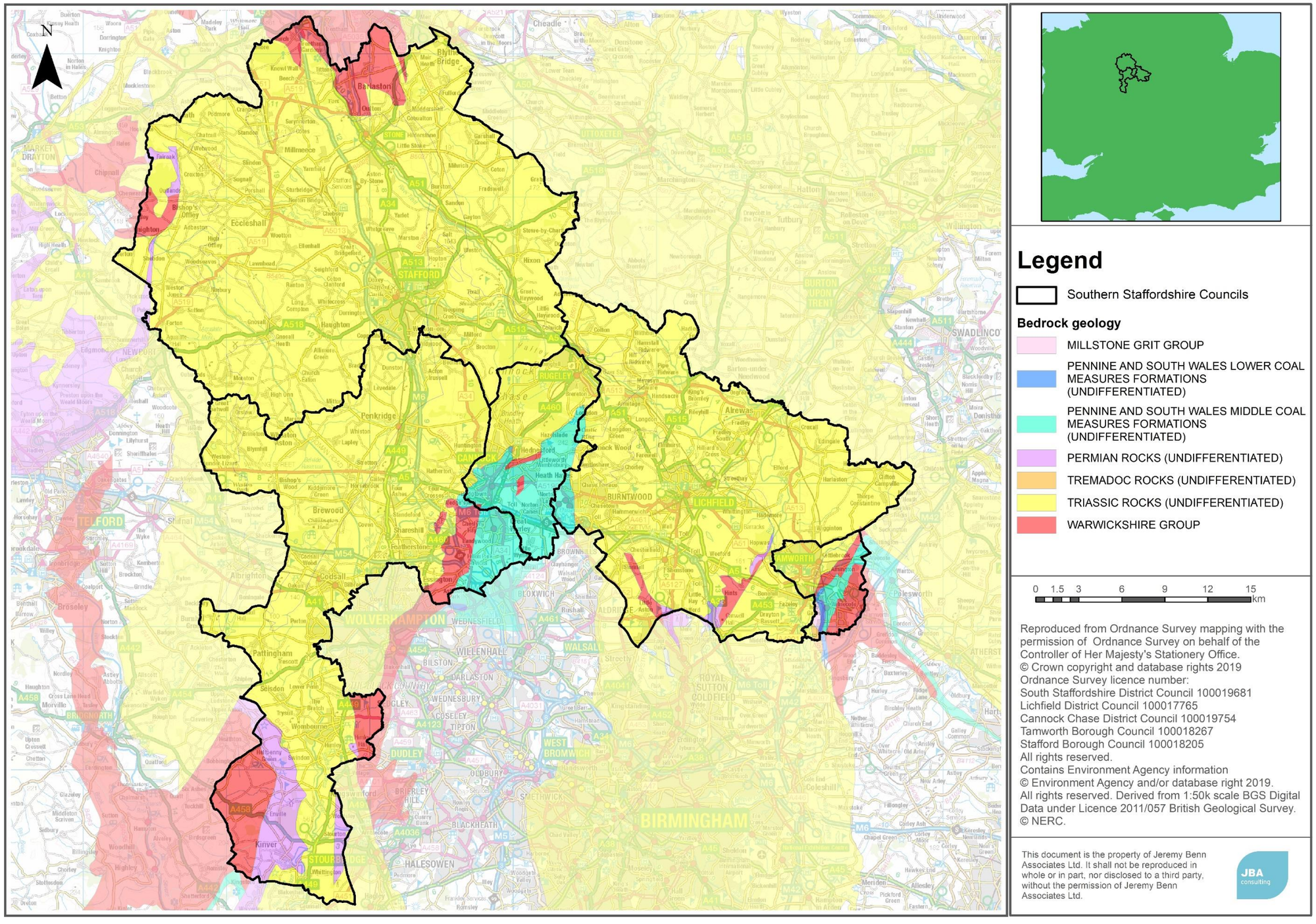
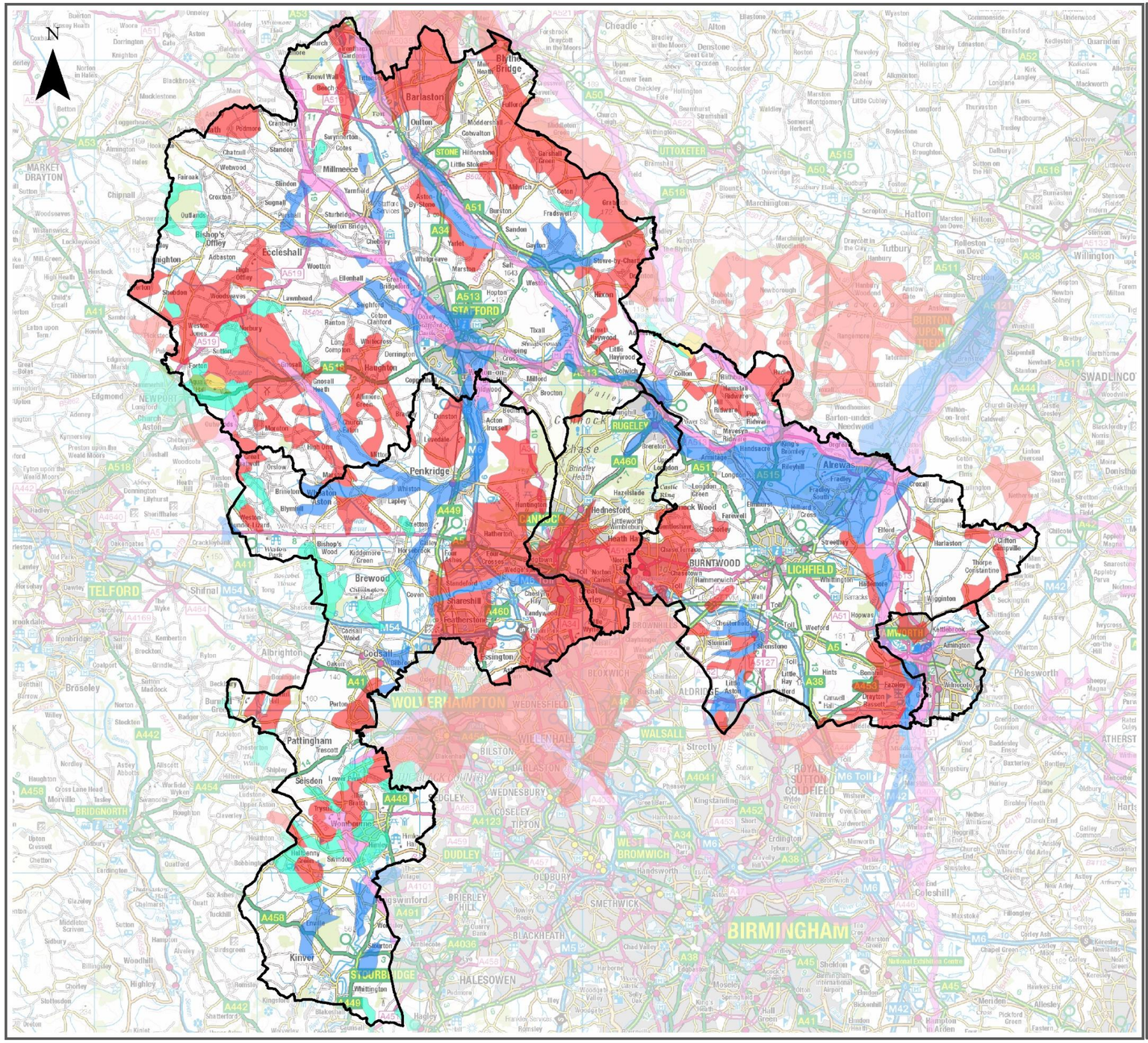


Figure 5-4 Superficial deposits in Southern Staffordshire



5.3 Watercourses

The River Trent is the main watercourse in the study area, with the majority of watercourses draining into the Trent. Other major watercourses in Southern Staffordshire include the River Sow, River Penk, River Tame, River Anker and the Smestow Brook. Figure 5-5 shows the key watercourses and river basin districts in the study area. Key watercourses and main rivers are also included in the Appendix A mapping.

5.4 Fluvial (river) flood risk

The floodplains of the River Anker, River Tame, River Sow, River Penk and River Trent are notably wide in places, posing a significant flood risk in Southern Staffordshire to areas including Tamworth, Fazeley, Rugeley, Stafford and other, more rural areas.

The Flood Zone maps for Southern Staffordshire are in Appendix A. These are interactive maps and show Flood Zones 2, 3a and 3b (including an 'Indicative 3b' where FZ3a acts as FZ3b in the absence of detailed model data). Where modelled data has been used to define the Flood Zones, this is shown in Appendix E.

5.4.1 Ordinary Watercourses managed by the IDB

The Sow and Penk IDB manage a number of Ordinary Watercourses and drains within Southern Staffordshire, covering parts of Stafford Borough and Southern Staffordshire District. Mapping of the watercourses maintained by the Sow and Penk IDB is shown in Figure 5-6 and on their **website**. The IDB have identified some main flooding issues within their area of remit:

- **Rickerscote area of Stafford, to the south of the A34**: There are severe issues with waterlogging in the floodplain areas due to high groundwater table. The IDB are working to better drain the land around here and measures to return the water to the river are critical.
- **Silkmore Drain area of Stafford:** There are severe waterlogging issues along the Silkmore Drain, particularly at the confluence with the Rickerscote Drain. The IDB are working with riparian owners and the LLFA to cleanse part of the system and re-establish the connection with the drain and the River Penk to reduce waterlogging.
- **Rickerscote Road:** There are issues with standing water outside gardens or properties, which are posing a health risk due to stagnant water.
- **Tixall Drain:** The main issues here are related more to access, i.e. trees and vegetation rather than flood risk from the watercourses. Small reservoirs associated with the canal have however caused concern for flood risk in the past.
- **Millmeece Drain:** There are no particular issues in this area, with emphasis on return to river of flood waters and maintenance.
- **Eccleshall:** No issues with the Ordinary Watercourses maintained by the IDB; however, the IDB are aware of flooding issues from the River Sow around Castle Street. The Flood Action Group in Eccleshall are aiming to do some de-silting on the River Sow following a permit from the EA. Return to river of flood waters is a concern in this area.
- **Millian Brook System upstream of Stafford:** There is a rotational maintenance system in place in conjunction with the Wildlife Trust.
- **Doxey Drain, Tillington Drain, Broad Meadow Drain, Forebridge Drain and Lammascote Drain:** No particular issues in these areas.

Figure 5-5 Key watercourses in Southern Staffordshire

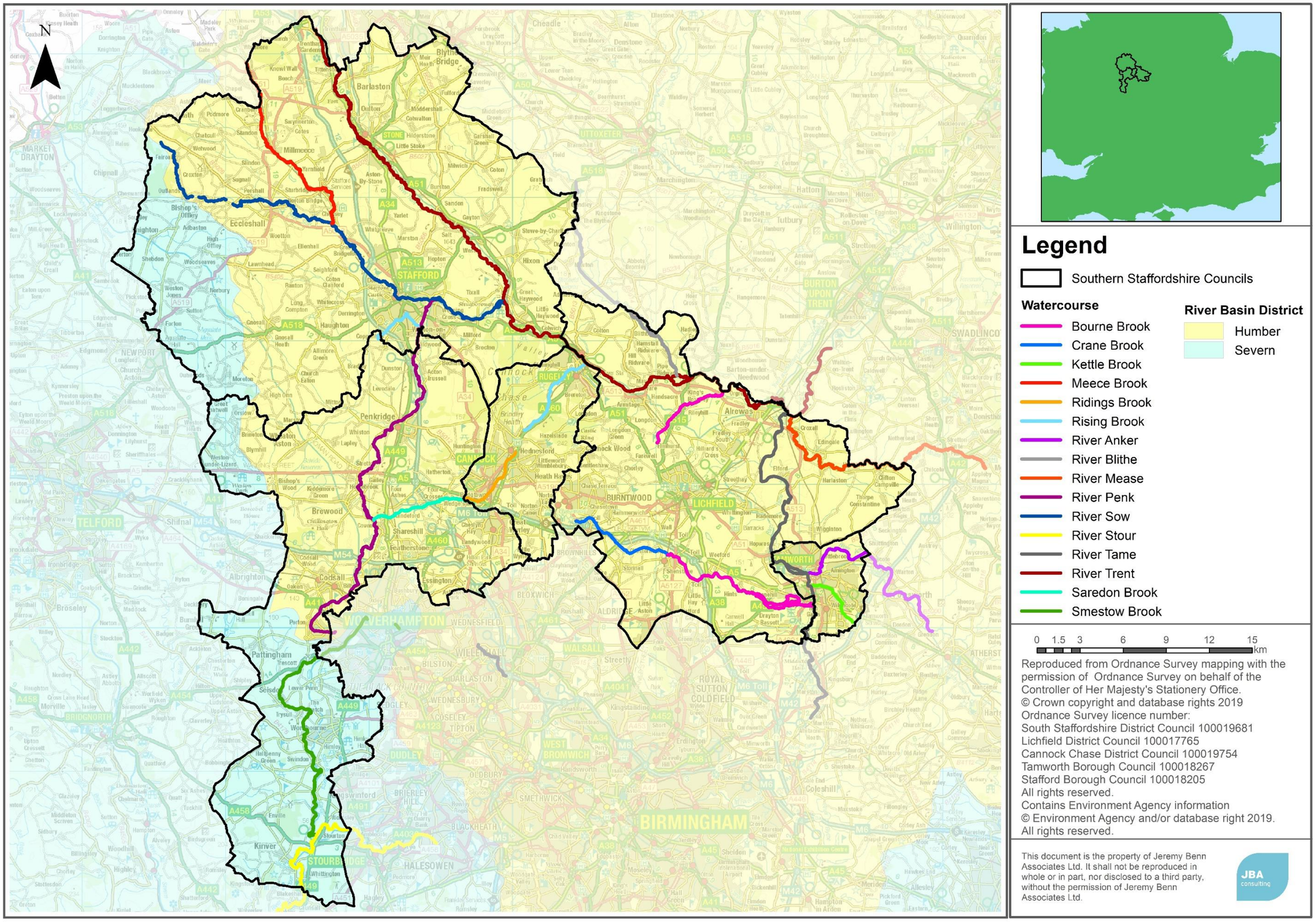
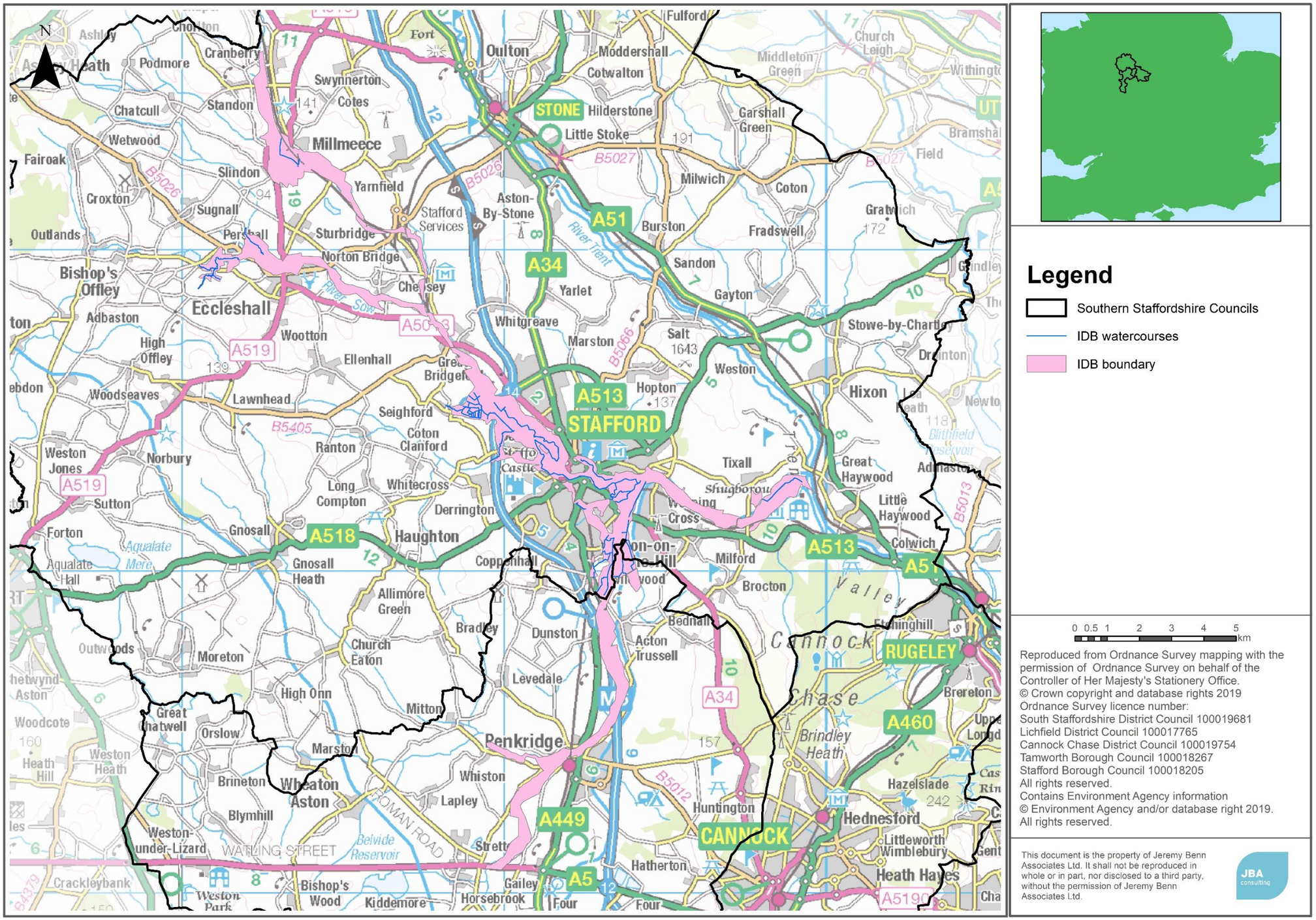


Figure 5-6 IDB maintained watercourses in Southern Staffordshire



5.5 Culverted watercourses

The term watercourse includes all open, bridged, culverted or piped rivers, streams, ditches, drains, cuts, dykes, sluices and passages through which water flows. There is a residual risk from such watercourses should they become blocked or collapse. This was very clearly highlighted in 1987, when blockage of twin culverts on the Scotch Brook under Stone caused major flooding in the town centre. In 2008, a section of the Rising Brook in Rugeley collapsed under Brook Square in the Town Centre, leading to a health and safety hazard and costly repairs.

Reinstatement of open watercourses provides continuity of the watercourse corridor habitat with recreational opportunities; furnishes additional capacity for flood water conveyance and storage; alleviates difficulties in identifying pollution sources; removes blockage, safety and maintenance hazards; and permits aquifer recharge or base flow support.

Throughout all of Staffordshire, there is an estimated 300km of culverted watercourse. There are known major culverts in locations such as Perton (River Penk), Elford (Green Brook), Stafford (Sandyford Brook), Stone (Scotch Brook) and Rugeley (Rising Brook). The LLFA hold some data on culverted watercourses, but given how extensive the network is, detailed records do not exist for every culvert.

To inform a site-specific FRA, any culvert should be surveyed by CCTV to inform an assessment of the condition of the existing culvert to determine it has sufficient capacity receive additional flows and to carry the loading from the development.

5.5.1 Staffordshire culvert blockage study

The residual risk of flooding from culvert blockage or failure should be considered when planning and designing new developments.

A culvert blockage study was undertaken in Staffordshire in 2017 by JBA Consulting, which assessed the culvert capacity for the 1 in 10, 1 in 30 and 1 in 100-year flows and the effects of the 100%, 66%, 33% and 0% blockage scenarios. A total of 89 culverts in Staffordshire were assessed, 54 of which are within Southern Staffordshire. The locations of the culverts assessed in the blockage study are shown in Figure 5-7 and results from the 1 in 100-year flood event for all blockage scenarios is shown in Table 5-2.

The extents of the blockage modelling for the 1 in 100-year flood event, for the 33% and 66% blockage scenarios are shown in Appendix A.

Figure 5-7 Culverts assessed in the blockage study

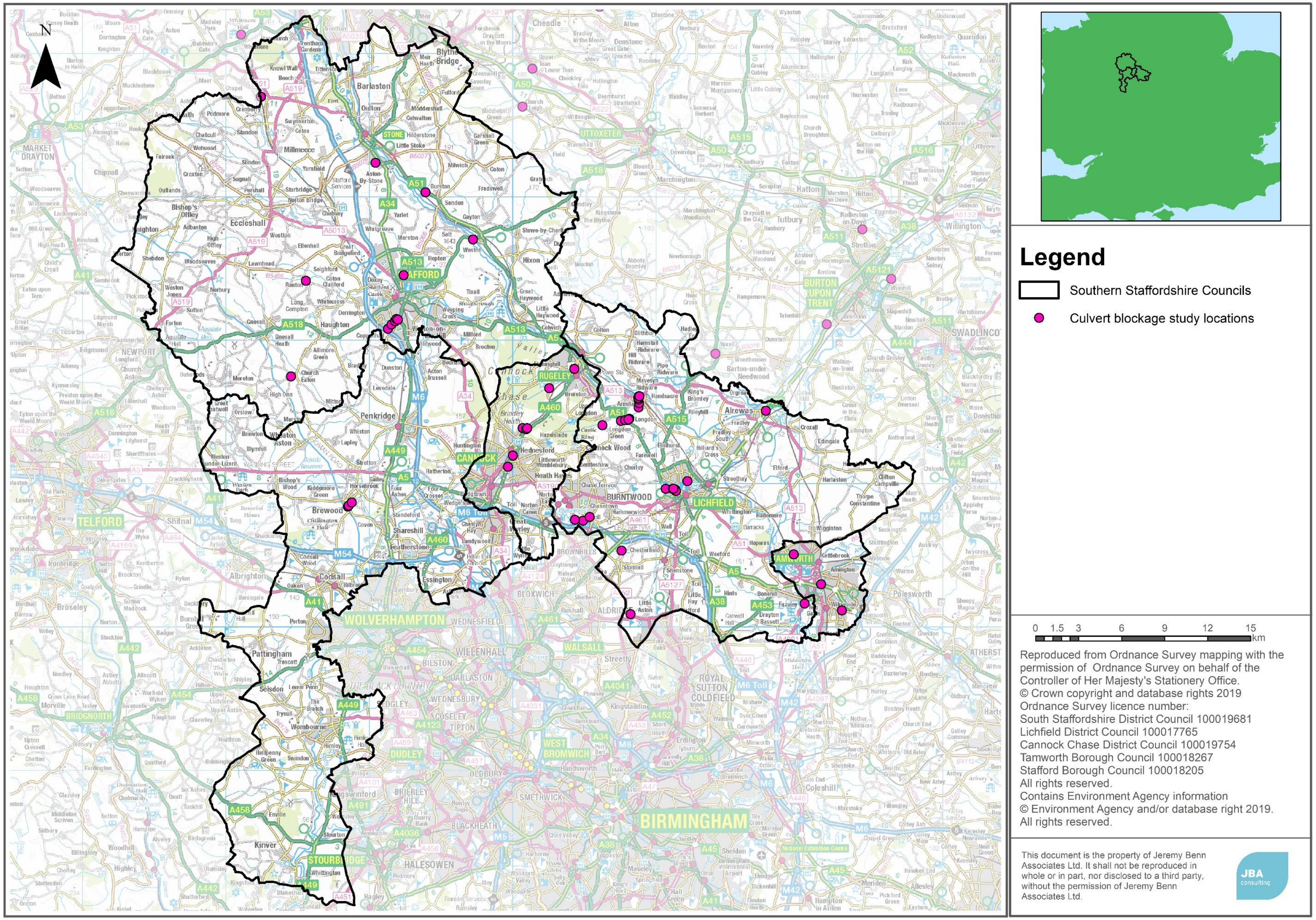


Table 5-2 Results of the culvert blockage study (1 in 100-year flood event)

Culvert ID	District	Ward	Number of properties affected			
			0% blockage	33% blockage	66% blockage	100% blockage
Staffs_001	Tamworth	Wilnecote Ward	0	0	20	30
Staffs_003	Lichfield	Longdon Ward	14	14	14	16
Staffs_004	Lichfield	Longdon Ward	0	0	0	15
Staffs_006	Lichfield	Longdon Ward	6	7	9	9
Staffs_014	Tamworth	Mercian Ward	0	2	2	2
Staffs_015	Lichfield	Bourne Vale Ward	1	11	28	32
Staffs_016	Tamworth	Bolehall Ward	0	0	1	109
Staffs_018	Lichfield	Little Aston & Stonnall Ward	10	10	10	10
Staffs_019	Lichfield	Little Aston & Stonnall Ward	4	4	4	4
Staffs_023	Lichfield	Alrewas & Fradley Ward	61	69	76	81
Staffs_032	Cannock	Hawks Green Ward	0	0	29	46
Staffs_035	Stafford	Seighford & Church Eaton Ward	21	22	26	26
Staffs_036	Stafford	Seighford & Church Eaton Ward	3	4	4	8
Staffs_038	Stafford	Walton Ward	11	13	20	25
Staffs_039	Stafford	Milwich Ward	2	2	12	12
Staffs_040	Stafford	Milwich Ward	0	7	8	44
Staffs_042	Stafford	Swynnerton & Oulton Ward	3	3	3	3
Staffs_043	Stafford	Swynnerton & Oulton Ward	0	2	2	3
Staffs_050	Lichfield	Leomansley Ward	0	0	0	0
Staffs_051	Lichfield	Leomansley Ward	2	2	140	140
Staffs_052	Lichfield	Leomansley Ward	2	2	2	139
Staffs_053	Lichfield	Leomansley Ward	2	2	2	139
Staffs_055	Lichfield	Hammerwich with Wall Ward	0	0	0	0

Culvert ID	District	Ward	Number of properties affected			
			0% blockage	33% blockage	66% blockage	100% blockage
Staffs_056	Lichfield	Hammerwich with Wall Ward	9	9	9	9
Staffs_057	Lichfield	Longdon Ward	0	0	0	0
Staffs_058	Lichfield	Longdon Ward	0	0	0	8
Staffs_059	Cannock	Hednesford North Ward	0	0	0	0
Staffs_060	Cannock	Hednesford North Ward	0	0	0	0
Staffs_061	Cannock	Hednesford North Ward	0	0	0	0
Staffs_062	Lichfield	Armitage with Handsacre Ward	19	20	20	20
Staffs_063	Lichfield	Armitage with Handsacre Ward	53	62	65	67
Staffs_064	Lichfield	Armitage with Handsacre Ward	62	64	64	64
Staffs_065	Lichfield	Armitage with Handsacre Ward	64	64	64	64
Staffs_066	Lichfield	Armitage with Handsacre Ward	56	61	64	64
Staffs_067	Lichfield	Armitage with Handsacre Ward	64	64	64	64
Staffs_070	South Staffordshire	Brewood and Coven Ward	5	5	6	6
Staffs_071	South Staffordshire	Brewood and Coven Ward	5	5	5	5
Staffs_072	South Staffordshire	Brewood and Coven Ward	5	5	5	5
Staffs_073	Stafford	Seighford & Church Eaton Ward	0	0	0	0
Staffs_074	Stafford	Highfields & Western Downs Ward	37	44	48	56
Staffs_075	Stafford	Highfields & Western Downs Ward	94	101	103	104
Staffs_076	Stafford	Highfields & Western Downs Ward	85	85	85	113
Staffs_077	Stafford	Rowley Ward	71	80	83	109
Staffs_078	Stafford	Common Ward	169	170	170	174
Staffs_107	Cannock	Etching Hill and The Heath Ward	0	0	0	0
Staffs_1079	Lichfield	Longdon Ward	12	13	13	15
Staffs_1083	Lichfield	Leomansley Ward	2	139	140	140

Culvert ID	District	Ward	Number of properties affected			
			0% blockage	33% blockage	66% blockage	100% blockage
Staffs_1084	Lichfield	Chasetown Ward	0	0	0	0
Staffs_1086	Cannock	Western Springs Ward	500	522	543	555
Staffs_1088	Lichfield	Stowe Ward	0	1	1	1
Staffs_213	Cannock	Hednesford South Ward	0	0	4	37
Staffs_367	Lichfield	Longdon Ward	14	15	15	20
Staffs_368	Lichfield	Longdon Ward	14	15	15	20
Staffs_369	Lichfield	Longdon Ward	0	0	0	14

5.6 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 can be inextricably linked to issues of poor drainage, or drainage blockage by debris, and sewer flooding. This can be made worse by local insufficient drainage capacity. Where discharge is directly to a watercourse, locally high-water levels can cause back-up and prevent water from draining into the drainage system.

The Environment Agency Risk of Flooding from Surface Water mapping (RoFfSW) provided shows that a number of communities are at risk of surface water flooding. The mapping shows that surface water predominantly follows topographical flow paths of existing watercourses or dry valleys and can pond in low-lying areas. Whilst in the majority of cases, the risk is confined to roads, there are notable prominent run-off flow routes around properties, e.g. properties situated at the foot of surrounding hills. The RoFfSW mapping for Southern Staffordshire can be found in Appendix A.

Surface water flooding is a known and recognised risk in Southern Staffordshire. The urban areas of Cannock, Tamworth, Lichfield, Rugeley, Stafford, Burntwood and Perton were recognised in the Local FRM Strategy as being in the top ten urban areas at risk of surface water flooding in the County. Armitage, Gnosall, Whittington and Brewood were identified as being in the top 10 rural areas at risk of surface water in the County.

At the time of writing this SFRA, the Sow and Penk IDB are producing more detailed modelling for Ordinary Watercourses in their area to inform an improved surface water flood map and should be contacted for the latest information on this modelling.

5.7 Groundwater flooding

In general, less is known about groundwater flooding than other sources. Groundwater flooding can be caused by:

- High water tables influenced by the type of bedrock and superficial geology.
- Seasonal flows in dry valleys, which are particularly common in areas of chalk geology.
- Rebounding groundwater levels, where these have been historically lowered for industrial or mining purposes.
- Where there are long culverts that prevent water easily getting into watercourses.

Groundwater flooding is different to other types of flooding. It can last for days, weeks or even months and is much harder to predict and warn for. Monitoring does occur in certain areas, from example where there are major aquifers or when mining stops.

Groundwater susceptibility mapping of Southern Staffordshire is shown in Appendix A. Notable areas at a higher risk of groundwater flooding is the north of Lichfield District, the north of South Staffordshire District and the south of Stafford Borough.

The Local FRM Strategy states that historically, information on the susceptibility to risk of groundwater flooding has been sparse and there is currently no evidence to suggest that this is a major problem within Southern Staffordshire. Based on this it is anticipated that groundwater flooding issues are likely to be localised in their nature, affecting only a small number of properties.

The **British Geological Survey** provides further information on groundwater flooding on their website.

5.8 Flooding from canals

Canals are regulated waterbodies and are unlikely to flood, unless there is a sudden failure of an embankment or a sudden ingress of water from a river in areas where they interact closely. Embankment failure can be caused by:

- Culvert collapse
- Overtopping
- Animal burrowing
- Subsidence/sudden failure e.g. collapse of former mine workings
- Utility or development works close or encroaching onto the footings of a canal embankment

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 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. The Canal and River Trust monitor embankments at the highest risk of failure.

There are several canals in Southern Staffordshire: the Coventry Canal, Birmingham and Fazeley Canal, Trent and Mersey Canal, Staffordshire and Worcestershire Canal, Shropshire Union Canal, Wyrley and Essington Canal, Cannock Extension Canal and the Stourbridge Canal, these are shown in Figure 5-8.

The Lichfield and Hatherton Canals are unnavigable but are currently being restored and both have sections which are in water; the Hatherton Canal from Hatherton Marina in South Staffordshire District to the Longford Island road bridge in Cannock Chase District, and the Lichfield Canal at the eastern end near Huddlesford Junction and in Lichfield City in Lichfield District. More details on the restoration can be found on the Lichfield and Hatherton Canals Restoration Trust **website**.

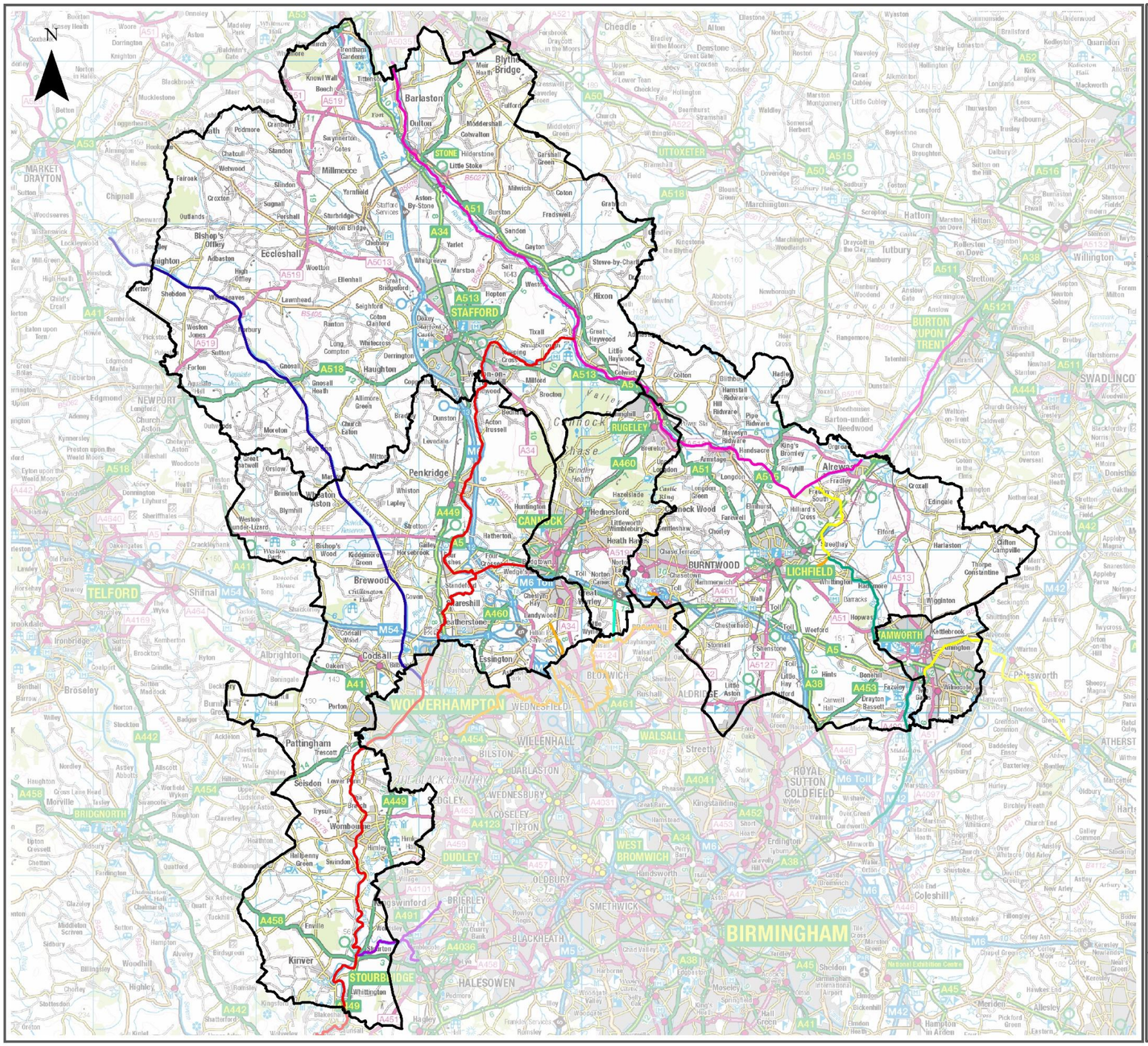
Table 5-3 shows incidences of breach and overtopping in Southern Staffordshire. The most recent incidences have been on the Trent and Mersey Canal near Stone in 2012 and 2013, and the Shropshire Union Canal, Staffordshire and Worcestershire Canal and the Birmingham and Fazeley Canal have all seen breach and/or overtopping since 2007. There has also been flooding in the past at Kinver (South Staffordshire District) due to interaction between the River Stour and Staffordshire and Worcestershire Canal.

Table 5-3 Incidents of canal breach and overtopping in Southern Staffordshire

District/Borough	Canal	Date	Location/information
Stafford	Shropshire Union Canal	February 1957	Breach of canal at High Onn Wharf Farm (Church Eaton)
		June 1991	Breach due to culvert failure at High Offley
		June 1999	A leak at Shelmore Embankment caused a drained pound, though this did not develop into a full breach
		August 2009	Leakage from canal bed at Shebdon
	Trent and Mersey Canal	October 2012	Overtopping incident approximately 800m south of Stone
		November 2012	4 incidents of overtopping on the stretch of canal between Stone and Salt

District/Borough	Canal	Date	Location/information
		January 2013	Overtopping over a culvert at Weston
South Staffordshire	Staffordshire and Worcestershire Canal	May 1969	Breach at Rodbaston due to a long period of torrential rain
		December 1976	Breach at Bells Mills (near Stourton)
		January 1981	Breach at Devils Den (near Stourton) due to sluice failure
		20th July 2007	5 records of overtopping incidents near Kinver and Dunsley
		6th September 2008	1 incident of breach and 4 incidents of overtopping near Stourton due to the River Stour overtopping causing the canal level to rise.
		12th March 2009	Overtopping into a field near Latherford
Lichfield	Birmingham and Fazeley Canal	21st July 2007	2 incidences of overtopping, one at Fazeley Junction and the other at Bourne Brook aqueduct

Figure 5-8 Canals in Southern Staffordshire



5.9 Flooding from sewers

Sewer flooding occurs when intense rainfall/river flooding overloads sewer capacity (surface water, foul or combined), and/or when sewers cannot discharge to watercourses due to high water levels. Sewer flooding can also be caused by blockages, collapses, equipment failure or groundwater leaking into sewer pipes.

Since 1980, the Sewers for Adoption guidelines mean that 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 sewers will be overwhelmed in larger rainfall and flood events. Existing sewers can also become overloaded as new development adds to the surface water 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.

Severn Trent Water record sewer flooding on their Hydraulic Flooding Risk Register. This database records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. Areas defined as at risk/that have historic incidences of sewer flooding are shown in Table 5-4.

For confidentiality reasons this data has been supplied on a postcode basis. The dataset was supplied on the 28/01/2019.

Table 5-4 Properties at risk from sewer flooding (Severn Trent Water)

Post code	Locality associated with postcode	Number of properties at risk	Post code	Locality associated with postcode	Number of properties at risk
WS6 7	Cheslyn Hay	39	WS13 6	Lichfield	4
WS6 6	Great Wyrley	29	WS7 1	Burntwood	4
ST17 0	Stafford	27	WV8 2	Codsall	4
ST16 1	Stafford	25	B77 5	Tamworth	3
ST17 4	Stafford	22	B79 9	Tamworth	3
ST21 6	Eccleshall	21	DE6 2	Ashbourne	3
B74 3	Little Aston	19	DY3 4	Himley	3
ST15 8	Stone	19	ST11 9	Blythe Bridge	3
WS11 0	Cannock	19	ST19 9	Brewood	3
WS12 4	Hednesford	19	WS11 3	Norton Canes	3
WS15 2	Rugeley, Etching Hill	16	WV10 7	Featherstone	3
WS14 0	Shenstone	15	WV6 7	Pattingham	3
WS15 1	Rugeley/Upper Longdon, Brereton	14	B77 1	Tamworth	2
WV8 1	Codsall	14	B78 1	Tamworth	2
ST17 9	Stafford	12	DY7 6	Kinver	2
B77 2	Tamworth	11	ST18 9	Haughton	2
ST16 3	Stafford	11	ST18 9	Derrington	2
WS11 6	Cannock	11	ST20 0	Woodseaves	2
WS12 0	Hednesford	11	WV10 7	Mets West	2

WS15 4	Handsacre, Longdon, Cannock Wood	11	WV4 4	Lower Penn	2
WS11 1	Cannock	10	WV8 1	Bilbrook	2
WS11 9	Cannock	10	WV9 5	Coven Heath	2
ST18 0	Hixon	9	B77 4	Tamworth	1
ST12 9	Barlaston	8	B79 0	Tamworth	1
WS14 9	Lichfield	8	DY3 3	Sedgley	1
B78 3	Tamworth	7	DY7 5	Stourton	1
B79 7	Tamworth	7	ST18 9	Seighford	1
ST16 2	Stafford	7	ST19 9	Lapley	1
WS11 2	Cannock	6	ST20 0	Gnosall	1
WS12 2	Hednesford	6	ST20 0	Knighton	1
WS13 7	Lichfield	6	ST4 8	Trentham	1
WS7 9	Burntwood	6	WS12 2	Heath Hayes	1
WV6 7	Perton	6	WS12 3	Norton Canes	1
B77 3	Tamworth	5	WS15 3	Hamstall Ridware	1
B79 8	Tamworth	5	WS7 0	Burntwood	1
ST12 9	Tittensor	5	WS7 4	Chasetown	1
ST19 5	Penkridge	5	WS7 4	Burntwood	1
ST3 7	Meir Heath	5	WS9 0	Little Aston	1
WS11 5	Cannock	5	WS9 9	Stonnall	1
WV5 8	Wombourne	5	WV10 7	Coven Heath	1
B74 4	Sutton Coldfield	4	WV11 2	Essington	1
DE13 7	Alrewas	4	WV11 2	Featherstone	1
ST15 0	Stone	4	WV4 5	Penn	1
WS11 7	Cannock	4	WV5 0	Wombourne	1
WS11 8	Cannock	4	WV5 9	Wombourne	1
WS12 1	Hednesford	4			**TOTAL=602**

A total of 602 properties have a history of sewer flooding. The localities with the highest number of incidences include Cheslyn Hay and Great Wyrley in South Staffordshire District and Stafford and its surrounding areas.

5.10 Flooding from reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are 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 very low.

Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. 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 is extremely low compared to flooding from other sources. 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 Environment Agency hold mapping showing what might happen if reservoirs fail. They are currently updating the mapping and new data should be available in late 2019, more details on how the maps will be updated are included in the **PFRA for England.** Developers and Planners should check the **Long-Term Risk of Flooding website** for the most up to date mapping.

The current mapping shows that there are 45 reservoirs shown to affect Southern Staffordshire; this includes reservoirs located within the study area and a number of reservoirs outside of the area whose inundation mapping is shown to affect Southern Staffordshire. These are shown in Table 5-5.

Table 5-5 Reservoirs that may potentially affect Southern Staffordshire in the event of a breach

Reservoir	Reservoir owner	Local Authority Area	Is the reservoir located within the study area?
Fens Pools - Upper Pool	Canal & River Trust	Dudley	No
(Field) Aston Pool (ID 34)	Greenhill	Telford and Wrekin	No
Dimmingsdale	Canal & River Trust	Staffordshire	Yes
Gap Pool, Ranton	Norbury Park	Staffordshire	Yes
Patshull Great Pool	Collins Leisure Ltd	Staffordshire	Yes
Patshull Church Pool	Collins Leisure Ltd	Staffordshire	Yes
Chillington Pool	Giffard	Staffordshire	Yes
Ridings Brook, Cannock (Mill Green)	Environment Agency	Staffordshire	Yes
Gailey Lower Pool	Canal & River Trust	Staffordshire	Yes
Lodgerail Pool	KGL Estates Ltd	Staffordshire	Yes
Himley Hall Pool	Dudley Metropolitan Borough Council	Staffordshire	Yes
Pool Hall	Pikerace Ltd	Staffordshire	Yes
Park Pool, Weston Park	Trustees of the Western Park Foundation	Staffordshire	Yes
Springslade Pool	KGL Estates Ltd	Staffordshire	Yes
Chatwell Park Farm Reservoir ID207	PDM Produce (UK) Ltd	Staffordshire	Yes
Lodge Farm	Dudley Metropolitan District Council	Dudley	No
Knighton	Canal & River Trust	Staffordshire	Yes
Calf Heath	Canal & River Trust	Staffordshire	Yes
Belfry	The De Vere Belfry	Warwickshire	No
Rugeley Ash Lagoon 4LH	International Power	Staffordshire	Yes

Rugeley Cooling Tower Ponds 6-9	International Power	Staffordshire	Yes
Rugeley Ash Lagoon 4RH	International Power	Staffordshire	Yes
Stowe Pool	Lichfield District Council	Staffordshire	Yes
Rotton Park	Canal & River Trust	Birmingham	No
Willesley Lake	Hart	Leicestershire	No
Little Aston Pool	Foster, Keogh	Staffordshire	Yes
Holly Bush Lake	Connors	Staffordshire	Yes
Barr Beacon No.2	South Staffordshire Water Plc	Walsall	No
Chasewater (Cannock Chase)	Staffordshire County Council	Staffordshire	Yes
Shustoke Lower	Severn Trent Water Authority	Warwickshire	No
Swinfen Lake	Smith	Staffordshire	Yes
Bartley	Severn Trent Water Authority	Birmingham	No
Canwell Estate Reservoir	Smith Bros. Farms Ltd	Staffordshire	Yes
Rugeley Amenity Lake	International Power	Staffordshire	Yes
Middleton Hall Lake	Middleton Hall Trust	Warwickshire	No
Merevale Park Estate	Dugdale	Warwickshire	No
Serpentine.	Staffordshire County Council	Staffordshire	Yes
Knypersley	Canal & River Trust	Staffordshire	Yes
Belvide	Canal & River Trust	Staffordshire	Yes
Bromley Mill Pool	Timmis	Staffordshire	Yes
Trentham Gardens Lake	Trentham Leisure Ltd	Staffordshire	Yes
Gailey Upper Pool	Canal & River Trust	Staffordshire	Yes
Black Lake, Knowle Wall Farm	Prestwood	Staffordshire	Yes
Tixall Park Pool	Bostock	Staffordshire	Yes
Blithfield	South Staffordshire Water Plc	Staffordshire	Yes

5.11 Flood alerts and flood warnings

The Environment Agency is the lead organisation for providing warnings of river flooding. Flood Warnings are supplied via the Flood Warning System (FWS) service, to homes and business within Flood Zones 2 and 3.

There are currently 15 Flood Alert Areas (FAA) and 43 Flood Warning Areas (FWAs) covering the SSCs. A list of the Flood Alert and Flood Warning Areas and detailed maps are available in Appendix C.

5.12 Summary of flood risk in Southern Staffordshire

A table with summaries of the key flood risks in Southern Staffordshire for each Council area can be found in Appendix D.

6 Flood alleviation schemes and assets

This section provides a summary of existing flood alleviation schemes and assets in Southern Staffordshire. Planners should note the areas that are protected by defences where further work to understand the actual and residual flood risk through a Level 2 SFRA may be beneficial. Developers should consider the benefit they provide over the lifetime of a development in a site-specific Flood Risk Assessment.

6.1 Asset management

Risk Management Authorities hold databases of flood risk management and drainage assets:

- The Environment Agency holds a national database that is updated by local teams.
- The LLFA holds a database of significant local flood risk assets, required under Section 21 of the Flood and Water Management Act (2010).
- Highways Authorities hold databases of highways drainage assets, such as gullies and connecting pipes.
- Water Companies hold records of public surface water, foul and combined sewers, the records may also include information on culverted watercourses.

The databases include assets RMAs directly maintain and third-party assets. The drainage network is extensive and will have been modified over time. It is unlikely that any RMA has full information on the location, condition and ownership of all the assets in their area. They take a prioritised approach to collecting asset information, which will continue to refine the understanding of flood risk over time.

Developers should collect the available asset information and undertake further surveys as necessary to present an understanding of current flood risk and the existing drainage network in a site-specific Flood Risk Assessment.

6.2 Standards of Protection

Flood defences are designed to give a specific Standard of Protection (SoP), reducing the risk of flooding to people and property in flood prone areas. For example, a flood defence with 100-year SoP means that the flood risk in the defended area is reduced to at least a 1% chance of flooding in any given year.

Over time, the actual SoP provided by the defence may decrease, for example due to deterioration in condition or increases in flood risk due to climate change. The understanding of SoP may also change over time as RMAs undertake more detailed surveys and flood modelling studies.

It should be noted that the Environment Agency's on-going hydraulic modelling programme may revise flood risk datasets and as a consequence, the standard of protection offered by flood defences in the area, may differ from those discussed in this report.

Developers should consider the standard of protection provided by defences and residual risk as part of a detailed FRA.

6.3 Maintenance

The Environment Agency and Local Authorities have permissive powers to maintain and improve Main Rivers and Ordinary Watercourses, respectively. There is no legal duty to maintain watercourses, defences or assets and maintenance and improvements are prioritised based on flood risk. The ultimate responsibility for maintaining watercourses rests with the landowner.

Highways Authorities have a duty to maintain public roads, making sure they are safe, passable and the impacts of severe weather have been considered. Water Companies have a duty to effectually drain their area. What this means in practice is that assets are maintained to common standards and improvements are prioritised for the parts of the network that do not meet this standard e.g. where there is frequent highways or sewer flooding.

There is potential for the risk of flooding to increase in areas where flood alleviation measures are not maintained regularly. Breaches in raised flood defences are most likely to occur where the condition of a flood defences has degraded over time. Drainage networks in urban areas can also frequently become blocked with debris and this can lead to blockages at culverts or bridges.

Developers should not assume that any defence, asset or watercourse is being or will continue to be maintained throughout the lifetime of a development. They should contact the relevant RMA about current and likely future maintenance arrangements and ensure future users of the development are aware of their obligations to maintain watercourses.

6.4 Major flood risk management assets in Southern Staffordshire

The Flood Map for Planning contains information on areas benefiting from defences. This shows areas that benefit from the defences that provide a SoP of at least a 100-year river flood event. It does not show areas that benefit from protection for more frequent events. North-east of Penkridge including Pinfold Lane, the A449 and Crown Bridge has been identified as an area benefiting from defences from the River Penk. A number of areas in Tamworth are designated as areas benefitting from defences, including around Bitterscote and Coton and Fazeley in Lichfield District.

There are also additional flood defences on Main Rivers in Southern Staffordshire, and these are shown on Table 6-1.

There are a number of other flood risk management assets in the study area, in Lichfield District, South Staffordshire District and Stafford Borough. A summary of these assets was provided by Staffordshire County Council and are shown in Appendix F. More details relating to assets in the Southern Staffordshire area can be obtained from Staffordshire County Council. Information on Environment Agency assets can be found on their **website**.

Table 6-1: Flood defences in Southern Staffordshire on Main River

Council	Watercourse	Location	NGR	Type	Design SoP	Approximate length	Condition rating	Comments
South Staffordshire District	River Stour	Kinver	384838, 283336	Wall/ embankment	Unknown	Right bank 70m, left bank, 265m	Fair (3) to Good (2)	Right bank flood wall behind properties on Mill Lane. Left bank embankment and flood wall
	Warstones Brook	Lower Penn	387410, 296743	Embankment	5 years	596m	Good (2)	Embankment surrounding pond along the Warstones Brook
	Otherton Brook	Penkridge	392288, 314320	Wall/ embankment	100 years	Right bank 125m, left bank 188m	Fair (3)	Defences at confluence with River Penk, downstream of Crown Bridge
	River Penk	Penkridge	392170, 314417	Embankment	100 years	196.28m	Poor (4) to Fair (3)	Embankment immediately upstream of confluence with the Otherton Brook
Cannock Chase District	Golly Brook	Bridgtown (Cannock)	397593, 308730	Wall	Unknown	99m	Fair (3)	Left bank, parallel with the A5
	Ridings Brook	Rumer Hill (Cannock)	398461, 30950	Wall	Unknown	1467m	Fair (3) to Good (2)	Both banks, crossing Rumer Hill Road
	Ridings Brook/ Mill Green reservoir	Mill Green (Cannock)	398735, 309986	Embankment	100 years	213m	Good (2)	Mill Green reservoir right bank dam
	Rising Brook	Rugeley	404148, 317950	Embankment	100 years	324m	Fair (3)	Right bank, along Hagley Playing Fields, parallel with Western Springs Road
Stafford Borough	Rising Brook	Stafford	392108, 321430	Wall	25 years	31m	Fair (3)	Left bank, behind Sherwood Avenue
	River Sow	Stafford	392177, 322972	Wall	100 years	243m	Fair (3) to Good (2)	Right bank from Moat House Bridge to Green Bridge
	Aston Chase Brook	Stone	391575, 333630	Embankment	100 years	125m	Good (2)	Online earth embankment dam
	Yarnfield Brook	Yarnfield	386342, 332999	Embankment	25 years	62m	Fair (3)	Deflector bank with land drain running in front of it, behind Fieldside
			386281, 333168	Embankment	100 years	360m	Good (2)	Online earth embankment dam

Council	Watercourse	Location	NGR	Type	Design SoP	Approximate length	Condition rating	Comments
Lichfield District	Manor Park Lake	King's Bromley	411598, 316700	Embankment	100 years	301m	Fair (3)	Earth embankment, protecting properties on Manor Road from high levels in the gravel pits
	River Trent and Bentley Brook	Handsacre	409212, 316827	Embankment	25 years	2065m	Fair (3) to Good (2)	Earth embankment, left bank of River Trent, right bank of Bentley Brook
	River Trent	Handsacre	408977, 316602	Embankment	25 years	929m	Fair (3)	Earth embankment, right bank of River Trent
	Bourne Brook	Fazeley	420681, 301646	Embankment/ wall	200 years	641m	Fair (3) to Very Good (1)	Left bank, behind Brook End and the B5404
	Bourne Brook/ unnamed drain	Fazeley	420358, 301518	Embankment/ wall/flood gate	200 years	592m	Good (2) to Very Good (1)	Protecting properties on Mayfair Drive and New Mill Lane
Tamworth Borough	River Tame	Fazeley to Bitterscote	420524, 302066 to 419390, 303537	Embankment/ wall	Up to 100 years	2355m	Fair (3) to Good (2)	Left bank of the River Tame from Fazeley to Bitterscote
	River Tame	Tamworth	419963, 301039	Embankment/ wall	100 years	728m	Fair (3) to Good (2)	Right bank of the River Tame, behind Lichfield Street and the A51
	River Tame and unnamed drains	Coton	418373, 305152	Embankment/ wall	200 years	2000m	Fair (3) to Very Good (1)	Right bank of the River Tame, defences adjacent to the A51 and Coton Lane

6.5 Actual and residual flood risk

A Level 2 SFRA (for strategic allocations) or developer site-specific Flood Risk Assessment will need to consider the actual and residual flood risk due to the presence of flood and drainage assets in greater detail.

6.5.1 Actual flood risk

This is the risk to the site considering existing flood mitigation measures and any planned to be provided through new development. Note that it is not likely to be acceptable to allocate developments in existing undefended areas on the basis that they will be protected by developer works, unless there is a wider community benefit that can be demonstrated.

The assessment of the actual risk should take into account that:

- 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 this to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the 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 and safe guarded that is required for affordable future flood risk management measures.
- 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.

6.5.2 Residual risk

Residual risk is the risk that remains after the effects of flood risk infrastructure have been taken into account. 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 larger flood than defences were designed to alleviate (the 'design flood'). This can cause 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 amount of water.
- Failure of the defences or flood risk management measures, such as breaches in embankments or walls, failure of flood gates to open or close or failure of pumping stations.
- Parts of Southern Staffordshire rely on formal flood defences for protection against fluvial flooding. Consequently, there are areas vulnerable to rapid inundation in the event of a breach/failure. The assessment of the residual risk should take into account:
    - The flood hazard, depth and velocity that would result from overtopping or breach of defences. Flood gate or pumping station failure and/or culvert blockage (as appropriate). The Environment Agency can provide advice at site-specific development level for advice on breach/overtopping parameters for flood models.
    - The design of the development to take account of the highest risk parts of the site e.g. allowing for flood storage on parts of the site and

considering the design of the development to keep people safe e.g. sleeping accommodation above the flood level.

- A system of warning and a safe means of access and egress from the site in the event of a flood for users of the site and the emergency services.

6.6 HS2

HS2 (High Speed 2) is a planned high-speed railway of which parts fall within Southern Staffordshire. Staffordshire County Council have been working with the Environment Agency and other Lead Local Flood Authorities to inform the consenting strategy for structures such as culverts and bridges where the proposed high-speed railway line between London and Fradley (Phase 1) crosses watercourses. This has been with the aim of ensuring that the new line should not have a detrimental impact on flood risk up or downstream and that the impact of climate change has been taken into account. As LLFA, the County Council also have a role in consenting to the detailed designs of such structures prior to construction. Staffordshire County Council have been working with the Environment Agency and Cheshire East Council to provide input and review from a flood risk perspective into options for Phase 2a of HS2 (from Fradley to Crewe) and the Environment Agency and Warwickshire County Council to provide input and review from a flood risk perspective into options for Phase 2b of HS2 (from Birmingham towards the East Midlands). Phase 2b is a later phase than 2a and the County Council will have a similar role in developing the consenting strategy and commenting on detailed designs before the line is constructed. Staffordshire County Council are also working with HS2 and the Environment Agency for surface water drainage design.

7 Cumulative impact of development, schemes and strategic solutions

This chapter provides a summary of flood alleviation schemes, catchments with highest flood risk and summarises strategic solutions applicable to Southern Staffordshire.

7.1 Introduction

Under the NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRA), are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para. 156), rather than just to or from individual development sites.

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume. 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.

All developments are required to comply with the NPPF and demonstrate they will not increase flood risk elsewhere. Therefore, providing developments comply with the latest guidance and legislation relating to flood risk and sustainable drainage, in theory they should not increase flood risk downstream.

Catchments within the study area that have the potential to influence existing flood risk issues in neighbouring Local Authorities were identified, as well as catchments in the study area that may be influenced by development in catchments in neighbouring Local Authorities.

Local planning policies can also be used to identify areas where the potential for development to increase flood risk is highest and identify opportunities for such new development to positively contribute to decreases in flood risk downstream.

7.2 Cross-boundary issues

The topography of the study area means that a number of major watercourses such as the River Trent, Smestow Brook and River Stour flow through the study area and into neighbouring authorities. As such, future development, both within and outside Southern Staffordshire can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. A number of watercourses flow into the study area from neighbouring authorities, including the River Trent, River Tame and River Anker. The SSCs have boundaries with the following Local Authorities, which can be seen on Figure 1-1:

- Newcastle-under-Lyme Borough Council
- Stoke on Trent City Council
- Staffordshire Moorlands District Council
- East Staffordshire Borough Council
- South Derbyshire District Council
- North West Leicestershire District Council
- North Warwickshire Borough Council
- Birmingham City Council
- Walsall Council
- City of Wolverhampton Council
- Dudley Metropolitan Borough Council

- Bromsgrove District Council
- Redditch Borough Council
- Wyre Forest District Council
- Shropshire Council
- Telford and Wrekin Council

The neighbouring authorities were contacted for information on their site allocations, to determine where development in neighbouring authorities may have an impact on flood risk within Southern Staffordshire. A large amount of development is proposed on the border of the Black Country Authorities (Dudley, Sandwell, Walsall and Wolverhampton) and this has been considered in the cumulative impact assessment in Chapter 7.3. Elsewhere, there is some development proposed on the North Warwickshire Borough on the border with Tamworth Borough, which would drain into the River Anker and into the study area. Development in Stoke on Trent City and Newcastle-under-Lyme Borough would drain into Southern Staffordshire via the Lyme Brook and River Trent. Other development in neighbouring authorities is located either on watercourses draining out of Southern Staffordshire, or on watercourses draining into the study area that are a sufficient distance away and where it is unlikely to have a significant impact on flood risk within Southern Staffordshire.

All developments are required to comply with the NPPF and demonstrate they will not increase flood risk elsewhere. Therefore, providing developments near watercourses in neighbouring authorities comply with the latest guidance and legislation relating to flood risk and sustainable drainage, they should result in no increase in flood risk within Southern Staffordshire.

7.3 Cumulative Impact Assessment

The cumulative impact assessment was undertaken in conjunction with the Black Country Authorities (BCAs) who neighbour the SSCs to the south of the study area, as a large number of proposed sites from both the SSCs and the BCAs lie on the border between the two areas and therefore could both influence flood risk in the other area.

Southern Staffordshire and the Black Country were split into river catchments using the ArcGIS hydrology toolset and 50m DTM and a number of datasets were used to determine which catchments are at the highest risk of flooding and where the cumulative impact of development may have the biggest effect. Historic flood risk, surface water flood risk, potential development, predicted flood risk from increased runoff upstream and sewer flooding were all considered during the assessment, and each catchment was ranked within each of these categories. The individual rankings were combined to give and overall risk ranking for each catchment and these were then allocated a Red, Amber, Yellow or Green rating corresponding to high-risk, medium-risk, lower-risk and low-risk overall. More detailed information on the methodology, assumptions and considerations of the cumulative impact assessment can be found in Appendix G.

The results of the cumulative impact assessment are summarised below and in Figure 7-1. Policy recommendations for the below catchments can be found in section 10.3.

The catchments rated as high-risk (red) are:

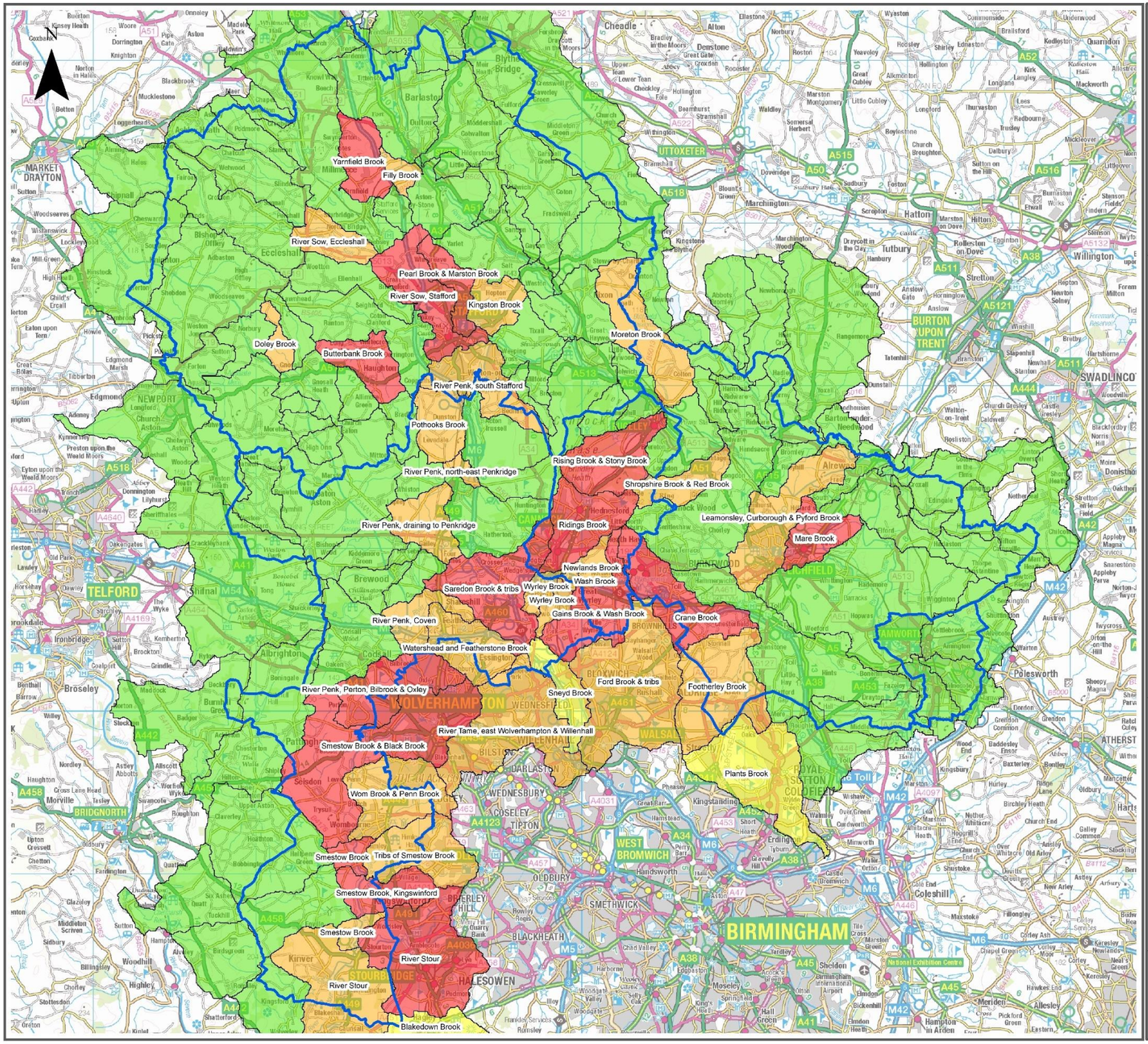
- Ridings Brook, Cannock
- Saredon Brook and tributaries, west Cannock to Standeford
- Mare Brook, east Lichfield
- Rising Brook and Stony Brook, draining towards Rugeley
- Pearl Brook and Marston Brook, Stafford
- River Sow, Stafford
- Butterbank Brook

- Yarnfield Brook, Yarnfield
- Smestow Brook, Smestow to Swindon
- River Penk, including Perton, Tettenhall, Bilbrook and Oxley
- River Stour, Stourbridge and Brierley Hill
- Smestow Brook, from Kingswinford
- Gains Brook and Wash Brook, including Norton Canes
- Crane Brook, Burntwood, draining towards Shenstone
- Smestow Brook and Black Brook, including Seisdon

The catchments rated as medium risk (amber) are:

- Doley Brook, draining towards Gnosall
- River Penk, draining towards Penkridge
- Smestow Brook, Spittle Brook to the River Stour
- Leamonsley, Curborough and Pyford Brook, Lichfield to Alrewas
- River Penk, north-east Penkridge
- Wyrley Brook, Cheslyn Hay and Great Wyrley
- Newlands Brook
- Filly Brook, draining towards Stone
- River Penk, south Stafford
- River Penk and tributary, Coven
- River Sow, Eccleshall, draining towards Little Bridgeford
- Shropshire Brook and Red Brook, draining towards Armitage and Handsacre
- Moreton Brook and tributaries, draining towards Rugeley
- Wyrley Brook, Cheslyn Hay and Churchbridge
- Kingston Brook, Stafford
- Pothooks Brook and tributaries, draining towards the River Penk, south of Stafford
- Wash Brook, Leacroft and Great Wyrley
- Tributaries of the Smestow Brook, draining towards Hinksford
- Wom Brook and Penn Brook, draining towards Wombourne
- Footherley Brook, draining towards Shenstone
- Watershead and Featherstone Brook, draining towards Coven

Figure 7-1 Final cumulative impact rating of catchments in Southern Staffordshire



7.4 Flood Alleviation Schemes

Information and location of flood alleviation schemes within Southern Staffordshire can be found on the Environment Agency's **Programme of flood and coastal erosion risk management (FCERM) schemes**.

7.4.1 Sow and Penk IDB

The IDB are currently undertaking work in a number of areas to return flood water to the river, including the Rickerscote Drain and Silkmore Drain. An ordinary watercourse in Rickerscote near Radford Bridge was cleansed to permit drainage and the return of flood water to river. Rickerscote has suffered from high groundwater levels in the past and this cleansing aims to improve and lower ground water in the area as well as permit all flows to return to river when possible.

7.4.2 South Staffordshire PLR

Property Level Resilience (PLR) measures are being implemented in multiple locations around South Staffordshire and Cannock Chase Districts with the aim to increase protection to a number of properties.

7.4.3 Perton – South Staffordshire District

This scheme is to alleviate flooding from fluvial, pluvial and sewer sources through collaboration of Staffordshire County Council, Severn Trent Water and adjacent landowners and developers.

7.4.4 Bishops Wood – South Staffordshire District

Bishops Wood has a history of flooding, caused by a complex interaction between surface water flows, ditches, streams and sewers. In the June 2016 floods, 10 properties were flooded making it the worst affected area for number of properties flooded in the County. As such, Staffordshire County Council are designing a scheme to alleviate flooding to 10-40 properties in the village planned for 2020-2021.

7.4.5 Cheslyn Hay – South Staffordshire District

As seen in Table 5-4, Cheslyn Hay has a significant number of properties at risk and with historic incidents of sewer flooding. Severn Trent is therefore upgrading sewers held by themselves and Staffordshire Highways to provide a greater capacity for surface water. Staffordshire County Council is contributing towards the scheme which aims to improve protection for 46 properties.

7.4.6 Lower Penn – South Staffordshire District

There is a potential Staffordshire County Council scheme to reduce flooding to properties at risk from overland flow from surrounding fields.

7.4.7 Hamstall Ridware – Lichfield District

There is a potential Staffordshire County Council surface water scheme to protect the village from overland flow from surrounding fields.

7.4.8 Stone – Stafford Borough

Natural flood management (NFM) measures are being implemented along the Scotch Brook and its tributaries with the aim to reduce flood risk to Stone, which is at risk of flooding from the blockage (due to sediment) of the Scotch Brook culvert through the town. This project is being conducted by Staffordshire Wildlife Trust in conjunction with the Environment Agency and aims to store sediment and water upstream to reduce sediment entering the culvert. The Staffordshire Wildlife Trust have also completed two other NFM schemes near the Scotch Brook. Slow the flow measures have been implemented on a tributary of the Scotch Brook near Cotwalton, and area for storage of flood water run-off has been created downstream.

7.4.9 Huntington – Cannock Chase District

There is a potential Staffordshire County Council surface water scheme to protect the village from overland flow from surrounding fields.

7.4.10 Rugeley – Cannock Chase District

Rugeley has a history of flooding from the Rising Brook which flows culverted through the town before entering the River Trent. Flooding occurs when the culvert is full and from overtopping upstream of Hagley playing fields causing water to back up and flow overland through the town. Additional flooding is seen on highways as surface water is unable to drain into the culvert. The Environment Agency along with Stoke-on-Trent and Staffordshire Local Enterprise Partnership, Staffordshire County Council and Cannock Chase District Council have been working on the Rugeley flood defence scheme which reduces the risk of flooding to more than 114 residential properties and 159 commercial properties. A 350m long embankment has been constructed on Hagley playing fields which has created a flood storage area which stores water from the Rising Brook during periods of heavy rainfall and gradually releases it back into the watercourse. Construction was completed in December 2017.

Staffordshire County Council also have a potential surface water scheme in Rugeley, which will involve retrofitting SuDS to reduce flood risk and provide amenity benefit.

7.4.11 Tame Valley Wetlands: "Taming the Tame"

In 2018 the Tame Valley Wetlands Partnership completed a scheme to create a backwater channel linked to the River Tame, between Birmingham and Tamworth. A 140m long, 15m wide back channel was created, which formed an island in the centre of the River Tame. The back channel provides storage of floodwater and softer banks which have enabled naturalising of the watercourse. The works have reconnected the river to the floodplain, promoting natural processes and making space for water.

7.5 Strategic solutions

The Risk Management Authorities have a vision for the future management of flood risk and drainage in Southern Staffordshire. This concerns flood risk management, alongside wider environmental and water quality enhancements. Strategic solutions may include upstream flood storage, integrated major infrastructure/FRM schemes, new defences and watercourse improvements as part of regeneration and enhancing green infrastructure, with opportunities for natural flood management and retrofitting sustainable drainage systems.

Chapter 2 sets out the strategic plans that exist for Southern Staffordshire. The list below summarises the key outcomes these are seeking to achieve and strategic solutions that can be implemented within Southern Staffordshire. This vision needs to be delivered by new development alongside retrofitting and enhancing green infrastructure and flood defence schemes in the existing developed area.

- Risk Management Authorities working in partnership to manage all sources of flooding.
- Managing flood risk to existing communities, infrastructure and the environment in a sustainable manner.
- De-culverting and restoring watercourses, including taking opportunities presented by new development to do so.
- Recognising that new development is one of the best ways to manage flood risk, by avoiding inappropriate development in flood risk areas and ensuring that new development does not increase flood risk elsewhere.
- Encouraging the take up of multi-functional Sustainable Drainage Systems and retrofitting and enhancing green infrastructure.

- Promoting the use of Natural Flood Management through a multi-agency project led by Staffordshire Wildlife Trust.
- To inform, engage and work with communities to manage flooding effectively by ensuring communities are prepared for flood events (and that the residual risk to new developments has been considered and planned for).
- Reconnecting the floodplain with the river, in particular in areas around Stafford and upstream managed by the IDB, where waterlogging is an issue along the ordinary watercourses.
- Recognising the role of strategic solutions in reducing flood risk to enable regeneration as well as the protection of existing communities, infrastructure and the environment.
- Recognising the potential for developers to contribute towards such flood risk management measures that reduce risk to their development sites, facilitate regeneration and the wider community.
- Consider the wider effects of flooding on communities in Staffordshire.
- Consideration should be given to identifying opportunities to remove existing development from floodplains (e.g. through land swapping) to maximise natural storage of flood water, reduce flooding problems and increase landscape, ecological and conservation value.

8 Guidance for developers

This chapter provides guidance on site-specific Flood Risk Assessments (FRAs). These are carried out by (or on behalf of) developers to assess flood risk to and from a site. They are submitted with Planning Applications and should demonstrate how flood risk will be managed over the development's lifetime, considering climate change and vulnerability of users.

The report provides a strategic assessment of flood risk in Southern Staffordshire. Prior to any construction or development, site-specific assessments will need to be undertaken so all forms of flood risk and any defences at a site are considered in more detail. Developers should, where required, undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood extent (including latest climate change allowances), to inform the sequential approach within the site and prove, if required, whether the Exception Test can be satisfied.

A detailed FRA may show that a site is not appropriate for development of a particular vulnerability or even at all. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not been seen as an alternative to proving these tests have been met.

8.1 Principles for new developments

Apply the Sequential and Exception Tests

Developers must provide evidence that the Sequential Test has been passed for windfall developments. If the Exception Test is needed, they must also provide evidence that all parts of the Test can be met for all developments, based on the findings of a detailed Flood Risk Assessment.

Developers should also 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 layout?
- Can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted?
- 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 statutory consultees at an early stage to understand their requirements

Developers should consult with the Environment Agency, Staffordshire County Council as LLFA, Severn Trent Water and the Sow and Penk IDB, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design.

Consider the risk from all sources of flooding and that they are using the most up to date flood risk data and guidance

The SFRA can be used by developers to scope out what further detailed work is likely to be needed to inform a site-specific Flood Risk Assessment. At a site level, Developers will need to check before commencing on a more detailed Flood Risk Assessment that they are using the latest available datasets. Developers should apply the 2019 Environment Agency climate change guidance and ensure the development has taken into account climate change adaptation measures

Ensure that the development does not increase flood risk elsewhere

Chapter 9 sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure that mitigation measures do not increase flood risk elsewhere and that floodplain compensation is provided where necessary.

Ensure the development is safe for future users

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. Developers should consider both the actual and residual risk of flooding to the site (**Chapter 6.5**).

Further flood mitigation measures may be needed for any developments in an area protected by flood defences, where the condition of those defences is 'fair' or 'poor', and where the standard of protection is not of the required standard.

Manage the surface water runoff rates of new development

On greenfield sites surface water runoff rates should not be increased and on brownfield sites surface water runoff should be reduced to the greenfield rate wherever practical. Approved development proposals will be expected to be supplemented by appropriate maintenance and management regimes for surface water drainage.

Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ecology and may provide opportunities to use the land for amenity and recreational purposes. Development that may adversely affect green infrastructure assets should not be permitted. Where possible, developers should identify and work with partners to explore all avenues for improving the wider river corridor environment.

Consider and contribute to wider flood mitigation strategy and measures in the area and apply the relevant local planning policy

Wherever possible, developments should seek to help to reduce flood risk in the wider area e.g. by contributing to a wider community scheme or strategy for strategic measures, such as defences or natural flood management or by contributing in kind by mitigating wider flood risk on a development site. More information on the contribution developers are expected to make towards achieving the wider vision for FRM and sustainable drainage in Southern Staffordshire can be found in **Chapter 7.3**. Developers must demonstrate in an FRA how they are contributing towards this vision.

8.2 Requirements for site-specific Flood Risk Assessments

8.2.1 When is an FRA required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments and change of use) in Flood Zones 2 and 3.
- Where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1).
- Where evidence of historical or recent flood events have been passed to the LPA.
- Where the site's drainage system may have an impact on an IDB's system.
- In an area of significant surface water flood risk.

8.2.2 Objectives of a site-specific FRA

Site-specific FRAs should be proportionate to the degree of flood risk and the scale, nature and location of the development. Site-specific FRAs should establish:

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

FRAs should follow the approach recommended by the NPPF (and associated guidance) and guidance provided by the Environment Agency and the SSCs. Guidance and advice for developers on the preparation of site-specific FRAs include:

- **Standing Advice on Flood Risk** (Environment Agency);
- **Flood Risk Assessment for Planning Applications** (Environment Agency);
- **Site-specific Flood Risk Assessment: CHECKLIST** (NPPF PPG, Defra);
- **SuDS and Standing Advice Information** (Staffordshire County Council);
- **Staffordshire County Council Land Drainage Consents**; and
- **IDB Consent Applications** (Sow and Penk IDB).

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 – Flood Risk Assessment: Local Planning Authorities.

8.3 Local requirements for mitigation measures

8.3.1 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 uses 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. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of 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.

8.3.2 Modification of ground levels

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

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 as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels

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

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). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C62430.

Where proposed development results in a change in building footprint, the developer should ensure that it does not impact upon the ability of the floodplain to store or convey water and seek opportunities to provide floodplain betterment.

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.

8.3.3 Raised floor levels

If raised floor levels are proposed, these should be agreed with the SSCs and the Environment Agency. The minimum Finished Floor Level (FFL) may change depending on the vulnerability and flood risk to the development.

The Environment Agency advises that minimum finished floor levels should be set 600mm above the 100-year plus climate change peak flood level, where the new climate change allowances have been used (see **Chapter 4** for the climate change allowances). An additional allowance may be required because of risks relating to blockages to the channel, culvert or bridge and should be considered as part of an FRA.

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.

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 2 will be required to pass the Exception Test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

8.3.4 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.

Where development is located behind, or in an area benefitting from defences, the residual risk of flooding must be considered, as set out in **Chapter 6**.

8.3.5 Developer contributions

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute 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). Where possible, opportunities should be sought to work with other bodies and landowners to encourage and promote implementation of natural flood management measures which will contribute towards delivering a reduction in local and catchment-wide flood risk and the impacts of climate change as well as achieve other wider environmental benefits. Further information can be found about where strategic flood risk solutions are being planned in **Chapter 7.5**.

8.4 Resistance and resilience measures

The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations.

Having applied planning policy, there will be instances where developments, such as those that are water compatible and essential infrastructure are permitted in high flood risk areas. The above measures should be considered before resistance and resilience measures are relied on. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumping to evacuate water from a property as quickly as possible. 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. The following measures are available:

- *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.
- *Community resistance 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.
- *Flood resilience measures:* These measures aim to ensure that no permanent damage is caused, the structural integrity of the building is not compromised and the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding can include electrical circuitry installed at a higher level and water-resistant materials for floors, walls and fixtures.

8.5 Reducing flood risk from other sources

8.5.1 Groundwater

Groundwater flooding has a very different flood mechanism to any other and so many conventional flood 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 a site. Developers should provide evidence and ensure that this will not be a significant risk.

8.5.2 Ordinary Watercourses managed by the IDB

Every planning application falling within 9m from the top of bank of any watercourse maintained by the Sow and Penk IDB will require a **Planning Consents Application**. The IDB are also undertaking hydraulic modelling of Ordinary Watercourses within their remit, with the aim to produce an improved surface water flood map. Developers should consult the IDB for the latest updates on this modelling.

8.5.3 Surface water and sewer flooding

Developers should discuss public sewerage capacity with the water utility company at the earliest possible stage. 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 floodproofing 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 of flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This should be demonstrated with suitable modelling techniques.

8.5.4 Culverted watercourses

Where a watercourse passes through a site (open or culverted), the developer should demonstrate that they have considered it when developing their proposals for development. They should do this by:

- Undertaking ground-truthing to locate in detail the presence of any culverted watercourse e.g. through historic mapping and utility searches, site visits, CCTV and ground investigation work should there be any suspicion of a culvert running under the site.
- Undertaking a detailed CCTV assessment of the extent and condition of any culverts present on site.
- Undertaking flood modelling to assess the capacity of any culverts on site.

Developments should naturalise urban watercourses and open up underground culverts, to provide biodiversity net gain as well as amenity improvements. Culverts are only acceptable for essential infrastructure crossings, e.g. a short length for site access crossings, where a culvert passes under a gas main and the length of culvert should be limited to that which is essential.

In exceptional circumstances where it is not possible to open up a culvert, e.g. due to the significant depth of the feature, the structural loading of surrounding properties should be taken into account, with an appropriate easement of at least 8m on either side of the culvert. Access should be provided for future maintenance of the culvert and the condition of the culvert should be improved so that it is sufficiently safe against failure for the lifetime of the development. Trash screens should be provided on culvert headwalls that are designed in line with best practice and appropriate maintenance secured to ensure the structure is kept clear for the lifetime of the development.

Where a site is shown on the SFRA mapping to be potentially affected by flooding from a culvert blockage either on or off site, the developer should:

- Undertake more detailed modelling of the culverted watercourse network based on detailed survey of the culverts, watercourse structures and site topographical survey to ascertain in more detail the extent and flood hazards from potential blockage.
- If the condition of the culvert is considered to be at least 'Fair': Design the development such that properties will not be flooded to account for a culvert blockage scenario during a 1 in 100-year flood event, where the culvert would be at least 50% blocked. Ensure that safe access and egress from the site is available in such a scenario.
- If the condition of the culvert is considered to be 'Poor' or 'Very Poor' or is unknown: Design the development such that properties will not be flooded to account for a culvert blockage scenario during a 1 in 100 year flood event,

where the culvert would be at least 90% blocked. Ensure that safe access and egress from the site is available in such a scenario.

- In all instances: Prepare a Flood Warning and Evacuation Plan to account for a culvert blockage scenario during a 1 in 100-year flood event, where the culvert would be at least 90% blocked.
- In all instances: Safe internal refuge should be available above the flood depths that might be expected should the culvert block by at least 90% in an extreme 1 in 1000-year flood event.
- Liaise with the Council about any potential to contribute towards on/off site works to help to alleviate known flooding issues related to the culverts. If such works can be taken forward, the effect of such works should be modelled as above and planned for in the site design.

It should be noted that opening up watercourses significantly reduces the chance of blockage and developers should seek to open up watercourses off site working with third parties where this can be proven to be feasible.

8.5.5 Canals

Developers should consult with the **Canal and Rivers Trust** who have produced a **checklist for developments** close to canals.

8.5.6 Reservoirs

The risk of reservoir flooding is extremely low. However, there remains a residual risk to development from reservoirs which developers should consider during the planning stage:

- Developers should contact the reservoir owner for information on:
  - the Reservoir Risk Designation;
  - reservoir characteristics: type, dam height at outlet, area/volume, overflow location;
  - operation: discharge rates/maximum discharge;
  - discharge during emergency drawdown; and
  - inspection/maintenance regime.
- The EA and NRW online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). Consideration should be given to the extent, depths and velocities shown in these online maps.

Developers should consult the **Staffordshire Resilience Forum** about emergency plans for reservoir breach.

Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond.
- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site-specific emergency plans if necessary and ensure the future users of the development are aware of these plans.

8.6 Flood warning and emergency planning

Emergency planning covers three phases: before, during and after a flood. 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. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and by considering the vulnerability of new developments to flooding.

The NPPF requires site level Flood Risk Assessments to demonstrate that

"d) any residual risk can be safely managed; and

e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan."

Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes;
- Camping and caravan sites;
- Sites with transient occupants e.g. hostels and hotels;
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences;
- Situations 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. at risk of a breach).

Emergency Plans will need to consider:

- The characteristics of the flooding e.g. onset, depth, velocity, hazard, flood borne debris;
- The vulnerability of site occupants;
- Structural safety;
- The impact of the flooding on essential services e.g. electricity, drinking water;
- Flood warning systems and how users will be encouraged to sign up for them;
- Safe access and egress for users and emergency services;
- How to manage the consequences of events that are un-foreseen or for which no warnings can be provided e.g. managing the residual risk of a breach;
- A safe place of refuge where safe access and egress and advance warning may not be possible, having discussed and agreed this first with emergency planners. Proposed new development that places an additional burden on the existing response capacity of the Councils will not normally be appropriate.

The **Staffordshire LRF** provides Emergency Planning relevant information that is both general and flood specific. This includes practical advice before, during and after flooding has occurred, including preparation, understanding warnings, actions to limit exposure to risk and recovery. Further information is available from:

- The **National Planning Policy Guidance**
- The **Environment Agency and DEFRA's** standing advice for FRAs
- Staffordshire County Council's **"Preparing for emergencies"**
- **Tamworth Prepared Campaign**
- Environment Agency's **"How to plan ahead for flooding"**
- Sign up for **Flood Warnings** with the Environment Agency
- **National Flood Forum**
- GOV.UK - Make a Flood Plan guidance and templates

9 Surface water management and SuDS

This chapter provides guidance and advice on managing surface water runoff and flooding.

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

In April 2015, Staffordshire County Council was made a statutory planning consultee on the management of surface water. They provide technical advice on surface water drainage strategies and designs put forward for major development proposals.

When considering planning applications, Staffordshire County Council will provide advice to the Planning Department on the management of surface water. As LPAs, the SSCs should satisfy themselves that the development's 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 lifetime of the development.

It is essential that developers consider sustainable drainage 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.

9.2 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are designed to maximise the opportunities and benefits that can be secured from surface water management practices.

SuDS provide a means of dealing with the quantity and quality of surface water and can also provide amenity and biodiversity benefits. Given the flexible nature of SuDS, they can be used in most situations within new developments as well as being retrofitted into existing developments. SuDS can also be designed to fit into most spaces. For example, permeable paving could be used in parking spaces or rainwater gardens as part of traffic calming measures.

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place. Likewise, minor developments should also ensure sustainable systems for runoff management are provided. 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's hydrological processes and current drainage arrangements is essential.

The runoff destination should always be the first consideration when considering design criteria for SuDS including the following possible destinations in order of preference:

- To ground;
- To surface water body;
- To surface water sewer;
- To combined sewer.

Effects on water quality should also be investigated when considering runoff destination in terms of the potential hazards arising from development and the sensitivity of the runoff destination. Developers should also establish that proposed outfalls are hydraulically capable of accepting the runoff from SuDS through consultation with the LLFA, EA, and STW.

The non-statutory technical standards for sustainable drainage systems (March 2015) set out appropriate design criteria based on the following:

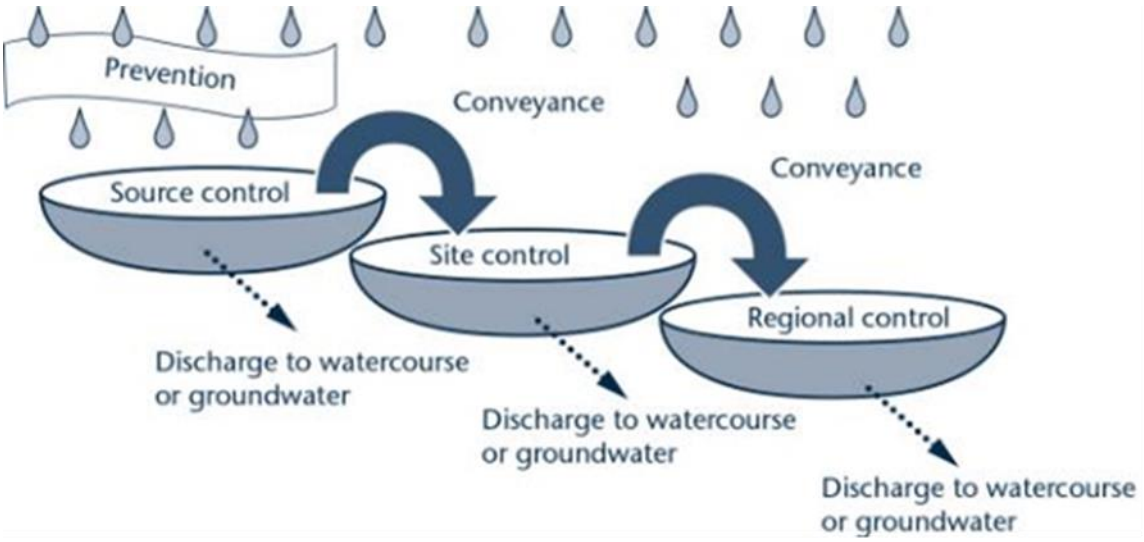
- Flood risk outside the development;
- Peak flow control;
- Volume control;

- Flood risk within the development;
- Structural integrity;
- Designing for maintenance considerations;
- Construction.

In addition, the Local Planning Authority may set local requirements for planning permission that include more rigorous obligations than these non-statutory technical standards. More stringent requirements should be considered where current Greenfield sites lie upstream of high-risk areas. This could include improvements on Greenfield runoff rates. CIRIA has also produced a number of guidance documents relating to SuDS that should be consulted by the LPA and developers.

Many different SuDS techniques can be implemented. As a result, there is no one standard correct drainage solution for a site. In most cases, a combination of techniques, using the Management Train principle (see Figure 9-1), will be required, where source control is the primary aim.

Figure 9-1 SuDS Management Train Principles



The effectiveness of a flow management scheme within a single site is heavily limited by land use and site characteristics including (but not limited to) topography; geology and soil (permeability); and available area. Potential ground contamination associated with urban and former industrial sites should be investigated with concern being placed on the depth of the local water table and potential contamination risks that will affect water quality. The design, construction and ongoing maintenance regime of any SuDS scheme must be carefully defined as part of a site-specific FRA. A clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential for successful SuDS implementation.

Maintenance options must clearly identify who will be responsible for SuDS maintenance and funding for maintenance should be fair for householders and premises occupiers; and, set out a minimum standard to which the sustainable drainage systems must be maintained.

9.3 Sources of SuDS guidance

9.3.1 C753 CIRIA SuDS Manual (2015)

The **C753 CIRIA SuDS Manual** (2015) provides guidance on planning, design, construction and maintenance of SuDS. The manual is divided into five sections ranging from a high-level overview of SuDS, progressing to more detailed guidance with progression through the document.

9.3.2 Non-Statutory Technical Guidance, Defra (March 2015)

Non-statutory technical guidance provides non-statutory standards on the design and performance of SuDS. It outlines peak flow control, volume control, structural integrity, flood risk management and maintenance and construction considerations.

9.3.3 Staffordshire SuDS Handbook

Staffordshire County Council have worked in partnership with seven other West Midlands LLFAs to produce the **SuDS Handbook**. The front end of the document is identical across LLFAs and each LLFA has a specific appendix in their version setting out local design considerations, constraints, case studies and arrangements for SuDS maintenance.

The SuDS Handbook presents design guidance alongside Local SuDS Standards that developers should meet when proposing SuDS systems on new developments. It also contains a proforma that a developer should submit with a Flood Risk Assessment/ Surface Water Drainage Strategy. The Local Standards are that:

Design Principles

Local Standard A – Phased Development and Drainage Strategies

For phased developments, the LLFA will expect planning applications to be accompanied by a Drainage Strategy which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.

Local Standard B – Pollution Prevention and Control

The LLFA will expect the SuDS to demonstrate how pollutants are prevented or controlled as part of the SuDS scheme. This should include consideration of the sensitivity of receiving waterbodies and particular attention should be given to the first 5mm of rainfall ('first flush' that mobilises the most pollutants).

Local Standard C – Conformity with the SuDS Management Train Principles

The LLFA will expect the SuDS design to demonstrate how the principles of the SuDS Management Train have been taken into account.

Local Standard D – Multiple Benefits

The LLFA will expect the SuDS design to demonstrate, where appropriate, how environmental site constraints have been considered and how the features design will provide multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.

Volume Control

Local Standard E – Climate Change

The LLFA will expect SuDS design to include an allowance for a 30%* increase in rainfall for a 1% Annual Exceedance Probability rainfall event in order to accommodate climate change. (*note that guidance may be subject to change and therefore the most up to date information should be referenced).

Local Standard F – Urban Creep

The LLFA will expect the SuDS design to include an allowance for an increase in impermeable area to accommodate urban creep.

Local Standard G – Emergency Overflows

The LLFA will expect an emergency overflow to be provided for piped and storage features above the predicted water level in a 1% Annual Exceedance Probability rainfall event, with an allowance for climate change.

Local Standard H – Freeboard Levels

The LLFA will expect all surface water storage ponds to provide a 300mm freeboard above the predicted water level arising from a 1% Annual Exceedance Probability rainfall event inclusive of an allowance for climate change. Care must be taken to ensure that excavations do not take place below the ground water level.

Flood Risk Within the Development

Local Standard I – Exceedance Flows

The LLFA will expect that exceedance flows, originating from both within and outside of the development site, must be directed through areas where the risks to both people and property are minimised.

When considering exceedance routes, particular attention should be paid to:

i. The position of walls, bunds and other obstructions that may direct water but must not cause ponding.

ii. The location and form of buildings (e.g. terraces and linked detached properties) that must not impede flows or cause ponding.

Submitted drawings and calculations must identify sources of water entering a site pre-development, how flows will be routed through a site, where flows leave the site pre-development and where they leave the site post development.

Local Standard J – Watercourse Floodplains

The LLFA will expect the floodplains of ordinary watercourses to be mapped to an appropriate level of detail considering the nature of the application (i.e. detailed flood modelling should be undertaken to support full planning applications). The layout of the development will then take a sequential approach, siting the least vulnerable parts of that development in the highest flood risk areas.

Local Standard K – Retention of Natural Drainage Features

The LLFA will expect natural drainage features on a site should be maintained and enhanced. Culverting of open watercourses will not normally be permitted except where essential to allow highways and/or other infrastructure to cross. In such cases culverts should be designed in accordance with CIRIA's Culvert design and operation guide, (C689).

Where a culverted watercourse crosses a development site, it should be reverted back to open channel. In such a case the natural conditions deemed to have existed prior to the culverting taking place should be re-instated.

Local Standard L – Impact of Downstream Water Levels

If high water levels within a receiving watercourse into which a SuDS scheme discharges are anticipated, the LLFA will expect that they will not adversely affect the function of that SuDS system.

Designing for Maintenance Considerations

Local Standard M – Maintenance Requirements

The LLFA will expect SuDS to be designed so that they are easy to maintain. Proper use of the SuDS management train, including surface features, is one way to achieve this.

The developer must set out who will maintain the system, how the maintenance will be funded and provide a maintenance and operation manual.

Local Standard N – Minimising the Risk of Blockages

The LLFA will expect the SuDS design to minimise the risk of blockage as far as is reasonably possible e.g. by using suitable pipe sizes and making underground assets as visible and accessible as possible.

Local Standard O – Use of Pumped Systems

If it can be demonstrated that a partial or completely pumped drainage system is the only viable option, the LLFA will expect the residual risk of flooding due to the failure of the pumps to be assessed. The design flood level must be determined under the following conditions:

- If the pumps were to fail;
- If the attenuation storage was full; and
- If a design storm occurred.

The finished floor levels of the affected properties should be raised above this level and all flooding should be safely stored onsite.

An emergency overflow must be provided for piped and storage features above the predicted water level arising from a 1% Annual Exceedance Probability rainfall event inclusive of allowances for climate change and urban creep.

9.4 Other surface water considerations

9.4.1 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 of the underlying bedrock. The map shows the vulnerability of groundwater at a location based on the hydrological, hydro-ecological and soil propertied within a one-kilometre grid square.

The groundwater vulnerability maps should be considered when designing SuDS. Depending on the height of the water table at the location of the proposed development site, restrictions may be placed on the types of SuDS appropriate to certain areas. Groundwater vulnerability maps can be found under the landscape section of **Defra's interactive mapping.**

9.4.2 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones near groundwater abstraction points. These protect areas of groundwater used for drinking water. The Groundwater SPZ requires attenuated storage of runoff to prevent infiltration and contamination. Groundwater Source Protection Zones can be viewed on the **Defra's website** under the non-statutory land-based designations section.

Depending on the nature of the proposed development and the location of the development site with regards to SPZs, restrictions may be in place on the types of SuDS used within appropriate areas. For example, infiltration SuDS are generally accepted within Zone 3, whereas in Zones 1 (Inner Protection Zone) or 2 (Outer Protection Zone), the Environment Agency will need to be consulted and infiltration SuDS may only be accepted if the correct treatments and permits are put in place. Any restrictions imposed on the discharge of the site generated runoff by the Environment Agency will be determined on a site by site basis using risk-based approach.

Large areas of Southern Staffordshire are within Zone 3, including Lichfield, Burntwood and Burntwood and the surrounding areas, and areas covering the south of South Staffordshire District, south-west of Lichfield District, north of Cannock District and to the north and west of Stafford Borough. There are also many smaller areas covered by Zones 1 and 2 within Zone 3, notably along the Smestow Brook and River Stour,

west of Rugeley, Cannock Chase AONB and around Lichfield Trent Valley station. Tamworth is not covered by any GSPZs.

9.4.3 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 potentially influence the choice of SuDS and should be assessed as part of the design process. Southern Staffordshire is entirely within an NVZ. The NVZ coverage can be viewed on the **Environment Agency's online maps**.

10 Summary and Recommendations

This Level 1 SFRA delivers a strategic assessment of risk from all sources of flooding in Southern Staffordshire. It also provides an overview of policy and provides guidance for planners and developers.

10.1.1 Sources of flood risk

Parts of Southern Staffordshire are at risk from the following sources; fluvial, surface water, groundwater, sewers, reservoir inundation and canal overtopping/breaches. This study has shown that the most significant sources of flood risk in Southern Staffordshire are fluvial and surface water.

- *Fluvial flooding*: The primary fluvial flood risk is along the River Trent, River Sow, River Penk, River Tame, River Anker, the Smestow Brook and the tributaries of these watercourses. These present fluvial flood risk to rural communities as well as some of the main urban centres, including, but not limited to Stafford, Tamworth, Rugeley, Stone and Penkridge. More recent significant flooding events across Southern Staffordshire occurred in July 2007, Summer 2012, Winter 2013/2014 and June 2016.
- *Surface water:* Surface water flooding is most likely caused by intense rainfall. There are many areas at high risk of surface water flooding in Southern Staffordshire. Staffordshire County Council's Local Flood Risk Management Strategy highlights that Cannock, Tamworth, Lichfield, Rugeley, Stafford, Burntwood, Perton, Armitage, Gnosall, Whittington and Brewood are in the Top 10 urban and rural areas at risk of surface water flooding in the County.
- *Sewer*: The sewers in Southern Staffordshire are managed by Severn Trent Water. Severn Trent Water provided their Hydraulic Flood Risk Register which denotes 602 properties at risk of sewer flooding in Southern Staffordshire, with the areas of highest risk/most historical incidents of sewer flooding in Cheslyn Hay, Great Wyrley and Stafford.
- *Groundwater:* The Areas Susceptible to Groundwater Flooding map shows that in general, the majority of Southern Staffordshire has a low risk of groundwater flooding. Parts of the study area including along the River Trent, the River Tame, Tamworth and Stafford have a higher risk of groundwater flooding. The Local Flood Risk Management Strategy states that historically, information on groundwater flooding has been sparse and there is currently no evidence to suggest that this is a major problem within Southern Staffordshire. Based on this, it is anticipated that groundwater flooding issues are likely to be localised in their nature, affecting only a small number of properties.
- *Canals*: There are eight canals in Southern Staffordshire; the Shropshire Union Canal, Birmingham and Fazeley Canal, Trent and Mersey Canal, Staffordshire and Worcestershire Canal, Coventry Canal, Wyrley and Essington Canal, Cannock Extension Canal and Stourbridge Canal. These have the potential to interact with other watercourses and become flow paths during flood events or in a breach scenario. There have been incidences of breach and overtopping on the Trent and Mersey, Shropshire Union, Staffordshire and Worcestershire and Birmingham and Fazeley Canals, affecting areas in Stafford Borough, Southern Staffordshire District and Lichfield District. The most recent incident of overtopping was on the Trent and Mersey Canal in Weston (Stafford Borough) in January 2013.
- *Reservoirs:* There is a potential risk of flooding from reservoirs both within Southern Staffordshire and those outside. There is one record of flooding from reservoirs in the study area, from Chasewater in 1799 (after which the reservoir embankment was rebuilt, and further major works have been undertaken since to reduce the risk). The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from the

reservoirs is relatively low. However, there is a residual risk of a reservoir breach and this should be considered in any site-specific Flood Risk Assessments (where relevant).

10.2 Recommendations for the Councils

Reduction of flood risk through site allocations and appropriate site design

- To locate new development in areas of lowest risk, in line with the Sequential Test, by steering sites to Flood Zone 1. If a Sequential Test is undertaken and a site at flood risk is identified as the only appropriate site for the development, the Exception Test shall be undertaken.
- After application of Exception Test, a sequential approach to site design will be used to reduce risk. Any re-development within areas of flood risk which provide other wider sustainability benefits will provide flood risk betterment and made resilient to flooding.
- Identification of long-term opportunities to remove development from the floodplain and to make space for water.
- Ordinary watercourses not currently afforded by flood maps should be modelled to an appropriate level of detail to enable a sequential approach to the layout of the development.
- Ensure development is 'safe'. Dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then an assessment should be made to detail the flood duration, depth, velocity and flood hazard rating in the 1 in 100-year plus climate change flood event, in line with FD2320.
- Raise residential and commercial finished floor levels 600mm above the 1 in 100 year plus climate change flood level. Protect and promote areas for future flood alleviation schemes.
- Safeguard functional floodplain from future development.
- Identify opportunities for brownfield sites in functional floodplain to reduce risk and provide flood risk betterment.
- Identify opportunities to help fund future flood risk management through developer contributions to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

Promote SuDS to mimic the natural drainage routes to improve water quality

- SuDS design should demonstrate how constraints have been considered and how the design provides multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.
- Planning applications for phased developments should be accompanied by a Drainage Strategy which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase.
- Use the SuDS management train to prevent and control pollutants to prevent the 'first flush' polluting the receiving waterbody.
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

Reduce surface water runoff from new developments and agricultural land

- SuDS should be considered and implemented as part of all new development, in line with the **Staffordshire SuDS handbook.**
- Space should be provided for the inclusion of SuDS on all allocated sites and outline proposals.
- Promote biodiversity, habitat improvements and **Countryside Stewardship schemes** to help prevent soil loss and to reduce runoff from agricultural land.

Enhance and restore river corridors and habitats

- Assess condition of existing assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures/flows for the lifetime of the development.
- Natural drainage features should be maintained and enhanced.
- Identify opportunities for river restoration/enhancement to make space for water.
- A presumption against culverting of open watercourses except where essential to allow highways and/or other infrastructure to cross, in line with CIRIA's Culvert design and operation guide, (C689) and the Local FRM Strategy and to restrict development over culverts.
- There should be no built development within 8m from the top of a watercourse or Main River for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.
- Building over culverts should be avoided.
- Opportunities should be sought to open up culverted watercourses to reduce the associated flood risk and danger of collapse whilst taking advantage of opportunities to enhance biodiversity and green infrastructure.
- Opportunities should be sought to work with other bodies and landowners to encourage and promote implementation of natural flood management measures which will contribute towards delivering a reduction in local and catchment wide flood risk and the impacts of climate change, as well as achieve other, wider environmental benefits.

Mitigate against risk, improved emergency planning and flood awareness

- Work with emergency planning colleagues and stakeholders to identify areas at highest risk and locate most vulnerable receptors.
- Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
- For a partial or completely pumped drainage system, an assessment should be undertaken to assess the risk of flooding due to any failure of the pumps to be assessed. The design flood level should be determined if the pumps were to fail; if the attenuation storage was full, and if a design storm occurred.
- An emergency overflow should be provided for piped and storage features above the predicted water level arising from a 100-year rainfall event, inclusive of climate change and urban creep.
- Consider and incorporate of flood resilience measures up to the 1 in 1000-year event.
- Ensure robust emergency (evacuation) plans are produced and implemented for major developments.

- Increase awareness and promote sign-up to the Environment Agency Flood Warnings Direct (FWD) within Southern Staffordshire and promote the **Tamworth Flood Prepared Campaign**.

10.3 Recommendations from the cumulative impact analysis

Recommendations applicable across Southern Staffordshire

Developers should:

- Incorporate SuDS and provide details of adoption, ongoing maintenance and management on all development sites (of any size). SuDS must be designed in line with the Staffordshire Local Standards for SuDS. Preference will be given to systems that contribute to the conservation and enhancement of biodiversity and green infrastructure in the wider area where practicable. The Staffordshire SuDS Handbook provides guidance on SuDS design and selection
- Provide Surface Water Drainage Strategies for all major developments, regardless of their size and the Flood Zone and catchment they are in to meet the requirements of the LLFA. These should take into account all sources of flooding to ensure that future development is resilient to flood risk and does not increase flood risk elsewhere.

For high and medium risk (red and amber) catchments

- All applicable developments (see amber box for those developments that are applicable) in these catchments should seek to provide wider betterment by demonstrating in site-specific Flood Risk Assessments and Surface Water Drainage Strategies what measures can be put in place to contribute to a reduction in flood risk downstream. This may either be by provision of additional storage on site e.g. through oversized SuDS, natural flood management techniques, green infrastructure and green-blue corridors and/or by providing a Partnership Funding contribution towards a wider community scheme (both within the Southern Staffordshire catchments and in shared catchments with the Black Country Authorities). Consultation on the site-specific requirements should be undertaken with the LPA at the earliest opportunity.
- In these catchments, it is recommended that the LPAs work closely with the Environment Agency and LLFA to identify areas of land that should be safeguarded for any future flood alleviation improvements etc. flood storage areas, set back/raising of flood defences to accommodate climate change.
- In rural areas and where catchments drain towards urban areas, it is recommended that the LPAs to work closely with the Environment Agency and LLFA to identify areas of land that should be safeguarded for the future use of natural flood management features.
- In addition, the Environment Agency, in consultation with the LPAs and the LLFAs, should consider whether to formally designate urban red and amber catchments as Critical Drainage Areas. This would mean that a detailed Flood Risk Assessment would be required for all developments that are proposed, regardless of their size.

For catchments with a high number of sewer flooding incidences – Ridings Brook, Wyrley Brook (Cheslyn Hay and Great Wyrley), River Penk (south Stafford), River Penk (Perton and Bilbrook), River Stour (Stourbridge and Brierley Hill), Smestow Brook (Kingswinford), Smestow Brook and Black Brook, and Wom Brook and Penn Brook

In these catchments the following recommendations should be considered:

- Developers should ensure that there is no increase in surface water flows and volumes for developments within these catchments for greenfield sites.
- Developers should seek to reduce surface water flows and volumes for developments within these catchments for brownfield sites.
- Developers should contact Severn Trent Water to identify any opportunities to contribute in kind (e.g. by the use of land for flood storage) and/or financially towards schemes to reduce flood risk in the wider area. They should contact the LPA in the first instance to ascertain if they hold information on the latest schemes Severn Trent Water are progressing.

All new developments in these catchments that meet the following criteria should be accompanied by a Flood Risk Assessment and Surface water Drainage Strategy that sets out how the development will provide a betterment in flood risk terms i.e. help to reduce flood risk both on and off site. More than one of these criteria may apply:

- Where the site is within Flood Zones 2 or 3
- Where the site is greater than 1 hectare and in Flood Zone 1
- Where the site has 10 or more houses or is greater than 0.5 hectares and residential i.e. a major residential development
- Where the site has at least 0.1 hectares of commercial development i.e. a major commercial development
- Where the site is a minerals or waste development
- Where the site is within 5m of an Ordinary Watercourse*
- Where the site is within 20m of a known flooding hotspot*
- Where the site is within the 1 in 30-year or 1 in 100-year flood extent based on the Risk of Flooding from Surface Water Map*

**Developers should refer to the Staffordshire County Council LLFA consultation criteria available from:*
https://www.staffordshire.gov.uk/environment/Flood-Risk-Management/Information-for-planners-and-developers.aspx

10.4 Recommendations for further work

10.4.1 Level 2 SFRA

To further inform the site allocations and development of local planning policies, a Level 2 SFRA could be used to:

- Apply the Exception Test should this be required in high flood risk areas;
- Review the possibilities for surface water mitigation measures on sites at high risk of surface water flooding;
- Consider the actual and residual flood risk in greater detail on a site-specific basis;
- Explore flood hazard in greater detail should sites be allocated in high flood risk areas and the Exception Test required;
- Explore in greater detail the impact of climate change in relation to the Flood Zones; and
- Undertake more detailed drainage strategy work as part of a Level 2 SFRA for high and medium flood risk catchments and rapid response catchments, as recommended in the cumulative impact assessment for the Level 1 SFRA.

This page is intentionally left blank

Appendices

A Interactive Flood Risk Mapping

The SFRA appendices are published separately to the main SFRA report.

A note on "indicative" mapping

For Flood Zone 3b and the climate change outlines, indicative outlines had to be used where detailed modelling was not present (Indicative Flood Zone 3b and Indicative Climate Change). Where detailed models were not present, the EA's Flood Zones are derived from 2D generalised modelling. Where Flood Zone 3b and the climate change outlines join with their respective indicative outlines, there can be abrupt changes in the outlines, as the detailed modelling is preferred; however, where there are large overland flow routes, detailed 2D generalised modelling has the tendency to spread to very wide extents. These abrupt changes can also be seen in the EA's Flood Map for Planning as well as between our modelled outlines and indicative outlines.

There are three climate change extents (central, higher central and upper end) with upper end being the largest and central being the smallest. This therefore makes it difficult to produce an indicative climate change outline, as matching the indicative outline to the central climate change outline may give an area where both indicative climate change and upper end climate change outlines are present, but matching the indicative outline to the upper end climate change outline may produce a gap between the central climate change outline and the indicative outline. In these cases, it was deemed more accurate and conservative to have climate change outlines overlapping with the indicative climate change outlines, where this is the case, the climate change outlines should be taken to be more accurate than the indicative outline.

B Data sources used in the SFRA

The SFRA appendices are published separately to the main SFRA report.

C Flood Alert and Flood Warnings

The SFRA appendices are published separately to the main SFRA report.

D Summary of flood risk

D.1 South Staffordshire District

D.2 Cannock Chase District

D.3 Lichfield District

D.4 Stafford Borough

D.5 Tamworth Borough

The SFRA appendices are published separately to the main SFRA report.

E Models used in the SFRA

The SFRA appendices are published separately to the main SFRA report.

F Flood management assets

The SFRA appendices are published separately to the main SFRA report.

G Cumulative impact assessment methodology

The SFRA appendices are published separately to the main SFRA report.

Offices at

Coleshill
Doncaster
Dublin
Edinburgh
Exeter
Glasgow
Haywards Heath
Isle of Man
Limerick
Newcastle upon Tyne
Newport
Peterborough
Saltaire
Skipton
Tadcaster
Thirsk
Wallingford
Warrington

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

+44(0)1756 799919
info@jbaconsulting.com
www.jbaconsulting.com
Follow us:

Jeremy Benn Associates Limited

Registered in England 3246693

JBA Group Ltd is certified to:
ISO 9001:2015
ISO 14001:2015
OHSAS 18001:2007