# Shropshire Council Level 2 Strategic Flood Risk Assessment

## Final Report

**July 2020**

**www.jbaconsulting.com**

**Shropshire Council**

## JBA Project Manager

Joanne Chillingworth
The Library
St Philip's Courtyard
Church End
Coleshill
B46 3AD

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## Contract

This report describes work commissioned by Shropshire Council, by an email dated 03 February 2020. Joanne Chillingworth, James Harvey and Copper Lewis of JBA Consulting carried out this work.

| | | |
|---|---|---|
| Prepared by | ..... | Copper Lewis BSc<br>Technical Assistant |
| | | James Harvey BSc |
| | ..... | Technical Assistant |
| | ..... | Joanne Chillingworth BSc MSc MCIWEM C.WEM<br>Principal Analyst |
| Reviewed by | ..... | Hannah Coogan BSc MCIWEM C.WEM<br>Technical Director |

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## Acknowledgements

We would like to acknowledge the assistance of:

- Shropshire Council
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# Executive summary

## Introduction and context

This Level 2 Strategic Flood Risk Assessment (SFRA) document undertakes a Level 2 assessment of site options identified by Shropshire Council for the Local Plan. It builds upon the Shropshire Level 1 SFRA (2018-19).

It involves the assessment of new proposed development sites of which there are 19 being assessed in this Level 2 assessment. In addition, since the previous SFRA was published, there have been updates to national and local planning policy, including the release of updated SFRA guidance in August 2019. This 2020 Level 2 SFRA has updated information on flood data, flood risk policy and recommendations for the cumulative impact of development.

## SFRA objectives

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

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

## Level 2 SFRA outputs

The Level 2 assessment includes detailed assessments of the proposed site options. These include:

- An assessment of all sources of flooding including fluvial flooding, surface water flooding, groundwater flooding, mapping of the functional floodplain and the potential increase in fluvial flood risk due to climate change.
- Reporting on current conditions of flood defence infrastructure, where applicable.
- An assessment of existing flood warning and emergency planning procedures, including an assessment of safe access and egress during an extreme event.
- Advice and recommendations on the likely applicability of sustainable drainage systems for managing surface water runoff.
- Advice on whether the sites are likely to pass the second part of the Exception Test with regards to flood risk and on the requirements for a site-specific FRA.

## Summary of Level 2 SFRA

Shropshire Council provided 98 sites for assessment. These were chosen through a combination of a site's potential for allocation and its flood risk as determined through the site assessment process. These sites were screened against flood risk datasets to assess how many were to be carried forward to a Level 2 SFRA assessment. In total, 19 were carried forward to a Level 2 assessment, with 21 sites flagged for lower risk; general recommendations are made in this report. Detailed site summary tables and GeoPDF mapping have been produced, provided in Appendix A.

The summary tables set out the flood risk to each site, including maps of extent, depth and velocity of flooding as well as hazard mapping for the 100-

year defended event and climate change extents where modelled outputs were available (e.g. River Severn). Where there were no hydraulic models present, Flood Zone 2 was used as indicative extent for fluvial climate change and the 1,000-year surface water extent as an indication of surface water climate change. The surface water mapping depth and velocity data was also used as an indication of flood risk for small watercourses. Each table sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. A broadscale assessment of suitable SuDS options has been provided, giving an indication where there may be constraints to certain types of SuDS techniques.

To accompany each site summary table, there is an Interactive GeoPDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow easy navigation of the data.

The following points summarise the Level 2 assessment:

- The majority of sites with a detailed Level 2 summary table are at fluvial flood risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site, such as SHR177 and IRN001, which will require more detailed investigations on sequential site layouts, SuDS possibilities, safe access and egress etc, as part of a site specific Flood Risk Assessment at a later stage. Whilst for sites such as these there are additional challenges to consider for developing the site safely (for example steering development and access away from highest risk areas), all sites should be able to pass the Exception Test if the advice provided in the site summary tables is followed.
- The majority of sites at fluvial risk are also at risk from surface water flooding, with more areas of ponding in the higher return period events. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. Some sites not at fluvial risk were subject to a Level 2 assessment where surface water risk was deemed to be significant from professional judgement (surface water should also be considered when assessing safe access and egress to and from the site). PON008 has the highest surface water flood risk out of all sites assessed.
- Fluvial climate change mapping indicates that flood extents will increase. As a result, the depths, velocities and hazard of flooding may also increase. The significance of the increase tends to depend on the topography of site and the percentage allowance used; extents would be larger than Flood Zone 3, but maximum extents are likely to be similar to Flood Zone 2. The Council and the Environment Agency require the 100-year plus 35% and 100-year plus 70% climate change fluvial scenarios to be considered in future developments. The 1,000-year surface water flood extent can also be used as an indication of climate change to surface water risk. Site-specific FRAs should confirm the impact of climate change using latest guidance.
- Blockage locations were determined by visual inspection of the OS mapping and ground topography in the vicinity of the site, to determine whether a structure upstream, downstream, or within the site could have an impact on the site. These would need to be considered further as part of a site-specific assessment.
- Sites which have areas designated by the Environment Agency as being a historic landfill site may require site ground investigations to determine the extent of the contamination and the impact this may have on SuDS.

- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.
- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles.
- In respect of cumulative impact assessment, there are a number of development sites proposed that have the potential to provide a betterment to existing communities downstream within the catchment. However, all of these developments also have the potential to increase flood risk offsite if both National and Local SuDS Standards are not applied. They also offer a great potential to enhance the wider Green and Blue Infrastructure of the local area through integrated planning for flood risk, sustainable drainage, biodiversity, amenity and sustainable transport provision.
- Developers proposing windfall sites in the high risk Cumulative Impact Assessment catchments should demonstrate through a site-specific FRA how SuDS and surface water mitigation techniques will ensure that development does not increase flood risk elsewhere and seeks to reduce flood risk to existing communities. The catchment based Cumulative Impact Assessment has been updated using the latest available data for the Level 2 SFRA and supersedes the catchment-based assessment in the Level 1 SFRA.

At the planning application stage, developers may need to undertake more detailed hydrological and hydraulic assessments of the watercourses where there are no detailed hydraulic models present, to verify flood extent (including latest **climate change allowances**), inform development zoning within the site and prove, if required, whether the Exception Test can be passed.

For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

It is recommended that as part of the early discussions relating to development proposals, developers discuss requirements relating to site-specific Flood Risk Assessment and drainage strategies with both the Local Planning Authority and the LLFA, to identify any potential issues that may arise from the development proposals.

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## Abbreviations and glossary of terms

| Term | Definition |
|---|---|
| 1D model | One-dimensional hydraulic model |
| 2D model | Two-dimensional hydraulic model |
| AEP | Annual Exceedance Probability – 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. |
| 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. |

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| 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 |
| Design flood | This is a flood event of a given annual flood probability, which is generally taken as:<br>fluvial (river) flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), or;<br>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 a method 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 |
| 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 |
| JBA | Jeremy Benn Associates |
| LFRMS | Local Food Risk Management Strategy |
| LIDAR | Light Detection and Ranging |
| LLFA | Lead Local Flood Authority - Local Authority responsible for taking the lead on local flood risk management |
| LPA | Local Planning Authority |
| 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 |
| NPPG | National Planning Practice Guidance |
| NRD | National Receptor Database |
| 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 of maintenance. |
| PFRA | Preliminary Flood Risk Assessment |
| 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. |
| RBMP | River Basin Management Plan |
| 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 (RMA) | 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. |

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| SFRA | Strategic Flood Risk Assessment |
| SoP | Standard of Protection - Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1 in 100-year standard of protection. |
| 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. |
| SWMP | Surface Water Management Plan - The SWMP plan should outline the preferred surface water management strategy and identify the actions, timescales and responsibilities of each partner. It is the principal output from the SWMP study. |
| 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. |

# 1 Introduction

## 1.1 Purpose of the Strategic Flood Risk Assessment

> ***"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.".***
>
> (National Planning Policy Framework, paragraph 156)

This Level 2 Strategic Flood Risk Assessment (SFRA) 2020 document provides a Level 2 assessment of strategic sites identified for potential allocation within Shropshire.

## 1.2 Levels of SFRA

The **Planning Practice Guidance**[1] (PPG) advocates a tiered approach to risk assessment and identifies the following two levels of SFRA:

- **Level One:** where flooding is not a major issue in relation to potential development sites and where development pressures are low. The assessment should be sufficiently detailed to allow application of the Sequential Test.
- **Level Two:** where land outside Flood Zones 2 and 3 cannot appropriately accommodate all the necessary development creating the need to apply the National Planning Policy Framework's (NPPF) 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 update fulfils the requirements of a **Level 2** SFRA.

## 1.3 SFRA objectives

The objectives of this 2020 Level 2 SFRA are to:

1 Provide individual flood risk analysis for site options using the latest available flood risk data, thereby assisting the Council in applying the Exception Test to its proposed site options in preparation of its Local Plan.

2 Using available data, provide information and a comprehensive set of maps presenting flood risk from all sources for each site option.

3 Where the Exception Test is required, provide recommendations for making the site safe throughout its lifetime.

4 Take into account most recent policy and legislation in the NPPF, PPG and LLFA SuDS guidance.

5 Update the catchments that are most sensitive to new development in flood risk terms and further review policy and recommendations for these catchments.

[1] Planning Practice Guidance – Flood Risk and Coastal Change - Paragraph: 012 Reference ID: 7-012-20140306

## 1.4 Context of the Level 2 assessment

A Shropshire-wide **Level 1 SFRA** was commissioned in 2018 by Shropshire Council and undertaken by JBA Consulting. The report was published in 2019.

The purpose of this study is to provide a comprehensive and robust evidence base to support the production of the Local Plan to 2036. This 2020 Level 2 SFRA builds on the work undertaken in the Level 1 SFRA and assesses flood risk at potential site allocations. In addition, there have been updates to national and local planning policy, flood event data and recommendations for the cumulative impact of development.

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

## 1.5 Consultation

SFRAs should be prepared in consultation with other risk management authorities. The following parties (external to Shropshire Council) have been consulted during the preparation of this Level 2 SFRA:

- Environment Agency
- Shropshire LLFA
- Other stakeholders were contacted as part of the Level 1 SFRA (Severn Trent Water, Welsh Water, United Utilities, neighbouring authorities, Fire and Rescue, Canal and Rivers Trust)

## 1.6 How to use this report

**Table 1-1 SFRA report guide**

| Section | Contents | How to use |
|---|---|---|
| 1. Introduction | Outlines the purpose and objectives of the Level 2 SFRA | For general information and context. |
| 2. The Planning Framework and Flood Risk Policy | Includes information on the implications of recent changes to planning and flood risk policies and legislation, as well as documents relevant to the study. | Users should refer to this section for any relevant policy which may underpin strategic or site-specific assessments. |
| 3. Planning policy for flood risk management | Provides an overview of both national and existing Local Plan policy on flood risk management<br>This includes the Flood Zones, application of the Sequential Approach and Sequential/Exception Test process.<br>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. | Users should use this section to understand and follow the steps required for the Sequential and Exception Tests. |
| 4. Impact of climate change | Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA<br>Sets out how developers should apply the guidance to inform site specific Flood Risk Assessments | This section should be used to understand the climate change allowances for a range of epochs and conditions, linked to the vulnerability of a development. |

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| 5. Sources of information used in preparing the Level 2 SFRA | Summarises the data used in the Level 2 assessments and GeoPDF mapping | Users should refer to this section in conjunction with the summary tables and GeoPDF mapping to understand the data presented.<br>Developers should refer back to this section when understanding requirements for a site-specific FRA. |
| 6. Level 2 Assessment Methodology | Summarises the sites taken forward to a Level 2 assessment and the outputs produced for each of these sites. | This section should be used in conjunction with the site summary tables and GeoPDF mapping to understand the data presented. |
| 7. Flood risk management requirements for developers | Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development.<br>Refers back to relevant sections in the L1 SFRA for mitigation guidance. | Developers should use this section to understand requirements for FRAs and what conditions/ guidance documents should be followed. Developers should also refer to the L1 SFRA for further information on flood mitigation options. |
| 8. Surface water management and SuDS | An overview of any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority.<br>Refers back to relevant sections in the L1 SFRA for information on SuDS and surface water management. | Developers should use this section to understand what national, regional and local SuDS standards are applicable. Hyperlinks are provided.<br>Developers should also refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information. |
| 9. Cumulative impact of development and strategic solutions | Builds on recommendations from the Level 1 SFRA, identifying the cumulative impact of development in the site catchments and providing recommendations for storage and betterment for all potential development sites in the catchment. | Planners should use this section to help develop policy recommendations for the sites specified.<br>Developers should use this section to understand the potential storage requirements and betterment opportunities for the sites assessed. |
| 10. Summary of Level 2 assessment and recommendations | Summarises the results and conclusions of the Level 2 assessment, and signposts to the L1 SFRA for planning policy recommendations. | Developers and planners should use this section to provide an overview of the Level 2 assessment.<br>Planners should use this section to identify which potential site allocations have the least risk of flooding.<br>Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments. |
| Appendix A:<br>Level 2 assessment - Site summary tables and Interactive mapping | Provides a detailed summary of flood risk for sites requiring a more detailed assessment. The section considers flood risk, emergency planning, climate change, broadscale assessment of possible SuDS, exception test requirements and requirements for site-specific FRAs. | Planners should use this section to inform the application of the Sequential and Exception Tests, as relevant.<br>Developers should use these tables to understand flood risk, access and egress requirements, climate change, SuDS and FRA requirements for site-specific |

| | | |
|---|---|---|
| | Provides interactive PDF mapping for each Level 2 assessed site showing flood risk at and around the site. | assessments.<br>Planners and developers should use these maps in conjunction with the site summary tables to understand the nature and location of flood risk. |

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

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

# 2 The Planning Framework and Flood Risk Policy

## 2.1 Introduction

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the Level 2 SFRA provides an overview of the planning framework, flood risk policy and flood risk responsibilities, given the changes since the previous SFRA publications. In preparing the subsequent sections of this SFRA, appropriate planning and policy amendments have been acknowledged and taken into account.

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

## 2.2 Roles and responsibilities for Flood Risk Management in Shropshire

There are a number of different organisations in and around Shropshire 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. More information can be found in the Environment Agency publication **Owning a watercourse** (2018).

When it comes to undertaking works to reduce flood risk, the Environment Agency and Shropshire Council as LLFA do have powers, but limited resources must be prioritised and targeted to where they can have the greatest effect.

**Table 2-1 Roles and responsibilities for flood risk management within Shropshire**

| Risk Management Authority | Strategic Level | Operational Level | Planning role |
|---|---|---|---|
| **Environment Agency** | • Strategic overview for all sources of flooding<br>• National Strategy<br>• Reporting and general supervision | • Main rivers<br>• Reservoirs | • Statutory consultee for development in Flood Zones 2 and 3 |
| **Shropshire Council as Lead Local Flood Authority (LLFA)** | • Preliminary Flood Risk Assessment<br>• Local Flood Risk Management Strategy | • Surface Water<br>• Groundwater<br>• Ordinary Watercourses (consenting and enforcement)<br>• Ordinary watercourses (works) | • Statutory consultee for all major developments |
| **Shropshire Council as Local Planning** | • Local Plans as Local Planning Authorities | • Determination of Planning Applications as Local Planning | • As left |

| | | | |
|---|---|---|---|
| **Authority** | | Authorities<br>• Managing open spaces under Council ownership | |
| **Water Companies:**<br>***Severn Trent Water***<br>***Welsh Water***<br>***United Utilities*** | • Asset Management Plans supported by Periodic Reviews (business cases)<br>• Develop Drainage and Wastewater management plans | • Public sewers | • Non-statutory consultee |
| **Internal Drainage Board:**<br>**Melverley**<br>**Rea** | • Water Level Management Plans | • Ordinary Watercourses within Internal Drainage Districts | • Non-statutory consultee |
| **Highways Authorities:**<br>***Highways England (motorways and trunk roads)***<br>***Shropshire Council (other adopted roads)*** | • Highway drainage policy and planning | • Highway drainage | • Internal planning consultee regarding highways and design standards and options |

## 2.3 Relevant legislation

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

- **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 produces 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.

## 2.4 Relevant flood risk policy and strategy documents

Table 2-2 summarises some of the relevant national, regional and local flood risk policy and strategy documents and how these apply to development and flood risk. There are hyperlinks to the documents in the table. These documents may:

- Provide useful and specific local information to inform flood risk assessments within the local 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 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 Shropshire.
- 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 |
|---|---|---|---|---|---|
| National | **Flood and Coastal Erosion Risk Management Strategy** (Environment Agency) 2011 published, updated version consulted on in 2019 and due in 2020 | No | Yes | No | Update due to be published later in 2020 |
| | **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 Severn Catchment Flood Management Plan** (Environment Agency) 2009 | Yes | Yes | No | - |
| | **Severn Flood Risk Management Plan** (Environment Agency) 2015 | Yes | 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) 2019 | No | No | Yes | 2020 for fluvial and rainfall allowances |
| Local | **Local Flood Risk Management Strategy** (Shropshire Council) 2015 | Yes | Yes | No | 2021 |
| | **SuDS Handbook** - This is currently being prepared and is expected shortly. | Yes | No | Yes | SuDS Handbook to be published later in 2020 |

| | Document, lead author and date | Information | Policy and measures | Development design requirements | Next update due |
|---|---|---|---|---|---|
| | **Surface Water Management: Interim Guidance for Developers** should be used in the interim | | | | |
| | Drainage and Wastewater Management Plan (Severn Trent Water) due 2023 | Yes | Yes | No | - |
| | **Shropshire Water Cycle Study** (2010 version published, updated version ongoing, due 2020) | Yes | Yes | Yes | Update due to be published later in 2020 |
| | **Shropshire Surface Water Management Plans** (Oswestry 2013, Church Stretton 2011, Shifnal 2013, Shrewsbury 2012, Craven Arms 2012 and Much Wenlock 2011) | Yes | Yes | No | - |

## 2.5 Relevant flood risk management studies and documents

### 2.5.1 The National Flood and Coastal Erosion Risk Management Strategy for England (2011 and 2020)

The **National Flood and Coastal Erosion Risk Management Strategy** (FCERM) 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.

A new Strategy has been in preparation since 2018. The Environment Agency brought together a wider range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one and looks ahead to 2100 and the action needed to address the challenge of climate change.

The Strategy has been split into 3 high level ambitions: climate resilient places, today's growth and infrastructure – resilient to tomorrow's climate and a nation of climate champions, able to adapt to flooding and coastal change through innovation. Measures include place-based resilience standards (applying a toolkit of different approaches to manage flood risk), adaptive approaches to climate change, updating the evidence base to inform long term investment needs, mainstreaming working with natural processes, aligning long term strategic planning cycles between stakeholders, ensuring FCERM works enhance the natural and cultural environment, exploring new funding options including green finance, planning for FCERM alongside regeneration and sustainable growth, infrastructure resilience, education, skills and capacity building, development of digital tools to communicate flood risk and flood warning, response and recovery support.

The Strategy was publicly consulted on in 2019 and the final version is due for publication later in 2020 once it has been approved by Parliament.

### 2.5.2 Shropshire Council Local Flood Risk Management Strategy (LFRMS) 2015

Shropshire Council is responsible for developing, maintaining, applying and monitoring a LFRMS. The **most recent Strategy** was published in 2015 and is used as a means by which the LLFA co-ordinates Flood Risk Management on a day-to-day basis. Once the new National Strategy has been published in 2020, LLFAs will need to update their Local Strategies so that they reflect how national objectives for flood risk management will be delivered locally.

The seven high-level objectives proposed in the strategy for managing flood risk are as follows, with further details in the Level 1 SFRA and LFRMS:

- Develop a strategic understanding of flood risk from all sources
- Promote effective management of drainage and flood defence systems
- Support communities to understand flood risk and become more resilient to flooding
- Manage local flood risk and new development in a sustainable manner
- Achieve results through partnership and collaboration
- Be better prepared for flood events
- Secure and manage funding for flood risk management in a challenging financial climate.

### 2.5.3 LLFAs, surface water and SuDS

The 2019 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

Shropshire 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 Shropshire are:

- Shropshire Local Development Framework: Adopted Core Strategy. Policy CS18: Sustainable Water Management
- Site Allocations and Management of Development (SAMDev) Plan. Policy MD2: Sustainable Design
- **Local Flood Risk Management Strategy**. Policy 4: The Role of the Lead Local Flood Authority in the Consideration of Proposals for Sustainable Development
- SuDS Handbook. This is currently being prepared and is expected shortly. **Surface Water Management: Interim Guidance for Developers** should be used in the interim

The 2019 NPPF states that flood risk should be managed "using opportunities provided by new development to reduce causes and impacts of flooding." As such, Shropshire Council expects SuDS to be incorporated on minor development as well as major development.

### 2.5.4 Surface water management plans

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

Shropshire Councils SWMPs are available on the Council's **website**. The SWMPs identify flooding hotspots and provide recommendations and objectives to reduce flooding in these areas.

### 2.5.5 Updated Strategic Flood Risk Assessment guidance

There was an update to the **'How to prepare a Strategic Flood Risk Assessment guidance'** in August 2019, which had some key additions to both Level 1 and Level 2 assessments. The Level 2 assessment is undertaken in accordance with this guidance.

# 3 Planning policy for flood risk management

## 3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (**NPPF**) was published 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 NPPG** 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 that 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.

**Important note on Flood Zone information in this SFRA**

The Flood Zones for the majority of sites presented in Appendix A GeoPDFs are the same as those shown on the Environment Agency's '**Flood Map for Planning**' at the time of publication. This is because most sites do not fall in locations of detailed hydraulic models.

The sites located adjacent to the River Severn in Shrewsbury (SHR166 and SHR173) use the latest 2020 Environment Agency River Severn Modelling Study Phase 1 outputs, which are not publicly published at the time of this SFRA, and hence are in draft form. The new modelled 100-year and 1,000-year flood extents have been used to form Flood Zones 3a and 2 respectively. Whilst Flood Zones 2 and 3a should be undefended, the locations of the defences in Shrewsbury are unlikely to have an impact at these sites, and the defended modelled extents are slightly larger than the EA's Flood Zones, hence this is most conservative dataset available. When the undefended runs become available in Phase 2 of the River Severn modelling study, the Flood Zone extents should be checked, in addition to considering the impact of the argaes upstream with regards to storage and how these natural features impact the undefended model runs. Results should be treated with caution, as the project is ongoing. Developers should request latest outputs from the EA, once publicly available.

The Environment Agency Flood Map for Planning Flood Zones do not cover all catchments or ordinary watercourses. As a result, whilst the Environment Agency Flood Zones may show an area is in Flood Zone 1, it may be that there is actually a degree of flood risk from smaller watercourses not shown in the Flood Zones.
Functional floodplain (Flood Zone 3b) is identified as land which would flood with an annual probability of 1 in 20 years, where detailed hydraulic modelling exists. The 1 in 20-year modelled flood extents have been used to represent Flood Zone 3b, where available from the Environment Agency. For areas outside of the detailed model coverage, or where no outputs were available, Flood Zone 3a can be used 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.

## 3.3 The Sequential Test

Firstly, land at the lowest risk of flooding and from all sources should be considered for development. A test is applied called the 'Sequential Test' to do this. 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 sides 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 NPPG** defines the vulnerability of different development types to flooding. **Table 3 of the NPPG** 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**

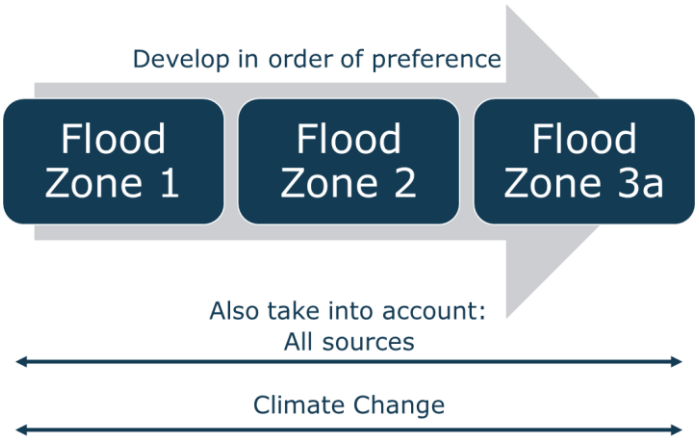
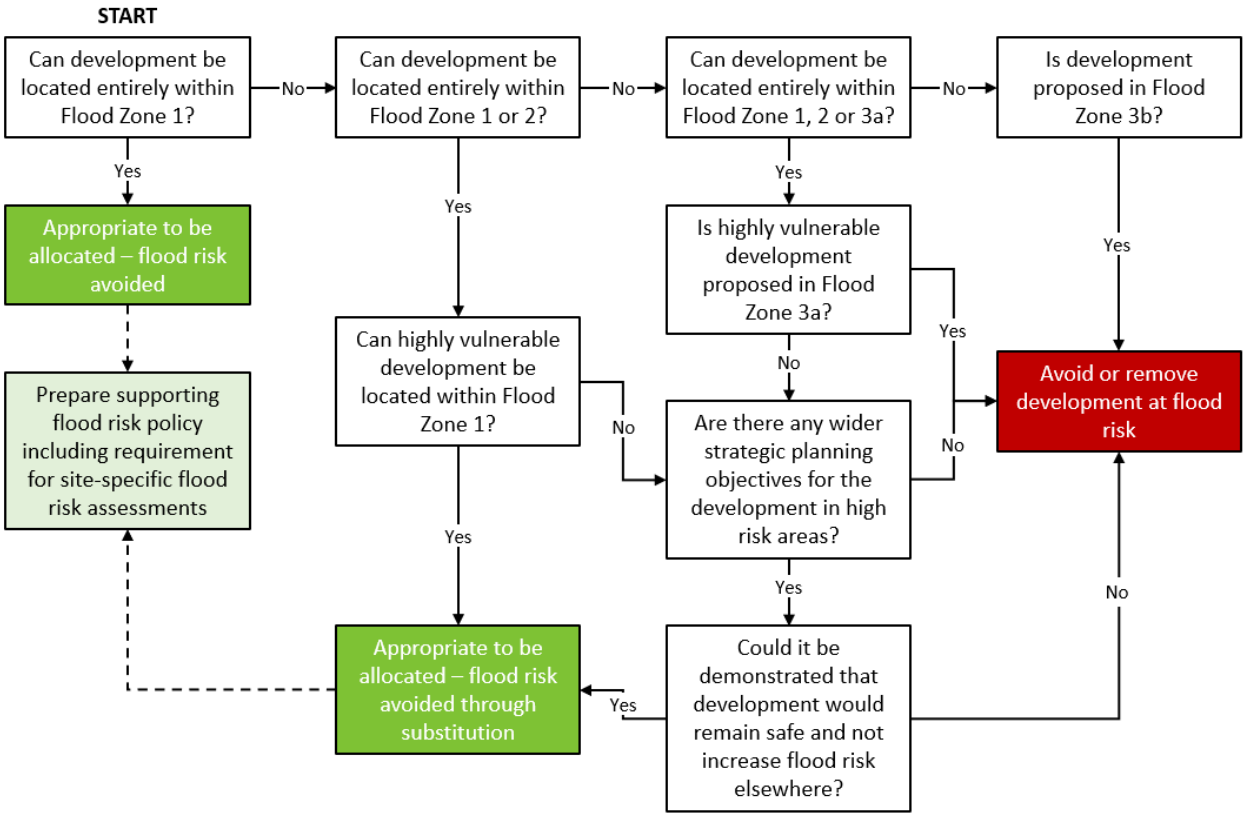



Figure 3-2 illustrates the Sequential and Exception Tests as a process flow diagram using the information contained in this SFRA to assess potential development sites against the EA's Flood Map for Planning flood zones and development vulnerability compatibilities.

This is a stepwise process, but a challenging one, as a number of the criteria used 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 outer 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**



### 3.3.1 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.

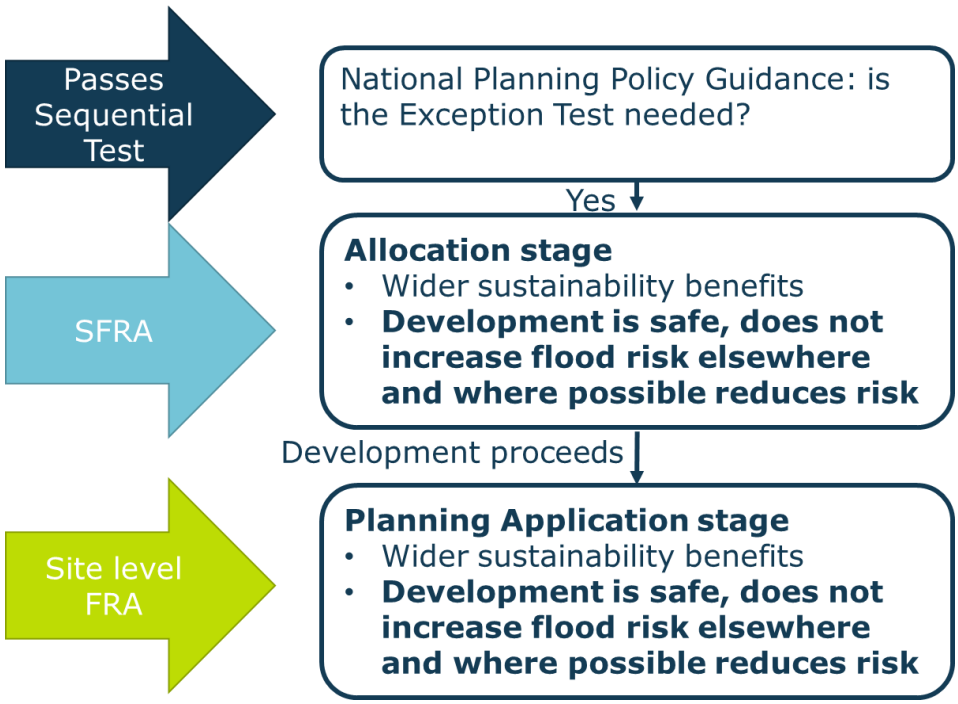
The Exception Test should only be applied following the application of the Sequential Test. It applies in the following instances:

- 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. For sites allocated within the Local Plan, the Local Planning Authority should use the information in this SFRA to inform the Exception Test. At planning application stage, the Developer must design the site such that is appropriate flood resistant and resilient in line with the recommendations in National and Local Planning Policy and supporting guidance and those set out in this SFRA. This should demonstrate that the site will still pass the flood risk element of the Exception Test based on the detailed site level analysis.

For developments that have not been allocated in the Local Plan, developers must undertake the Exception Test and present this information to the Local Planning Authority for approval. The Level 1 SFRA can be used to scope the flooding issues that a site-specific FRA should look into in more detail to inform the Exception Test for windfall sites.

**Figure 3-3: The Exception Test**




There are two parts to demonstrating a development passes the Exception Test:

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

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

At the stage of allocating development sites, Local Planning Authorities should consider wider sustainability objectives, such as those set out 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.

The Local Planning Authority should consider the sustainability issues 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.

2 *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.*

A Level 2 SFRA is likely to be needed to inform the Exception Test in these circumstances for strategic allocations. At Planning Application stage, a site-specific Flood Risk assessment will be needed. Both would need to consider the actual and residual risk and how this will be managed over the lifetime of the development.

### 3.3.2 Making a site safe from flood risk over its lifetime

Local Planning Authorities will need to consider the actual and residual risk of flooding and how this will be managed over the lifetime of the development:

- The actual risk is the risk to the site considering existing flood mitigation measures. The fluvial 1% chance flood in any year event is a key event to consider because the National Planning Policy Guidance refers to this as the 'design flood' against which the suitability of a proposed development should be assessed and mitigation measures, if any, are designed.
- Safe access and egress should be available during the design flood event. Firstly, this should seek to avoid areas of a site at flood risk. If that is not possible then access routes should be located above the design flood event levels. Where that is not possible, access through shallow and slow flowing water that poses a low flood hazard may be acceptable.
- Residual risk is the risk that remains after the effects of flood defences have been taken into account and/ or from a more severe flood event than the design event. The residual risk can be:
- The effects of an extreme 0.1% chance flood in any year event. Where there are defences this could cause them to overtop, which may lead to failure if this causes them to erode, and/ or
- Structural failure of any flood defences, such as breaches in embankments or walls.

Flood resistance and resilience measures should be considered to manage any residual flood risk by keeping water out of properties and seeking to reduce the damage it does, should water enter a property. Emergency plans should also account for residual risk, e.g. through the provision of flood warnings and a flood evacuation plan where appropriate.

In line with the NPPF, the impacts of climate change over the lifetime of the development should be taken into account when considering actual and residual flood risk.

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

### 3.4.1 Sequential Test

Shropshire Council, 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 has 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 relate 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
- Site 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.

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 NPPG). Developers are required to apply the Exception Test to all applicable sites.

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 the development will address and how doing out 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; and
  - Any funding arrangements required for implementing measures.

# 4 Impact of Climate Change

The Climate Change Act 2008 creates a legal requirement for the UK to put in place measures to adapt to climate change and to reduce carbon emissions by at least 80% below 1990 levels by 2050.

Shropshire Council published its **Sustainability, Environment and Climate Change Strategy** in 2011 which details how the council intend to reduce emission and advancement with the climate change agenda. The Shropshire Climate Change Task Force also published in 2019 a **Shropshire Climate Change Strategy Framework**; a route map to a zero carbon Shropshire. This document is to provide a framework for the development of a strategy and action plan to reduce Shropshire Council's carbon footprint and promote adaptation measures and increase the resilience of the Council's services. The document also identifies a set of clear objectives and principles to guide future corporate actions and a description of the process and programme through which the Council will take its response to the Climate Emergency forward.

## 4.1 Revised climate change guidance

The Environment Agency published **updated climate change guidance** in 2019 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. Whilst the guidance was updated in 2019, fluvial allowances are still to be updated from those in the original 2016 guidance.

In 2018, the government published new UK Climate Projections (UKCP18). The Environment Agency are currently using these to further update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. 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 likely to be due in late 2020, but is not yet released.

## 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 **NPPG**
- 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 a FRA
- The River Basin that the site is in – Shropshire is situated in the Severn River Basin District.
- 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 '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

## 4.3 Relevant allowances for Shropshire

Table 4-1 shows the peak river flow allowances that apply to Shropshire and Table 4-2 shows the peak rainfall intensity allowances that apply in Shropshire. Both the central and upper end allowances should be considered to understand the range of impact. The table below shows anticipated changes in extreme rainfall intensity in small and urban catchments:

**Table 4-1 Peak river flow allowances by river basin district**

| River basin district | Allowance category | Total potential change anticipated for '2020s' (2015 to 39) | Total potential change anticipated for '2050s' (2040 to 2069) | Total potential change anticipated for '2080s' (2070 to 2115) |
|---|---|---|---|---|
| Severn | Upper end | 25% | 40% | 70% |
| | Higher central | 15% | 25% | 35% |
| | Central | 10% | 20% | 25% |
| Dee | Upper end | 20% | 30% | 45% |
| | Higher central | 15% | 20% | 25% |
| | Central | 10% | 15% | 20% |
| North-West | Upper end | 20% | 35% | 70% |
| | Higher central | 20% | 30% | 35% |
| | Central | 15% | 25% | 30% |

**Table 4-2 Peak rainfall intensity allowance in small and urban catchments**

| Applies across all of England | Total potential change anticipated for 2010 to 2039 | Total potential change anticipated for 2040 to 2059 | Total potential change anticipated for 2060 to 2115 |
|---|---|---|---|
| **Upper end** | 10% | 20% | 40% |
| **Central** | 5% | 10% | 20% |

## 4.4 Representing climate change in the Level 2 SFRA

For this Level 2 SFRA, the Level 1 climate change modelling was used where this aligned with sites being assessed and where detailed models were present. Three scenarios were previously modelled 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% defended scenario.

For any sites not covered by the EA's detailed modelling, Flood Zone 2 was used as an indicative climate change extent. This is appropriate given the 100-year +70% flows are often similar to the Flood Zone 2 extents, therefore the impacts of climate change would be minimal. The 1,000-year surface water extent was also used as an indication of surface water risk, and risk to smaller watercourses, which are too small to be covered by the EA's Flood Zones.

Developers will need to undertake a more detailed assessment of climate change as part of the planning application process when preparing FRAs, using the percentage increases which relate to the proposed lifetime and the vulnerability classification of the development. In areas where no modelling is present, this may require development of a 'detailed' hydraulic model, using channel topographic survey. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

Climate change mapping has been provided in Appendix A: GeoPDFs. In summary, the climate change outputs on the GeoPDF maps for the SFRA may be from:

- 'Indicative Climate Change (FZ2)': Flood Zone 2, which is used outside of the areas covered by specific flood models and should be considered to be indicative.
- 'Climate Change Central, Higher Central and Upper End': The latest 2020 Environment Agency River Severn Modelling Study Phase 1, based on the 2016 climate change allowances for the modelling.

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 this Chapter and in the SHWG Climate Change Guidance. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

## 4.5 Adapting to climate change

The NPPG sections on climate change contain information and guidance for how to identify suitable mitigation and adaptation measure 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; and

- 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.

**The Working Together in a Changing Climate** section of Shropshire Council's Sustainability, Environment and Climate Change Strategy predicts the following climatic changes within Shropshire:

- Average annual maximum temperatures are expected to rise by 4°C by 2080
- Average summer temperatures increased by 4.7°C by 2080
- Average winter temperatures increased by 3.4°C by 2080
- Summer rainfall is expected to decrease by 25% by 2080
- Winter rainfall is expected to increase by 24% by 2080
- Increased rainfall intensity in summer months
- More short duration extreme weather events such as storms and flooding.

# 5 Sources of information used in preparing the Level 2 SFRA

## 5.1 Data used to inform the SFRA

Table 5-1 provides an overview of the supplied data, used to inform the appraisal of flood risk for Shropshire.

**Table 5-1 Overview of supplied data for Shropshire Level 2 SFRA**

| Source of flood risk | Data used to inform the assessment | Data supplied by |
|---|---|---|
| **Historic (all sources)** | Historic Flood Map and Recorded Outlines<br>Hydraulic Modelling Reports, where provided | Environment Agency |
| | 2018-19 L1 SFRA | Shropshire Council |
| | Historic flood incidents/records, including from February 2020 floods | Shropshire Council |
| **Fluvial (including climate change)** | River Severn Phase 1 modelling outputs (draft)<br>Flood Zones<br>Risk of Flooding from Rivers and Sea | Environment Agency |
| **Surface Water** | Risk of Flooding from Surface Water dataset<br>Local Flood Risk Management Strategy Communities at Risk | Environment Agency |
| **Groundwater** | Areas Susceptible to Groundwater Flooding dataset<br>Bedrock geology/superficial deposits dataset | Environment Agency |
| **Sewer** | At Risk Register<br>Historic flooding records | Severn Trent Water (and Welsh Water and United Utilities as part of the Level 1 SFRA) |
| **Reservoir** | National Inundation Reservoir Mapping | Environment Agency |
| **Canal** | Description of flood incidences | Canal and Rivers Trust |

## 5.2 Flood Zones 2 and 3a

Flood Zones 2 and 3a have been taken from the Level 1 SFRA, which incorporated all recent modelled Flood Zones which may not be shown in the Environment Agency's Flood Map for Planning. Where there are no detailed models, the Flood Zones are represented by older 2D generalised model outputs (Flood Map for Planning).

For the River Severn at Shrewsbury, the draft modelled outputs for the 2020 Environment Agency River Severn Modelling Study Phase 1 were available and

obtained from the Environment Agency. The results have been signed off by the Environment Agency, but as the project is still ongoing, there are still aspects which could be subject to change in Phase 2. For the two sites which fall in this area, SHR166 and SHR173, the new modelled 100-year and 1,000-year flood extents have been used to form the Flood Zones. Whilst Flood Zones 2 and 3a should be undefended, the locations of the defences in Shrewsbury are unlikely to have an impact at these sites, and the defended modelled extents are slightly larger than the EA's Flood Zones, hence this is most conservative dataset available. When the undefended runs become available in Phase 2 of the River Severn modelling study, the Flood Zone extents should be checked, in addition to considering the impact of the argaes upstream with regards to storage and how these natural features impact the undefended model runs. Results should be treated with caution, as the project is ongoing. Developers should request latest outputs from the EA, once publicly available.

### 5.2.1 Flood Zone 3b

Flood Zone 3b has been identified as land which would flood with an annual probability of 1 in 20 years (5% AEP). It has been derived from the 20-year defended modelled flood extent (or 25-year in the absence of 20-year), where detailed Environment Agency hydraulic models exist, and where no detailed models exist, Flood Zone 3a should be used as an indication of Flood Zone 3b.

For the River Severn at Shrewsbury, the draft modelled outputs for the 2020 Environment Agency River Severn Modelling Study Phase 1' were available and obtained from the Environment Agency. The 20-year flood extent has been used here to form the functional floodplain. Results should be treated with caution, as the project is ongoing. Developers should request latest outputs from the EA, once publicly available.

**Note on the Environment Agency Flood Map for Planning**

Where flood outlines are not informed by detailed hydraulic modelling, the Flood Map for Planning is based on generalised modelling to provide an indication of flood risk. Whilst the generalised modelling is generally accurate on a large scale, they are not provided for specific sites or for land where the catchment of the watercourse falls below 3km$^2$.

For watercourses with smaller catchments, the Risk of Flooding from Surface Water map provides an indication of the floodplain of small watercourses and ditches. It is more accurate in upper to mid river valley locations (like the Upper Trent and Tame catchments) than lower valley locations near the coast. This is because it does not represent the floodplain for small watercourses as well in largely flat areas.

Even where more detailed models of Main Rivers have been used by the Environment Agency to inform the Flood Map for Planning, they will be largely based on remotely detected ground model data and not topographic survey.

For this reason, the Flood Map for Planning is not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. Accordingly, for site-specific assessments it will be necessary to perform more detailed studies in circumstances where flood risk is an issue.

## 5.3 Climate change

For the majority of sites assessed, there were no detailed hydraulic models, therefore Flood Zone 2 was used as a conservative indication, and also the 1,000-year surface water extent as an indication for smaller watercourses not shown to be in the Flood Zones.

The mapping provides a strategic assessment of climate change risk; developers should undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the **climate change guidance** set out by the Environment Agency. This would be the Central (100-year +25%), Higher Central (100-year +35%) and Upper End (100-year +70%) climate change allowances for the 2080s epoch, for the Severn basin's 2080s epoch.

For the River Severn at Shrewsbury, the draft modelled outputs for the 2020 Environment Agency River Severn Modelling Study Phase 1 were available and obtained from the Environment Agency. The 100-year flows were upscaled for the 2080s scenarios and run through the model. Results should be treated with caution, as the project is ongoing, and the climate change results derived for this SFRA have not been signed off by the Environment Agency. Developers should request latest outputs from the EA, once publicly available.

## 5.4 Surface Water

Mapping of surface water flood risk in Shropshire has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping, which is a slightly more detailed resolution than that published online by the Environment Agency. Surface water flood risk is subdivided into the following four categories:

- **High**: An area has a chance of flooding greater than 1 in 30 (3.3%) each year.
- **Medium**: An area has a chance of flooding between 1 in 100 (0.1%) and 1 in 30 (3.3%) each year.
- **Low**: An area has a chance of flooding between 1 in 1,000 (0.1%) and 1 in 100 (1%) each year.
- **Very Low**: An area has a chance of flooding of less than 1 in 1,000 (0.1%) each year.

The results should be used for high level assessments such as SFRAs for local authorities. If a particular site is indicated in the Environment Agency mapping to be at risk from surface water flooding, a more detailed assessment should be required to more accurately illustrate the flood risk at a site-specific scale. Such an assessment should use the RoFSW in partnership with other sources of local flooding information to confirm the presence of a surface water risk at that particular location. Detailed modelling based on site survey will be necessary where there is a significant risk of surface water flooding.

## 5.5 Groundwater

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater (AStGWF) dataset. The AStGWF dataset is a strategic-scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square, where geological and hydrogeological conditions indicate that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring and does not take account of the chance of flooding from groundwater rebound. This dataset covers a large area of land, and only isolated locations within the overall susceptible area are actually likely to suffer the consequences of groundwater flooding.

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

## 5.6 River networks

Main Rivers are represented by the Environment Agency's Statutory Main River layer. Ordinary Watercourses are represented by the Environment Agency's Detailed River Network Layer. Caution should be taken when using these layers to identify culverted watercourses which may appear as straight lines but in reality, are not.

Developers should be aware of the need to identify the route of and flood risk associated with culverts. CCTV condition survey will be required to establish the current condition of the culvert and hydraulic assessments will be necessary to establish culvert capacity of both culverts on site and those immediately offsite that could pose a risk to the site. The risk of flooding should be established using site survey, including the residual risk of culvert blockage.

The policy in the Shropshire Local Flood Risk Management Strategy requires culverts to be opened up as part of redevelopments. New culverting should be resisted unless it is for essential infrastructure crossings and as short as is reasonably possible. Any new culverts will require a Land Drainage Consent outside of the planning process from the Lead Local Flood Authority.

## 5.7 Flood warning

Flood Warning Areas are represented by the Environment Agency's Flood Warning Area GIS dataset.

## 5.8 Reservoirs

The risk of inundation as a result of reservoir breach or failure of a number of reservoirs within the area has been identified from the Environment Agency's **Long Term Flood Risk Information website**.

## 5.9 Sewer flooding

Historical incidents of flooding are detailed by Severn Trent Water and Welsh Water through their sewer flooding register. The sewer flooding register records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. Due to licencing and confidentiality restrictions, sewer flooding data has not been represented on the mapping.

## 5.10 Historic flooding

Historic flooding was assessed using the Environment Agency's Historic Flood Map, as well as any incidents picked up in the historic flooding register provided by Shropshire Council as LLFA. Data from the February 2020 floods was provided to ensure the SFRA was as up to date as possible.

## 5.11 Flood defences

Flood defences are represented by Environment Agency's Asset Information Management System (AIMS) Spatial Defences data set. Their current condition and standard of protection are based on those recorded in the tabulated shapefile data. None of the sites being assessed are formally protected by a flood defence, though defences are present in Shropshire, notably in Shrewsbury on the River Severn. The Council's asset register was also obtained in the Level 1 SFRA.

## 5.12 Residual risk

The residual flood risk to sites is identified as where potential blockages or overtopping/ breach of defences could result in the inundation of a site, with the sudden release of water with little warning.

Potential culvert blockages that may affect a site were identified on OS Mapping and the Environment Agency's Detailed River Network Layer to determine where watercourses flow into culverts or through structures (i.e. bridges) in the vicinity of the sites. Any potential locations were flagged in the site summary tables.

These will need to be considered by the developer as part of a site-specific Flood Risk Assessment.

Residual risk from breaches to flood defences, whilst rare, needs to be considered in Flood Risk Assessments. Considerations include the location of a breach, when it would occur and for how long, the depth of the breach (toe level), the loadings on the defence and the potential for multiple breaches. There are currently no national standards for breach assessments and there are various ways of assessing breaches using hydraulic modelling. Work is currently being undertaken by the Environment Agency to collate and standardise these methodologies. It is recommended that the Environment Agency are consulted if a development site is located near to a flood defence, to understand the level of assessment required and to agree the approach for the breach assessment.

## 5.13 Depth, velocity and hazard to people

The Level 2 assessment seeks to map the probable depth and velocity of flooding as well as the hazard to people during the defended fluvial 100-year event. The 100-year flood event has been investigated in further detail because the Level 2 assessment helps inform the Exception Test and usually flood mitigation measures and access/ egress requirements focus on flood events lower than the 1,000-year event (e.g. the 100-year plus climate change event).

For Shrewsbury, the 100-year depth, velocity and hazard data has been used from the latest 2020 Environment Agency River Severn Modelling Study Phase 1. In the absence of detailed hydraulic models, the Risk of Flooding from Rivers and Sea dataset has been used, as well as the Risk of Flooding from Surface Water datasets. The depth, hazard and velocity of the 100-year surface water flood event has also been mapped and considered in this assessment. Hazard to people has been calculated using the below formula as suggested in Defra's FD2321/TR2 "Flood Risk to People". The different hazard categories are shown in Table 5-2. Developers should also test the impact of climate change depths, velocities and hazard on the site, at Flood Risk Assessment stage.

**Table 5-2 Defra's FD2321/TR2 "Flood Risks to People" classifications**

| Description of Flood Hazard Rating | Flood Hazard Rating | Classification Explanation |
|---|---|---|
| **Very Low Hazard** | < 0.75 | Flood zone with shallow flowing water or deep standing water" |
| **Danger for some (i.e. children)** | 0.75 - 1.25 | "Danger: flood zone with deep or fast flowing water" |
| **Danger for most** | 1.25 - 2.00 | Danger: flood zone with deep fast flowing water" |
| **Danger for all** | >2.00 | "Extreme danger: flood zone with deep fast flowing water" |

As part of a site-specific FRA, developers will need to undertake more detailed hydrological and hydraulic assessments of the watercourses to verify flood depth, velocity and hazard based on the relevant 100-year plus climate change event, using the relevant climate change allowance based on the type of development and its associated vulnerability classification. Not all of this information is known at the strategic scale.

## 5.14 Note on SuDS suitability

The hydraulic and geological characteristics of each site were assessed to determine the constraining factors for surface water management. This

assessment is designed to inform the early-stage site planning process and is not intended to replace site-specific detailed drainage assessments.

The assessment is based on catchment characteristics and additional datasets such as the AStGWF map and British Geological Survey (BGS) Soil maps of England and Wales which allow for a basic assessment of the soil characteristics on a site by site basis. LIDAR data was used as a basis for determining the topography and average slope across each development site. Other datasets were used to determine other factors. These datasets include:

- Historic landfill sites
- Groundwater Source Protection Zones
- Detailed River Network
- Flood Zones derived as part of this Level 2 SFRA

This data was then collated to provide an indication of particular groups of SuDS systems which might be suitable at a site. SuDS techniques were categorised into five main groups, as shown in Figure 5-3. This assessment should not be used as a definitive guide as to which SuDS would be suitable but used as an indicative guide of general suitability. Further site-specific investigation should be conducted to determine what SuDS techniques could be used on a particular development, informed by detailed ground investigations.

**Table 5-3: Summary of SuDS categories**

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

The suitability of each SuDS type for the site options has been described in the summary tables, where applicable. The assessment of suitability is broadscale and indicative only; more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. Shropshire Council as LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors. SuDS in Shropshire must be designed so that they are in accordance with the Surface Water Management: Interim Guidance for Developers and the forthcoming Shropshire SuDS Handbook which contains Local SuDS Standards.

# 6 Level 2 assessment methodology

## 6.1 Site screening

Shropshire Council provided 98 sites for assessment. These were chosen through a combination of a site's potential for allocation and its flood risk as determined through the site assessment process. These sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site. Sites were screened to provide a summary of flood risk to each site, including:

- The proportion of the site in each Flood Zone
- Whether the site is shown to be at risk from surface water flooding in the RoFfSW and, if so, the lowest return period from which the site is at surface water flood risk
- Whether the site is within, or partially within, the Environment Agency's Historic Flood Map.

The screening was undertaken using JBA in-house software called "FRISM". FRISM is an internal JBA GIS package that computes a range of flood risk metrics based on flood and receptor datasets.

The results of the screening provide a quick and efficient way of identifying sites that are likely to require a Level 2 Assessment, assisting Shropshire Council with Sequential Test decision-making so that flood risk is taken into account when considering allocation options.

The screening also provides an opportunity to identify sites which have an ordinary watercourse flowing through or adjacent to them but for which no Flood Zone information is currently available. Note: although there are no Flood Zone maps available for these watercourses, it does not mean the watercourse does not pose a risk, it just means no modelling has yet been undertaken to identify the risk.

The Flood Zones are not provided for specific sites or land where the catchment of the watercourse falls below 3km$^2$. For this reason, the Flood Zones are not of a resolution to be used as application evidence to provide the details of possible flooding for individual properties or sites and for any sites with watercourses on, or adjacent to the site. The Risk of Flooding from Surface Water has been used in these cases because this provides a reasonable representation of the floodplain of such watercourses to use for a strategic assessment.

## 6.2 Sites taken forward to a Level 2 assessment

Out of the 98 sites provided by Shropshire Council, 19 sites were carried forward to a Level 2 assessment. This included 3 strategic sites.

A Red-Amber-Green system was applied to the sites on the basis, that: red sites needed a Level 2, amber sites did not need a Level 2 due to less significant flood risk, but still needed flagging in this report (recommendations provided in section 6.3), and green sites that had no/ negligible risk. The Environment Agency was consulted on these sites and agreed which sites should be taken forward to a Level 2 assessment.

Sites were taken forward if they were at fluvial flood risk or if surface water risk was deemed significant. In order to assess whether a site was deemed to have significant surface water risk, professional judgment was used based on the extent and location of the surface water issues relative to the site and access and egress. For example, if there was an area of deep ponding, a prominent flow route bisecting a site, immediate constraints to site access at the boundary, potential for highly vulnerable types of development to occupy a site etc.

For other sites with less significant but still noteworthy surface water issues, these have been highlighted in Table 6-2 and the LLFA expect the developer to take

these into account at an early stage when planning the form and layout of the site, the surface water drainage system and any surface water mitigation measures that may be necessary.

Table 6-1 summarises the sites which have been taken forward to the Level 2 assessment on this basis.

**Table 6-1: Sites carried forward to a Level 2 assessment**

| Site code | Site name | Reason for Level 2 | Updated Flood Zones %* | | | | Risk of flooding from surface water % | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | FZ3b | FZ3a | FZ2 | FZ1 | 30yr | 100yr | 1,000yr |
| CST021 | Snatchfield Farm, Snatchers Lane | Fluvial risk unmodelled | 0% | 0% | 0% | 100% | 3% | 5% | 11% |
| MDR034 | Land to north of A53 and west of Maer Lane | Fluvial risk | 5% | 5% | 29% | 71% | 1% | 6% | 12% |
| MIN018 | Land west of A488 Little Minsterley | Fluvial/ surface water risk | 0% | 0% | 6% | 94% | <1% | 3% | 20% |
| KCK009 | Church Lane | Fluvial risk | 0% | 3% | 4% | 96% | 0% | <1% | 1% |
| SHR173 | Land at Ellesmere Rd | Fluvial risk | 6% | 6% | 6% | 94% | 3% | 3% | 4% |
| SHR177 | Oak Farm Gains Park | Fluvial risk | 18% | 21% | 23% | 77% | 2% | 4% | 7% |
| SHR166 | East of Shrewsbury A49 nr Preston Boats roundabout | Fluvial risk | 5% | 6% | 7% | 93% | 1% | 1% | 4% |
| WEM033 | Hill House Farm | Fluvial risk unmodelled | 0% | 0% | 0% | 100% | <1% | 4% | 17% |
| WHT042 | The Oaklands Farm | Fluvial risk | 6% | 6% | 6% | 94% | 0% | <1% | 4% |
| PPW025 | Land North of Tudor House | Fluvial risk | 3% | 3% | 7% | 93% | 0% | <1% | 1% |
| BNT002 | Clive Barracks | Strategic site | <1% | <1% | <1% | 99% | 1% | 1% | 2% |
| BRD030 | Tasley Garden Village | Fluvial and surface water risk | 5% | 5% | 6% | 94% | 1% | 1% | 7% |
| SHF013 | Land north of Meadow Drive | Surface water/ access | 0% | 0% | 0% | 100% | 9% | 9% | 12% |
| PON008 | Land west of the Ozarks | Fluvial risk unmodelled | 0% | 0% | 0% | 100% | 10% | 15% | 41% |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| IRN001 | Power Station Site | Strategic site | 10% | 17% | 20% | 80% | 4% | 6% | 12% |
| ELL005 and ELL008 and ELL033 | Adj A495 | Fluvial risk | 7% | 7% | 10% | 90% | 0% | 0% | 1% |
| SHR057 | Land at Oak Farm, Gains Park. | Fluvial risk | 1% | 1% | 1% | 99% | 2% | 2% | 5% |
| P28, P30 and P40 | RAF Cosford | Strategic site | 0% | 0% | 0% | 100% | 1% | 2% | 8% |
| PYC021 | Land at Penygarreg Lane, Pant | Surface water risk | 0% | 0% | 0% | 100% | 7% | 12% | 35% |

**Flood Zones updated using latest modelling data; hence these may differ from the EA's Flood Map for Planning Flood Zones.*

*'Unmodelled' fluvial risk relates to there being the presence of watercourses on OS mapping, but the catchments are smaller than those represented in the EA's Flood Zones.*

The Flood Zone values quoted show the percentage of the site at flood risk from that particular Flood Zone/event, including the percentage of the site at flood risk at a higher risk zone. For example: If 50% of a site is in the Flood Zones, taking each Flood Zone individually, 50% would be in Flood Zone 2 but say only 30% might be in Flood Zone 3a and only 10% in Flood Zone 3b. This would be displayed as stated above, i.e. the total % of that particular Flood Zone in that site. Flood Zone 1 is the remaining area of the site outside of Flood Zone 2, so Flood Zone 2 + Flood Zone 1 will equal 100%.

## 6.3 Recommendations for sites not taken forward to a Level 2 assessment

The 'amber' sites identified as having some lower level flood risk, but not requiring a Level 2 assessment, are shown in Table 6-2 below.

**Table 6-2: Sites flagged at lower flood risk**

| Site code | Site name | Nature of low flood risk/ considerations for the developer |
|---|---|---|
| ALV009 | Land Adjacent to The Cleckars | Approximately 20m away from an unmodelled watercourse, majority of the site is at higher ground, but steer development away from the watercourse. |
| BKL008a | PHASE 1 | Unmodelled watercourse directly along site boundary - drain looks to be confined with the topography. Steer development away from this boundary/ potential flood risk. |
| BUR004 | Worcester Road | Unmodelled watercourse near the site boundary and the site is at low elevations. Very close to the River Teme extent, but FZ2 does not encroach into the site. |
| MDR043 | MDNDP6 | Very close to the fluvial flood extent – steer development away from this boundary. |
| HKW009 | Land at School Bank Rd | Small pond and stretch of watercourse upstream of the site, which looks to be culverted under the site. Residual risk would follow the lower road as the site is elevated. |

| | | |
|---|---|---|
| OSW017 | Land at Trefonen Road | No fluvial risk, low surface water risk, on high ground, no access/ egress issues. Flagged for the reservoir potential risk. |
| PKH032 | Land at Hinsdale | Very close to the fluvial flood extent - flagged for steering development away from that boundary. |
| LYH007 | East of Barley Meadows | Unmodelled watercourse through the north of the site. Surface water risk very low though so most of the site can still be developed. Recommend FRA-level investigation of the unmodelled watercourse. |
| WHN024 | land off Donnett Close | Unmodelled watercourse along site boundary - mostly at higher ground. Steer development away from the boundary. |
| SHF018d | Not provided | Near an unmodelled watercourse, but the site is mostly at higher ground and at the upper end of the catchment. Also flagged for potential reservoir risk. |
| SHF029 | North of The Uplands | Downstream of a small reservoir; risk is low but site-specific assessments may need to consider this risk in more detail if the residual risk flow path could encroach into the site. |
| SHR054a | Site at Sundorne Road | Near the Flood Zone but mostly situated on higher ground, access/egress via A49 and B50629 (west). |
| SHR060 | Land adj. Oakfields Edgebold | Unmodelled watercourse at north-eastern corner of site, flagged to steer development away from this corner. |
| BAY050 | Oakmeadow | Unmodelled watercourse directly along the site boundary – blockage potential of culvert upstream of Eric Lock Road West. |
| BAY039 | Land off Lyth Hill Road, Bayston Hill | Unmodelled watercourse directly along site boundary and culverted through site. Blockage potential for consideration. |
| SHA019 | Between A53 Shrewsbury Rd and Poynton Rd | Unmodelled tributary (starting at the A53) of the Roden runs along the northern site boundary. Areas of surface water flooding lie adjacent to the watercourse, with highest risk at the downstream end near Poynton Road. The vast majority of the site is not at risk of flooding and there appears to be safe access available on Poynton Road. Development in the northern edge of the site needs to be 'avoided' or utilised as open space/ another. Site-specific FRA will be needed. |
| BUR001 | Green field adj. Aspire Centre | No fluvial risk, some surface water risk. |
| PKH013 | The Piggeries Site C | Only a small amount of flood risk adjacent to railway line (would likely be a buffer strip as part of a development layout). Uncertain how flood water would get past the railway line. No surface water issues. |
| PKH029 | Land at Hinsdale, Twmpath | Very low fluvial flood risk (site catching 1 pixel of a modelled flood extent). |
| SHR158 | Upper Edgebold | Unmodelled watercourse through the centre of the site but no clear connection to other watercourses and surface water risk ponds in alignment. |
| WBR007&008 | Site 2 & 3 merge | No fluvial risk and surface water risk low, but access and egress in surface water flooding events could be an issue. |

Some recommendations are stated below for consideration at the site-specific Flood Risk Assessment stage:

- For sites not represented in the Environment Agency's Flood Zones, or where Flood Zones do exist but no detailed hydraulic modelling is present, it is recommended that developers construct detailed hydraulic models at these sites as part of a site-specific FRA using channel, structure and topographic survey, to confirm flood risk.
- Where necessary, blockages of nearby culverts may need to be simulated in a hydraulic model to confirm residual risk to the site.
- Surface water risk should be considered in terms of the proportion of the site at risk in the 30-year, 100-year or 1,000-year events, whether the risk is due to isolated minor ponding or deeper pooling of water, or whether the risk is due to a wider overland flow route.
- Surface water risk and mitigation should be considered as part of a detailed site-specific Flood Risk Assessment and Surface Water Drainage Strategy.
- Access and egress should be considered at the site, but also in the vicinity of the site, for example, a site may have low surface water risk, but in the immediate locality, access/ egress to and from the site could be restricted for vehicles and/ or people.

## 6.4 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above in Table 6-1. The summary tables can be found in Appendix A.

Where available, the results from existing detailed Environment Agency hydraulic models were used in the assessment to provide depth, velocity, and hazard information (e.g. River Severn). Most sites were not located in areas where detailed hydraulic models are present.

Using the model information combined with the Flood Zones, climate change and Risk of Flooding from Surface Water (RoFfSW) extents, detailed site summary tables have been produced for the site options (see Appendix A). Each table sets out the following information:

- Basic site information
- Area, type of site, current land use (greenfield/ brownfield), proposed site use
- Sources of flood risk
  - Existing drainage features
  - Fluvial – proportion of site at risk including description from mapping/ modelling
  - Surface Water – proportion of site at risk including description from RoFfSW mapping
  - Reservoir
  - Canal
- Flood History
- Flood risk management infrastructure
  - Defences – type, Standard of Protection, and condition (if known), and description
  - Description of residual risk (blockage scenarios)
- Emergency Planning
  - Flood Warning Areas

- Access and egress
- Climate change
  - Summary of climate change allowances and increase in flood extent compared to Flood Zones
- Requirements for drainage control and impact mitigation
  - Broadscale assessment of possible SuDS to provide indicative surface water drainage advice for each site assessed for the Level 2 SFRA.
  - Groundwater Source Protection Zone
  - Historic Landfill Site
- NPPF Planning implications
  - Exception Test requirements
- Summary of cumulative impact of development (where required from the assessment in Chapter 9)
- Requirements and guidance for site-specific FRA (including consideration of opportunities for strategic flood risk solutions to reduce flood risk)
- Key messages – summarising considerations for the Exception Test to be passed
- Mapping information – description of data sources for the following mapped outputs:
  - Flood Zones
  - Climate change
  - Surface water
  - Fluvial depth, velocity, and hazard mapping
  - Surface water depth velocity and hazard mapping

### 6.4.1 Interactive GeoPDF mapping

To accompany each site summary table, there is an Interactive GeoPDF map, with all the mapped flood risk outputs per site. This is displayed centrally, with easy-to-use 'tick box' layers down the right-hand side and bottom of the mapping, to allow navigation of the data.

Flood risk information in the GeoPDFs include:

- Site boundary and Council boundary
- Title bar showing area, grid reference, site name, proposed development use (e.g. residential/ employment) and percentage Flood Zone coverage
- Flood Zones 2, 3a and 3b (functional floodplain) and indicative FZ3b (FZ3a in the absence of detailed models)
- Modelled 100-year fluvial depth, velocity, and hazard rating (where available, e.g. Severn in Shrewsbury)
- Risk of Flooding from Rivers and Sea
- Surface water 100-year depth, velocity, and hazard rating
- Fluvial climate change extents – Central, Higher Central and Upper End allowances (where detailed models are available) and Indicative climate change extents (FZ2, where no detailed models are available)

- Flood risk from surface water dataset (30-years, 100-years, and 1,000-years)
- Areas Susceptible to Groundwater Flooding
- Flood Warning and Flood Alert Areas
- Historic Landfill
- Defences (embankment and wall)
- Main Rivers/ Ordinary watercourses

# 7 Flood risk management requirements for developers

The report provides a strategic assessment of flood risk in Shropshire. 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 Flood Risk Assessment (FRA) may show that a site is not appropriate for development of a particular vulnerability or even at all. However, a detailed Flood Risk Assessment undertaken for a windfall site[2] may find that the site is entirely inappropriate for development of a particular vulnerability, or even at all.

## 7.1 Principles for new developments

**Apply the Sequential and Exception Tests**

Developers should refer to Section 3 for more information on how to consider the Sequential and Exception Tests. For allocated sites, Shropshire Council has already applied the Sequential and Exception Tests. For windfall sites a developer must undertake the Sequential Test, which includes considering reasonable alternative sites at lower flood risk. Only if it passes the Sequential Test should the Exception Test then be applied if required. The Sequential and Exception Tests in the NPPF apply to all developments and an FRA should not be seen as an alternative to proving these tests have been met.

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? and
- Can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

**Consult with the statutory consultees at an early stage to understand their requirements**

Developers should consult with the Environment Agency, Shropshire Council as LLFA and Severn Trent Water, Welsh Water and United Utilities as the water and sewerage companies, 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 development does not increase flood risk elsewhere and in line with the NPPF, seeks to reduce the causes and impacts of flooding**

[2] 'Windfall sites' is used to refer to those sites which become available for development unexpectedly and are therefore not included as allocated land in a planning authority's development plan.

Chapter 8 sets out these requirements for taking a sustainable approach to surface water management. Developers should also ensure 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.

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.

**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 an 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. Developers should open up existing culverts and should not construct new culverts on site except for short lengths to allow essential infrastructure crossings.

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

Wherever possible, developments should seek to help 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. Developers must demonstrate in an FRA how this has been considered at a site level.

## 7.2 Requirements for site-specific Flood Risk Assessments

### 7.2.1 When is a 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.
- Proposals for new development (including minor development and change of use) in an area within Flood Zone 1 which has critical drainage problems (as notified to the LPA by the Environment Agency).
- 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); the Environment Agency should be contacted to agree the breach assessment approach.
- Where evidence of historical or recent flood events have been passed to the LPA.

- In an area of significant surface water flood risk.

### 7.2.2 Objectives of site-specific FRAs

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

- whether a proposed development will be at risk of flooding, from all sources, both now and in the future, taking into account climate change.
- 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 Shropshire Council. 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)
- FRA Guidance Notes (Environment Agency SHWG Area Sustainable Places Team)
- **Shropshire Council flood risk advice to developers** and
- **Site-specific Flood Risk Assessment: CHECKLIST** (NPPF PPG, Defra).

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**.

## 7.3 Local requirements for mitigation measures

The Level 1 SFRA provides details on the following mitigation measures in Section 9.3, and should be referred to alongside this report:

- Site layout and design (9.3.1)
- Raised floor levels (9.3.2)
- Flood resilient design (9.3.3)
- Access and egress (9.3.4)
- Modification of ground levels (9.3.5)
- Development and raised defences (9.3.6)
- Developer contributions (9.3.7)
- Resistance and resilience measures (9.4)

## 7.4 Reducing flood risk from other sources

Section 9.6 of the Level 1 SFRA discusses how to reduce flood risk from other sources, such as groundwater, surface water and sewer flooding.

## 7.5 Flood warning and emergency planning

Section 6.9 of the Level 1 SFRA discusses NPPF requirements and what Emergency Plan will need to consider. It also references the **West Mercia Local Resilience Forum** and other relevant information on emergency planning.

## 7.6 Duration and onset of flooding

The duration and onset of flooding affecting a site depends on a number of factors:

- The position of the site within a river catchment, with those at the top of a catchment likely to flood sooner than those lower down. The duration of flooding tends to be longer for areas in lower catchments.

  The River Severn and its Welsh tributary the River Vyrnwy drain a large area of mid and south Wales. In the upper reaches in Wales in particular, Llyn (Lake) Clywedog and Llyn Vyrnwy (which are water supply reservoirs) provide some online flood storage that reduce the flood risk downstream and delays the onset of flooding. At the confluence of the Rivers Severn and Vyrnwy, just beyond the English border, there is a complicated system of historical agricultural flood defences. Because these overtop at different times, they provide some flood storage and reduce the peak as well as delay the onset of flooding in Shrewsbury.
- The principal source of flooding. Where this is surface water, depending on the intensity and location of the rainfall, flooding could be experienced within 30 minutes of the heavy rainfall event e.g. a thunderstorm. Typically, the duration of flooding for areas at risk of surface water flooding or from flash flooding from small watercourses is short (hours rather than days).
- The preceding weather conditions prior to the flooding. Wet weather lasting several weeks will lead to saturated ground. Rivers respond much quicker to rainfall in these conditions.
- Whether a site is defended, noting that if the defences were to fail, a site could be affected by very fast flowing and hazardous water within 15 minutes of a breach developing (depending on the size of the breach and the location of the site in relation to the breach), causing danger to life. There are no Level 2 sites assessed that could be affected by a breach in flood defences within the Council area; however, future developments located near flood defences, such as those on the River Severn in Shrewsbury Town Centre, should consider the potential risk from a breach.
- Catchment geology, for example chalk catchments talk longer to respond than typical clay catchments.

**Table 7-1: Guidelines on the duration of and onset of flooding**

| Principal source of flooding | Duration | Onset |
|---|---|---|
| **Surface water** | Up to 4 hours | Within 30 minutes |
| **Fluvial** | 4 – 24* hours | Within 2 - 8 hours |

**Depending on where in the catchment a site is located, flooding could be rapid and flashy in the upper catchment, and slower responding and longer in duration in the lower catchment.*

It is recommended that a site-specific Flood Risk Assessment refines this information, based on more detailed modelling work where necessary.

# 8 Surface water management and SuDS

The Level 1 SFRA summarises guidance and advice on managing surface water runoff and flooding in Chapter 10. Below is a guide to what is included in sections not expanded on here, for reference alongside this Level 2 SFRA:

- Section 10.1 – what is meant by surface water flooding?
- Section 10.2 – Role of the LLFA and Local Planning Authority in surface water management

## 8.1 Sources of SuDS guidance

### 8.1.1 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.

### 8.1.2 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.

### 8.1.3 Shropshire SuDS Handbook

Shropshire Council have worked in partnership with seven other West Midlands LLFA 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. Shropshire Council have widely consulted with other RMAs when preparing the document to ensure their views have been taken into account.

Section 10.3 of the Level 1 SFRA outlines details on the SuDS Handbook and its Local Standards (based on the 2018 consultation version). The reader should check the **Shropshire Council website** for the latest version.

## 8.2 Other surface water considerations

### 8.2.1 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 on **Defra's interactive mapping.**

### 8.2.2 Groundwater Source Protection Zones (GSPZ)

The Environment Agency also defines Groundwater Source Protection Zones (SPZs) 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 website**.

The Level 1 SFRA, Figure 10-3, shows the Groundwater SPZ on a map. The vast majority of Shropshire is not located within a Groundwater SPZ. Areas within a Groundwater SPZ are predominantly located along the Severn towards Shrewsbury, to the east of Shropshire near Shifnal, Albrighton and east of Bridgnorth, and isolated areas in the north.

The east and parts of the northern areas of Shropshire are underlain by a bedrock classified as Principal and due to the permeable nature of this bedrock, infiltration may not be a suitable SuDS technique in this area. For SuDS techniques that are designed to encourage infiltration, it is imperative that the water table is low enough and a site-specific infiltration test is conducted early on as part of the design of the development. Infiltration should be considered with caution within areas of possible subsidence or sinkholes. Where sites lie within or close to groundwater protection zones (GSPZs) or aquifers or near areas of contaminated land / areas of former mining works, further restrictions may be applicable, and guidance should be sought from the LLFA.

### 8.2.3 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. The NVZ coverage can be viewed on the **Environment Agency's online maps**.

Parts of Shropshire are located within surface water NVZ, mainly in the north and east, covering the urban centres of Whitchurch, Wem, Market Drayton, Ellesmere, Bridgnorth and Much Wenlock. The north-eastern and eastern parts of Shropshire are also located within groundwater NVZ, covering the urban centres of Market Drayton, Newport and Bridgnorth. There are a few isolated areas of eutrophic water NVZ, notably around the Meres in Shropshire; Colemere, Ellesmere, White Mere and Crose Mere in the north-west of the county.

# 9 Cumulative impact of development and strategic solutions

## 9.1 Introduction

Under the NPPF, strategic policies and their supporting Strategic Flood Risk Assessments (SFRAs) 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, as well as the impact of increased flows on flood risk downstream. 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.

The Level 1 SFRA assessed catchments within Shropshire to determine which catchments are at the highest risk from the cumulative impact of development and made recommendations based on the results. These catchments and recommendations have been reviewed for the Level 2 SFRA and hence the Level 1 SFRA Cumulative Impact Assessment is now superseded.

The latest development site boundaries and historical flooding information was used to update the cumulative impact assessment for the Level 2 SFRA. The assessment ranked catchments based on the number of properties within the catchment at risk of surface water flooding, the number of historic flooding events within a catchment and the amount of proposed development within the catchment. For each catchment the rankings of all three assessments were added together to provide a 'final ranking'. The top 10 overall ranked catchments throughout Shropshire were considered to be the highest risk catchments.

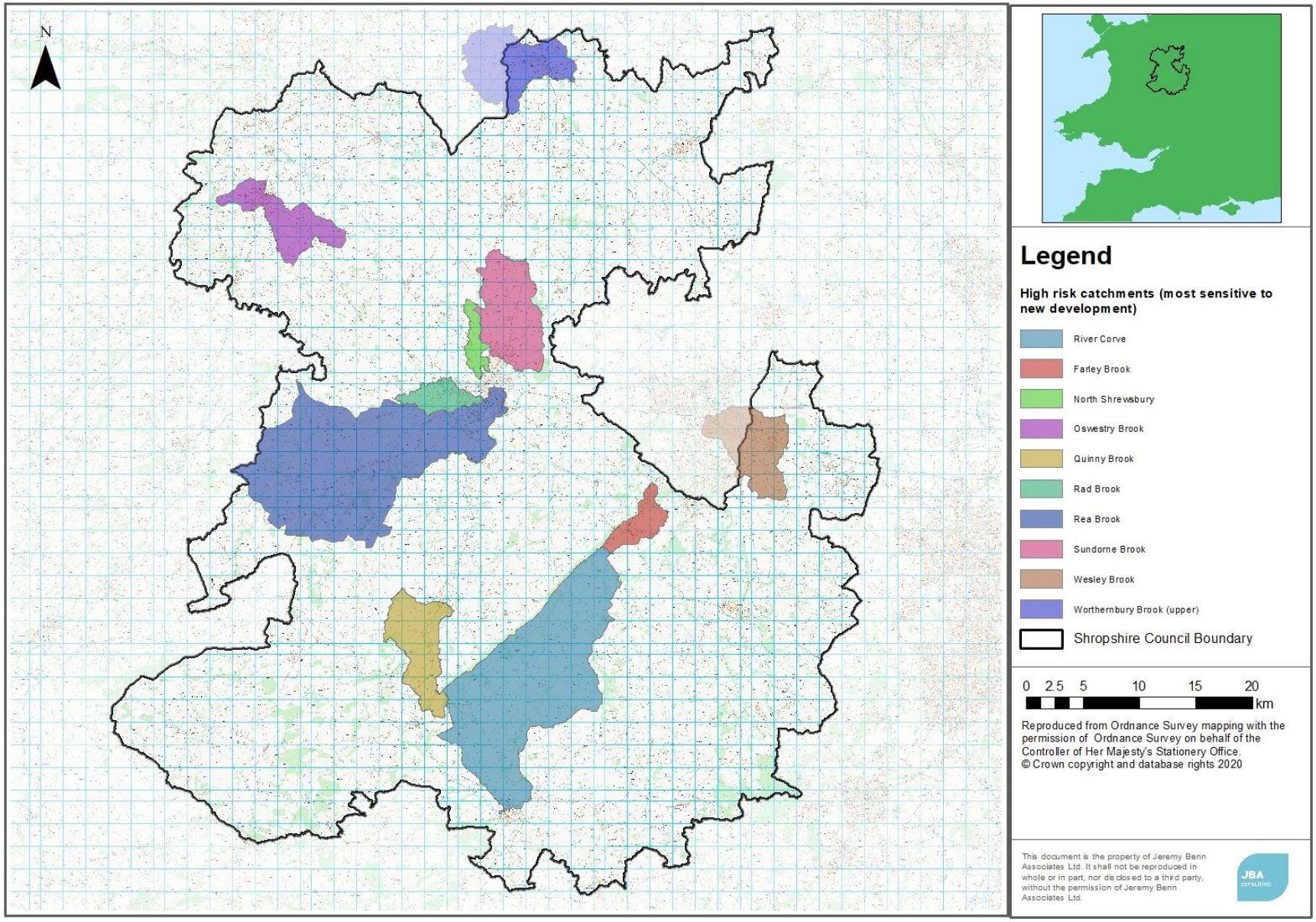
The top 10 high risk catchments identified as part of the updated cumulative impact assessment are shown in Figure 9-1. These include:

- River Corve*

  **A sub-catchment of the River Corve from Seifton Brook to the confluence with the River Teme ranked within the top 10 high risk catchments. The whole catchment has been considered in this cumulative impact assessment after discussion with Shropshire Council.*
- Farley Brook
- North Shrewsbury
- Oswestry Brook
- Quinny Brook
- Rad Brook
- Rea Brook
- Sundorne Brook
- Wesley Brook
- Worthernbury Brook (upper)

This cumulative impact assessment, as part of the Level 2 SFRA, looks at the effect of the proposed development in the high risk catchments listed above and gives a strategic indication of the storage measures that could be implemented at the sites to ensure flood risk is not increased downstream. Development at Cosford Airfield has also been considered because of the size of the allocation.

**Figure 9-1 The most sensitive catchments in Shropshire to the cumulative impact of development**



## 9.2 Strategic flood risk solutions

Shropshire Council has a vision for the future management of flood risk and drainage in the district. 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. The Local FRM Strategy and Severn Flood Risk Management Plan set out specific actions for the County.

The Level 1 SFRA details Flood Alleviation Schemes (Section 11.2), Natural Flood Management (11.3), flood storage (11.4), catchment and floodplain restoration (11.5) and culverts (11.6). This section, alongside Chapter 2, sets out strategic plans that exist for Shropshire. The list below summarises the key outcomes these are seeking to achieve. This vision needs to be delivered by new development alongside retrofitting and enhancing green infrastructure and flood defence schemes in the existing developed area.

The strategic policy vision from the CFMP and RBMP focuses on re-naturalising watercourses, safeguarding the floodplains and the encouraging collaboration and creating new partnerships to reduce the risk of flooding and to enhance the natural environment. Within Shropshire, strategic solutions encourage development to:

- Use sustainable flood storage and mitigation schemes to store water and manage surface water runoff in locations that provide overall flood risk reduction as well as environmental benefits.
- In areas where flood risk is being managed effectively, there will be a need in the future to keep pace with increasing flood risk as a result of climate change.
- Promote partnership working with all relevant stakeholders in the Severn River Basin. This includes working with land managers and farmers to reduce soil erosion from intensively farmed land.
- Assess long-term opportunities to move development away from the floodplain and create green river corridors through Shropshire.
- Identify opportunities to use areas of the floodplain to store water during high flows, to reduce long term dependence on engineered flood defences located both within Shropshire and outside Shropshire.
- Safeguard the natural floodplain from inappropriate development.
- Where possible, land management change should be used to reduce run-off rates from the development whilst maintaining or enhancing the capacity of the natural floodplain to retain water. Land management and uses that reduce runoff rates in upland areas should be supported.
- Development should maintain conveyance of watercourses through hamlets and villages to help reduce the impact of the more frequently experienced floods and to improve the natural environment.
- Use SFRAs to inform future development and minimise flood risk from all sources.
- Implement upstream catchment management e.g. slow the flow and flood storage schemes could be implemented in upper catchments to reduce flooding downstream and across neighbouring authority boundaries; and

- Promote and consider SuDS at the earliest stage of site development.

The **River Severn Catchment Flood Management Plan** gives an overview of the flood risk in the River Severn catchment, and sets out plans for sustainable flood risk management across 9 sub-areas. Shropshire is covered by several sub-areas:

- Severn Uplands and Vyrnwy confluence
- Middle Severn Corridor
- Shropshire Tributaries
- Middle Avon, Tributaries, Arrow and Alne, Redditch, Rugby and Teme
- Telford, Black Country, Bromsgrove, Kidderminster & Coventry cluster

Generic flood risk management policies have been allocated to each of these areas.

## 9.3 Proposed development in Shropshire

Of the 98 sites provided for assessment by Shropshire Council, 34 of these sites fall within the high-risk catchment boundaries. Twenty-nine of these sites lie wholly within a single catchment whilst five sites extend across multiple catchment boundaries. Table 9-1 displays the proposed development sites and the catchments that each site falls within.

**Table 9-1 Site areas within the most sensitive catchments**

| Site Reference | Catchment 1 | Site area within catchment 1 (%) | Catchment 2 | Site area within catchment 2 (%) |
|---|---|---|---|---|
| BAY039 | Rea Brook | 100% | - | - |
| BAY050 | Rea Brook | 100% | - | - |
| CST021 | Quinny Brook | 100% | - | - |
| HDL006 | Sundorne Brook | 100% | - | - |
| IRN001 | Farley Brook | 15% | Severn* | 85% |
| LUD056 | River Corve | 100% | - | - |
| MIN018 | Rea Brook | 100% | - | - |
| MUW012 | Farley Brook | 100% | - | - |
| OSW017 | Oswestry Brook | 100% | - | - |
| PON008 | Rea Brook | 100% | - | - |
| PON017 | Rea Brook | 100% | - | - |
| PON030 | Rea Brook | 100% | - | - |
| SHF013 | Wesley Brook | 100% | - | - |
| SHF015 | Wesley Brook | 100% | - | - |
| SHF018b | Wesley Brook | 6% | Burlington Brook* | 94% |
| SHF022/3 | Wesley Brook | 100% | - | - |

| | | | | |
|---|---|---|---|---|
| SHF029 | Wesley Brook | 100% | - | - |
| SHR054a | Sundorne Brook | 100% | - | - |
| SHR057 | Rad Brook | 100% | - | - |
| SHR060 | Rad Brook | 100% | - | - |
| SHR145 | Rea Brook | 100% | - | - |
| SHR158 | Rad Brook | 97% | Rea Brook | 3% |
| SHR161 | Rad Brook | 100% | - | - |
| SHR173 | North Shrewsbury | 71% | Severn* | 29% |
| SHR177 | Rad Brook | 100% | - | - |
| SHR197VAR | Sundorne Brook | 100% | - | - |
| WBR007&008 | Rea Brook | 100% | - | - |
| WBR010 | Rea Brook | 100% | - | - |
| WEF025 | Oswestry Brook | 32% | Weir Brook* | 68% |
| WHT014 | Worthernbury Brook | 100% | - | - |
| WHT037 | Worthernbury Brook | 100% | - | - |
| WHT042 | Worthernbury Brook | 100% | - | - |
| WHT044 | Worthernbury Brook | 100% | - | - |

**Not considered as a high-risk catchment in terms of sensitivity to the cumulative impact of development. For example, for the River Severn this is due to the relative size of proposed development areas compared to the entire catchment upstream.*

## 9.4 Methodology

### 9.4.1 Impact of proposed development

To ascertain the impact of the proposed development on downstream flows, catchment descriptors from the FEH Webservice were downloaded for each catchment. These catchment descriptors were then amended to account for modification to the catchment boundaries based on topography data and for the proposed development in the catchment. The URBEXT (urban extent) value was increased in line with the total area of development proposed in the catchment. The imperviousness factor was assumed to be 0.4 across all catchments. This value assumes that 40% of built up areas in the catchment is covered by impermeable surfaces.

From this information hydrographs showing the flood response in both a pre-development and post-development scenario in each catchment were generated for the 100-year flood event. It should be noted that these hydrographs have been derived from ReFH2 using catchment descriptors only, a detailed hydrological assessment to obtain these hydrographs has not been undertaken.

The pre- and post-development hydrographs produced with REFH2 were compared to calculate the additional volume of storm water passing through the

catchment as a result of increased impermeable surfaces from development. This value represents the volume of on-site storage required across the whole catchment to limit peak flow rates to the existing greenfield response. An additional scenario was calculated for each catchment hydrograph to show the potential impacts of the installation of SuDS across a catchment in a post-development scenario. Peak hydrograph flow was limited to pre-development levels and the additional volume generated in the post-development scenario was added onto the falling limb of the hydrograph. The results display how SuDS can limit the peak flow and release excess stormflows through the catchment at a lower rate, potentially reducing flood risk downstream.

### 9.4.2 Assessing the storage need at potential development sites

The UK SuDS Website provides a variety of tools for the design and evaluation of sustainable drainage systems. The surface water storage volume estimation tool was used to provide estimates of storage volume requirements needed to meet best practice criteria from Environment Agency guidance "Rainfall runoff management for developments", SC030219 (2013), the SuDS Manual C753 (CIRIA, 2015) and the non-statutory technical standards for SuDS (Defra, 2015). It should be noted that the estimates from this tool should not be used for the detailed design of drainage systems and sewer modelling is recommended when designing a drainage scheme.

The tool works by selecting a point on a map for the calculation and entering characteristics for the proposed development site. For this assessment, the most downstream point of each catchment was selected, the site area was entered, and a developable area/ impermeable area was assumed based on council recommendations and similar values from neighbouring authority SHLAA methodologies. The impermeable area of the site was assumed to be 70% of the total site area for both residential and employment sites.

All other variables in the tool were left as default, to avoid a large number of assumptions. The REFH2 method to calculate surface water storage requirements was used to allow comparison to the catchment scale assessment.

Where a site only partially fell into a high risk catchment, storage estimations have been provided for two scenarios: the first assuming that the entire site will discharge into the chosen catchment and the second assuming only the proportion of the site within the catchment will discharge to this catchment, with the rest discharging to another catchment. In reality, a site will generally discharge all to one catchment and where a site will discharge to is not yet known, this should be considered at a site-specific stage.

These analyses are carried out for the purpose of developing strategic planning policy buy highlighting the need for considering drainage amongst sites or groups of sites within a catchment. It is not intended at this stage to set out the absolute level of storage that must be provided at site level because specific information about development sites is not yet known, such as how much of the site will be developed and in what way, as well as information on underlying geological and soil conditions based on ground investigations. At a site-level, developers will need to undertake detailed drainage strategies to refine calculations of the amount of storage required on site. In line with national planning policy and national requirements for SuDS, storage will always be required for the 100-year plus applicable climate change event. Whether any additional storage would benefit downstream areas depends on where the site is located within the catchment.

## 9.5 Cumulative impact within high risk catchments

### 9.5.1 River Corve

One proposed development site in Ludlow, close to the catchment outlet into the River Teme, falls within this high-risk catchment (Figure 9-2). This catchment ranks highly for communities at risk from surface water flooding in the 100-year surface water event and there are a number of historic flooding events within the catchment, particularly in the lower part of the catchment. Within the River Corve catchment, the lower part of the catchment from Seifton Brook to the confluence with the River Teme is at a higher risk than the mostly rural upper catchment. Any increased flows through the upper-middle catchment would have impacts on Ludlow which lies at the catchment outlet.

**Figure 9-2 River Corve catchment development sites and proposed flood risk management schemes**

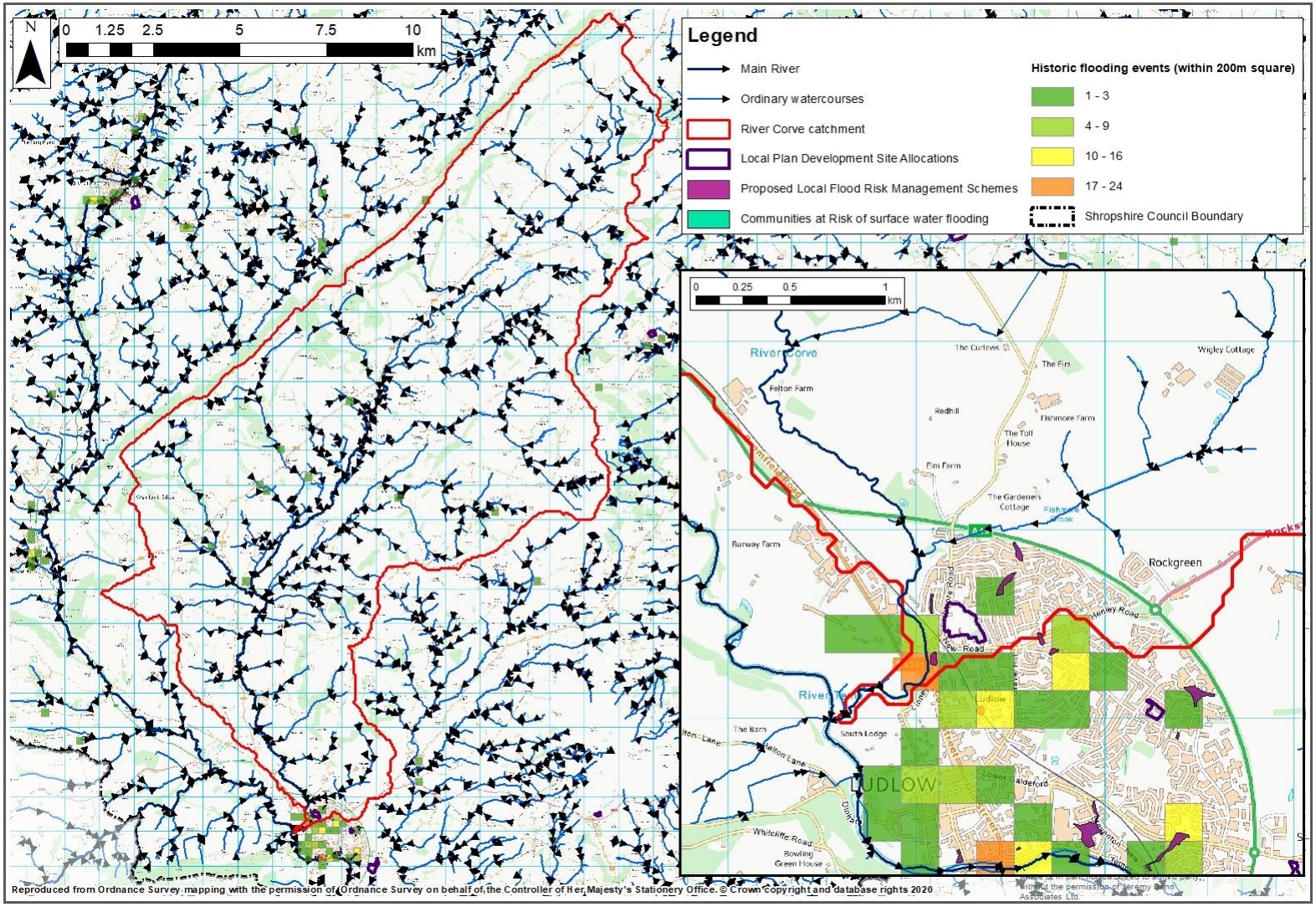


**Figure 9-3 River Corve hydrograph pre- and post-development**

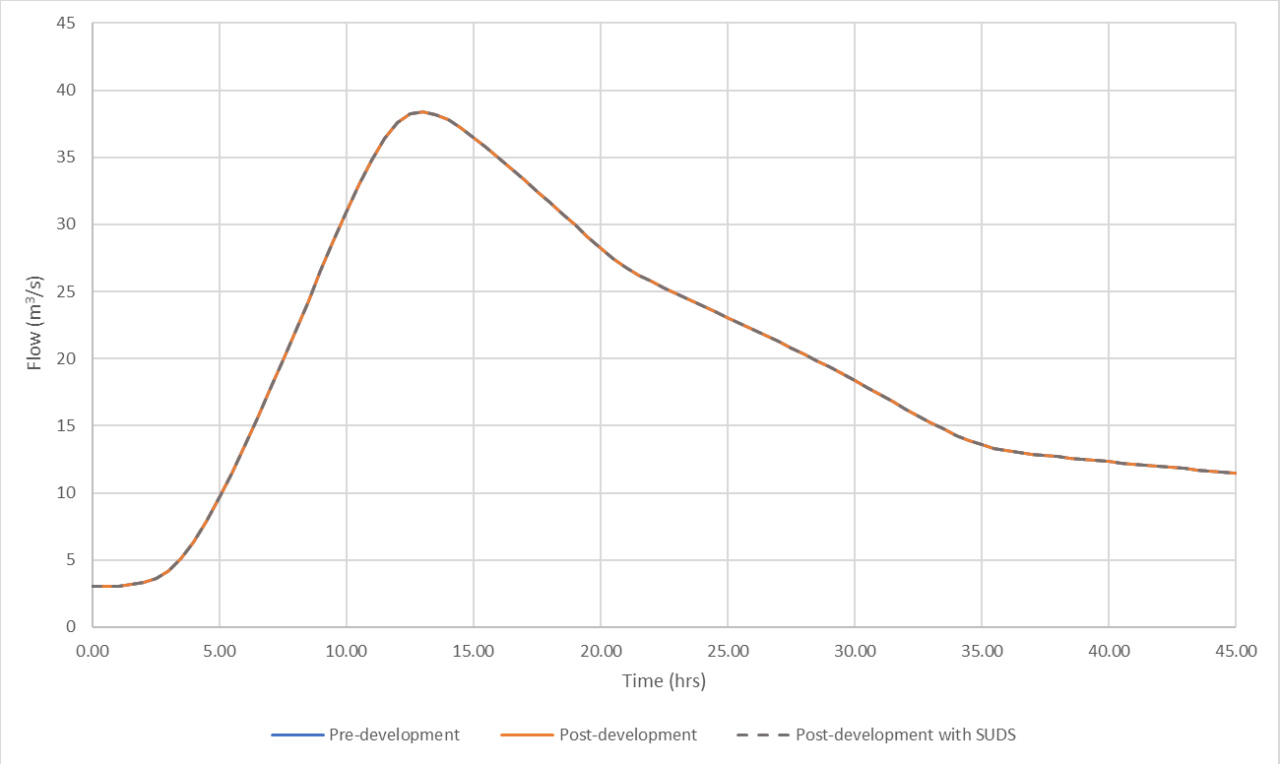



Figure 9-3 shows that proposed development in the River Corve catchment has minimal impact on peak flows at the catchment outlet with limited additional volume estimated to pass through the hydrograph in the post-development scenario. The proposed development covers only 0.08% of the River Corve catchment and is located close to the catchment outlet, a location that is unlikely to have a major impact on the remainder of the downstream catchment.

Table 9-2 describes the estimated storage volumes required in the Corve catchment to limit the surface water runoff to existing greenfield runoff rates.

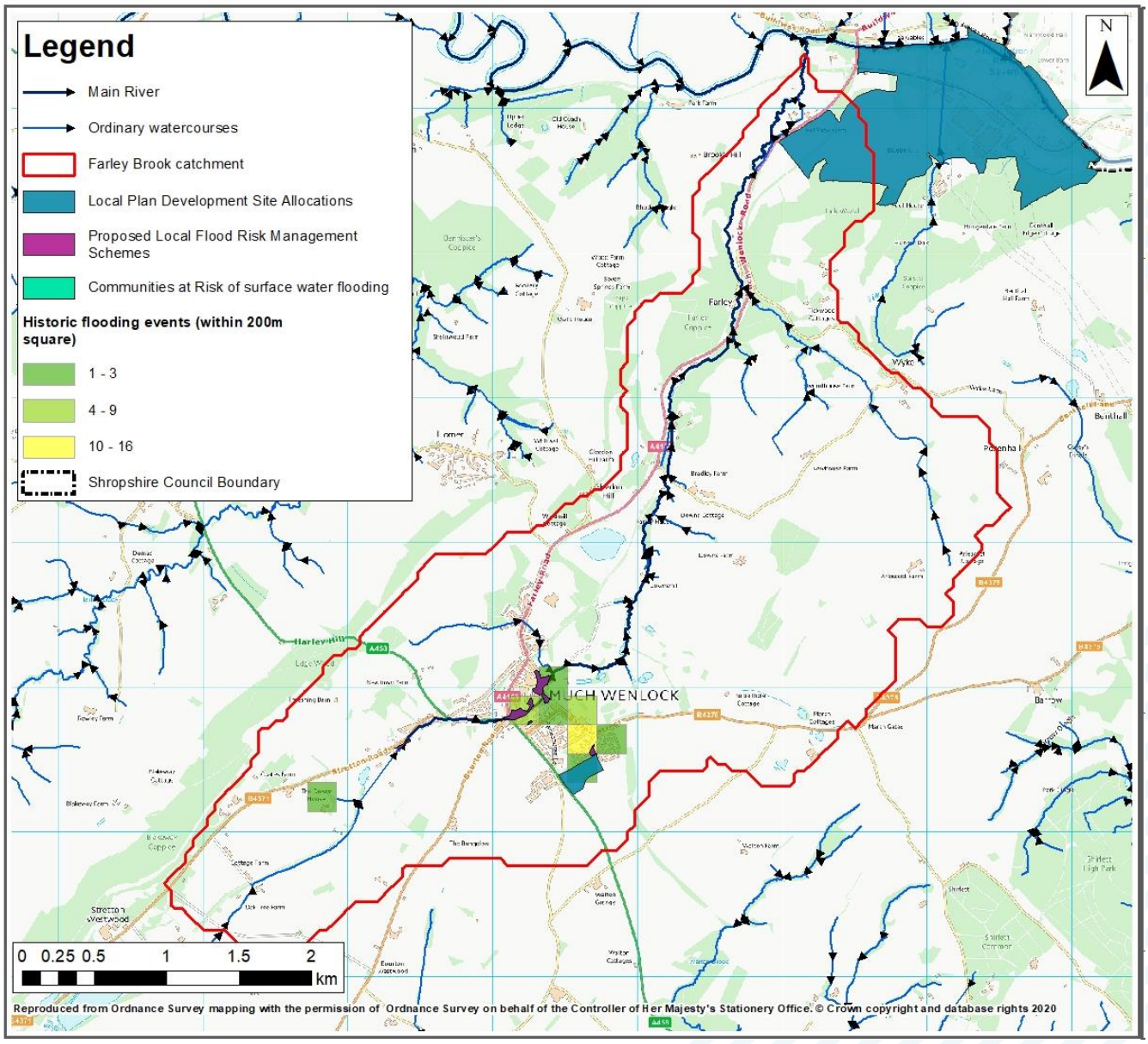
**Table 9-2 Estimated storage volumes required at sites in the River Corve catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years ($m^3$) | Long term storage 1 in 100 years ($m^3$) | Total storage 1 in 100 years ($m^3$) |
|---|---|---|---|---|
| **Ludlow** | LUD056 | 1197 | 0 | 1197 |

### 9.5.2 Farley/Shlyte Brook

Two sites have been identified that fall within or partially within this catchment boundary which can be seen in Figure 9-4. One site is located in the upstream area of the catchment in Much Wenlock. A large development site at the former Ironbridge Power Station site lies partially within the catchment close to the downstream outlet into the River Severn. The area covered by proposed development sites within this catchment is 1.7% of the total catchment area.

**Figure 9-4 Sites within the Farley/Shlyte Brook catchment**




The impact on the hydrograph due to this proposed development can be seen in Figure 9-5. The hydrograph peak in the post-development scenario is slightly higher with an estimated additional volume of 2701m$^3$ moving through the catchment compared to the current catchment response. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-5 Pre- and post-development hydrographs on the Farley Brook**

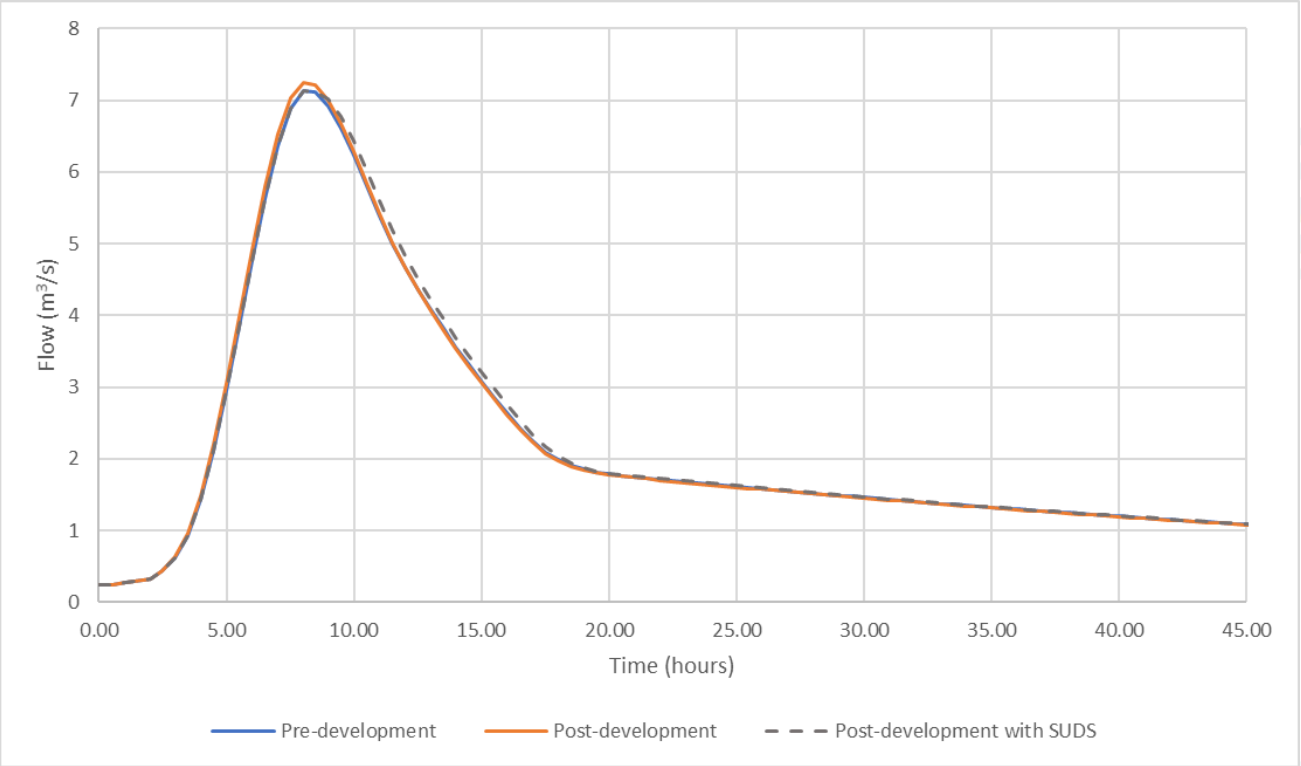



Table 9-3 describes the estimated storage required at each site to limit surface water runoff rates to existing greenfield rates. When considering only the part of the Ironbridge power station that drains directly into the Farley Brook catchment, a total of 1947m$^3$ of long-term storage capacity is required in the Farley Brook catchment.

**Table 9-3 Estimated storage volumes required at sites in the Farley Brook catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years (m³) | Long term storage 1 in 100 years (m³) | Total storage 1 in 100 years (m³) |
|---|---|---|---|---|
| **Ironbridge** | IRN001 | 53872* | 10758* | 64629* |
| | | 8348** | 1667** | 10015** |
| **Much Wenlock** | MUW012 | 1402 | 280 | 1682 |

**Storage assuming entire site is discharged into the Farley Brook catchment*

***Storage assuming only site area within the Farley Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

### 9.5.3 North Shrewsbury

One development site falls partially within the North Shrewsbury catchment. It is located in the southern part of the catchment, close to the downstream extent (Figure 9-6Figure 9-6) and covers 2.4% of the catchment area. This sub-catchment of the River Severn has also seen high incidence of historic flood events and ranks highly for communities at risk of surface water flooding.

**Figure 9-6 Proposed development in the North Shrewsbury catchment**

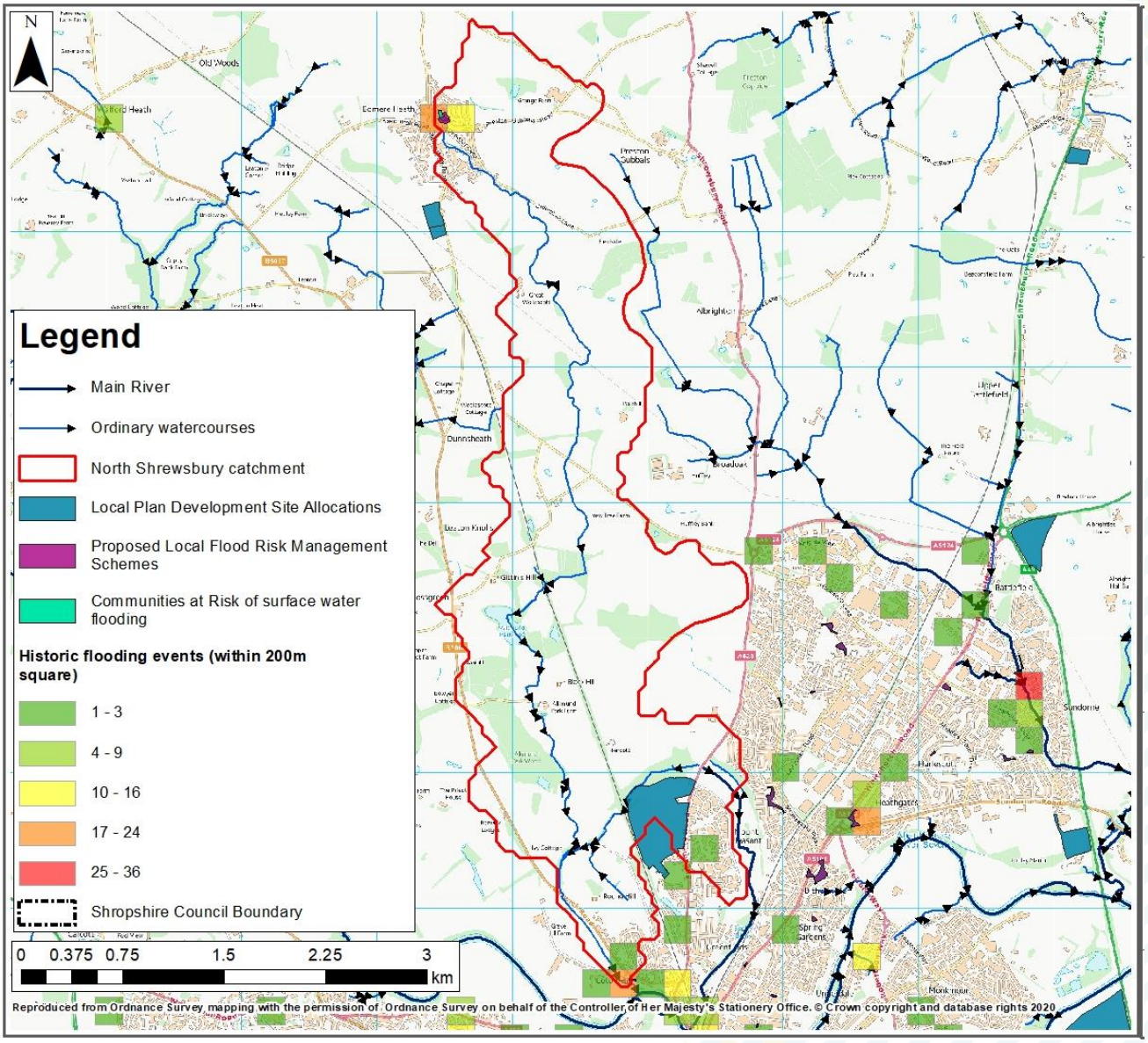



Figure 9-7 shows a slight increase in peak flow with an estimated 2180.4m$^3$ increase in the volume of water moving through the catchment in the 100-year storm event during the post-development scenario. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-7 Pre- and post-development hydrographs in North Shrewsbury catchment**

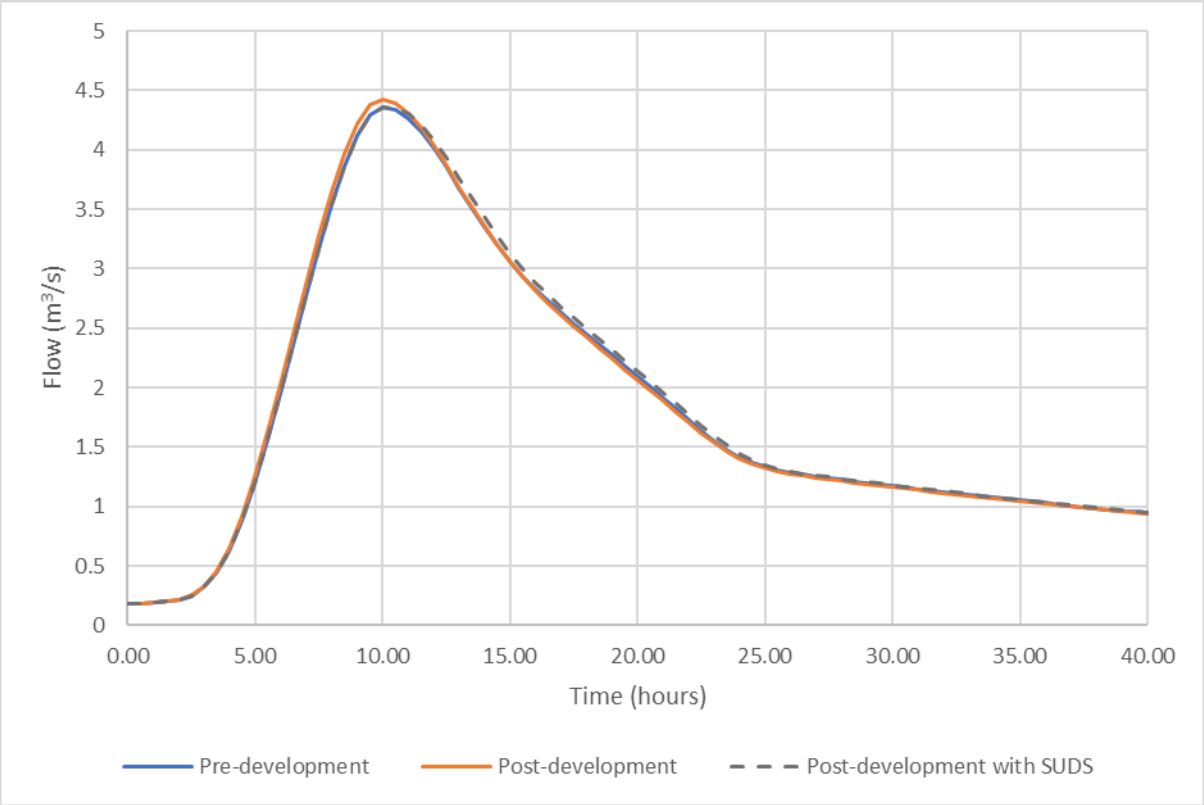



Table 9-4 suggests that long term storage provision on this site should have a volume of 1171m3 to ensure that surface water runoff rates from the site remain at current greenfield runoff rates in the North Shrewsbury catchment.

**Table 9-4 Estimated storage volumes required at sites in the North Shrewsbury catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years ($m^3$) | Long term storage 1 in 100 years ($m^3$) | Total storage 1 in 100 years ($m^3$) |
|---|---|---|---|---|
| **Shrewsbury** | SHR173 | 7929* | 1657* | 9586* |
| | | 5600** | 1171** | 6771** |

**Storage assuming entire site is discharged into the North Shrewsbury catchment*

***Storage assuming only site area within the North Shrewsbury catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

### 9.5.4 Oswestry Brook

There are two development sites that fall within or partially within the Oswestry Brook catchment shown in Figure 9-8. One site lies on the southwest border of the town of Oswestry. A residential development site in West Felton, in the southeast of the catchment, lies partially within this catchment. Only 0.07% of the catchment

area is covered within these development site boundaries but this catchment ranks highly for communities at risk of surface water flooding in the 100-year event.

**Figure 9-8 Proposed development sites in Oswestry Brook catchment**

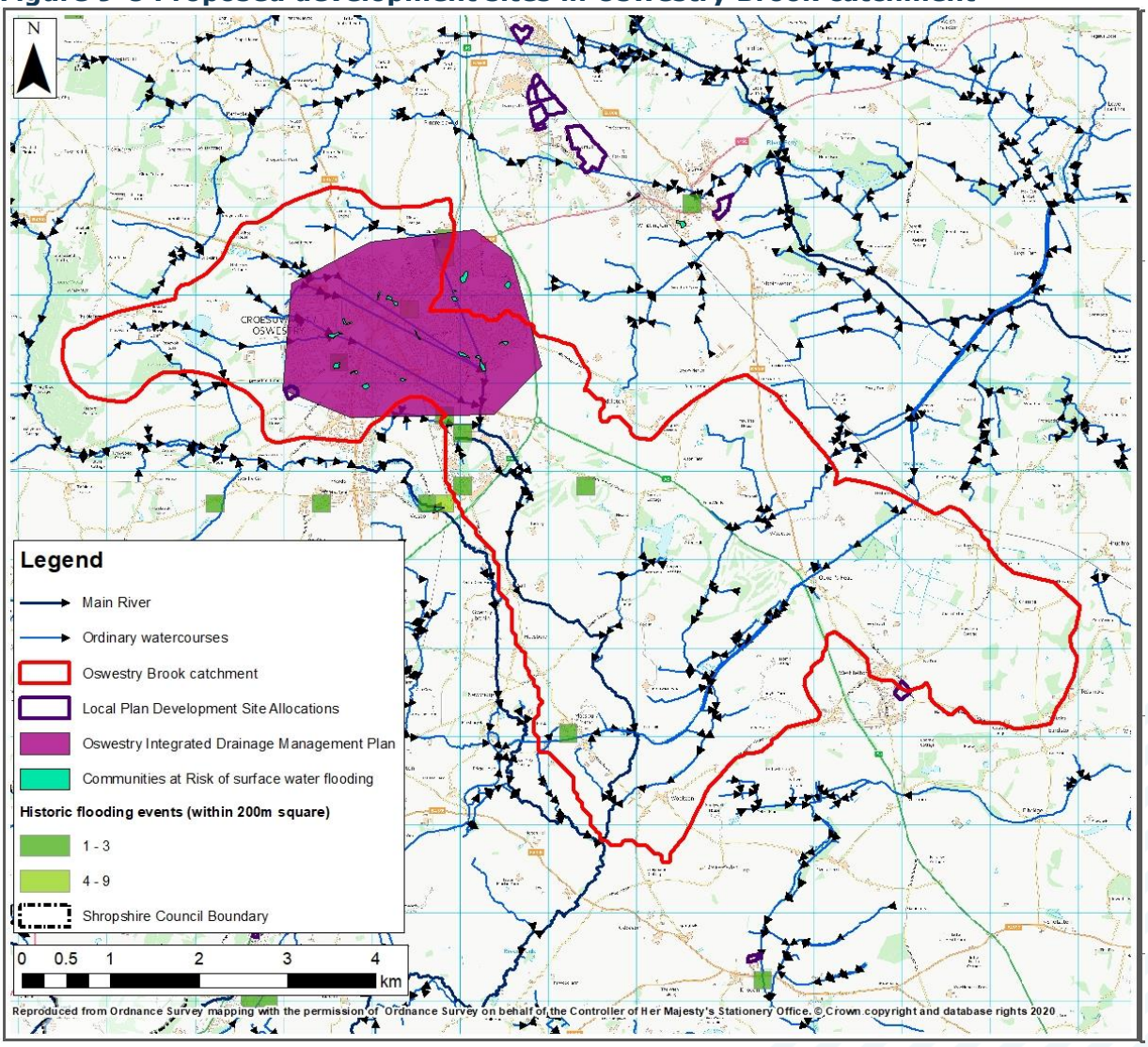



Figure 9-9 shows that these proposed development sites have minimal impact on peak flow moving through the catchment with only 243.5m3 of additional volume estimated to be moving though the catchment as a result of development. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-9 Pre- and post-development hydrographs in Oswestry Brook**

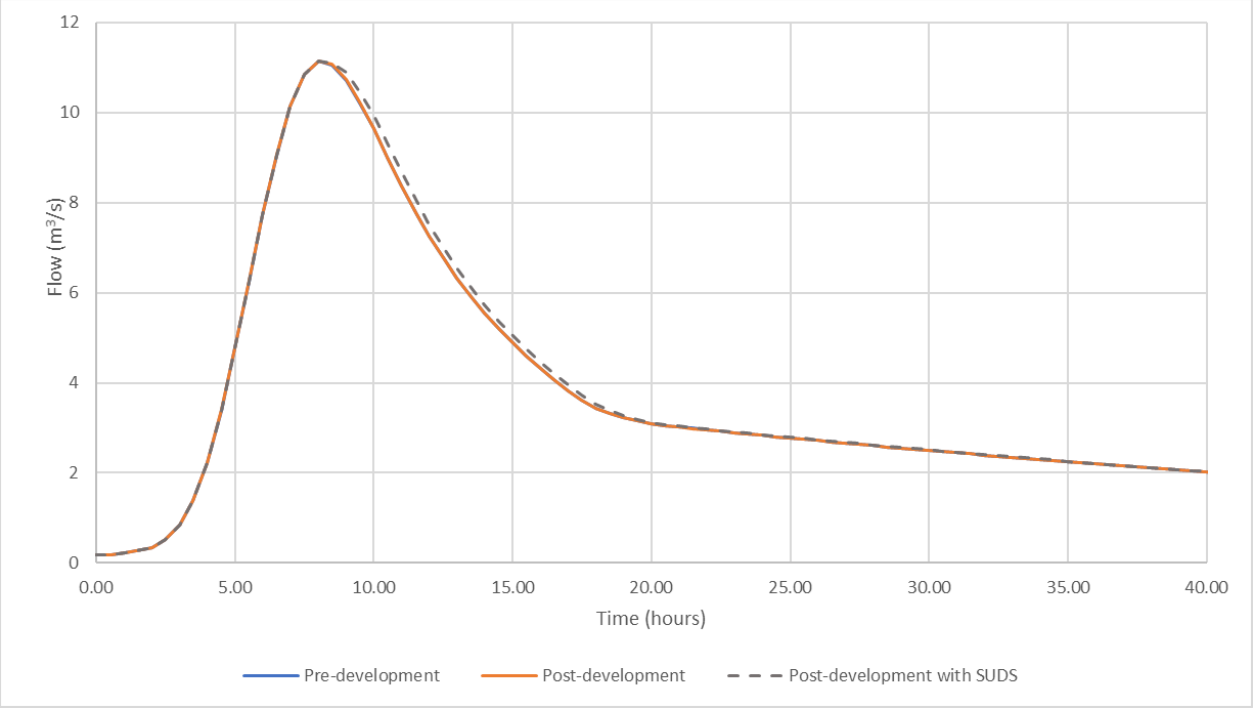



Table 9-5 describes the estimated storage required at each site to limit surface water runoff rates to existing greenfield rates.

**Table 9-5 Estimated storage volumes required at sites in the Oswestry Brook catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years ($m^3$) | Long term storage 1 in 100 years ($m^3$) | Total storage 1 in 100 years ($m^3$) |
|---|---|---|---|---|
| **Oswestry** | OSW017 | 534 | 0 | 534 |
| **West Felton** | WEF025 | 785* | 0* | 785* |
| | | 158** | 0** | 158** |

**Storage assuming entire site is discharged into the Oswestry Brook catchment*

***Storage assuming only site area within the Oswestry Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

### 9.5.5 Quinny Brook

There is one proposed development site located within the Quinny Brook catchment which covers approximately 0.11% of the catchment area and is located in Church Stretton, close to the watershed in the northwest of the catchment (Figure 9-10). This catchment is also subject to surface water risk in the 100-year event. Figure 9-11 shows that this development has minimal impact on peak flows moving through the catchment with an estimated 431.3$m^3$ increase in volume of water passing through the catchment in the post-development scenario. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-10 Proposed development in the Quinny Brook catchment**

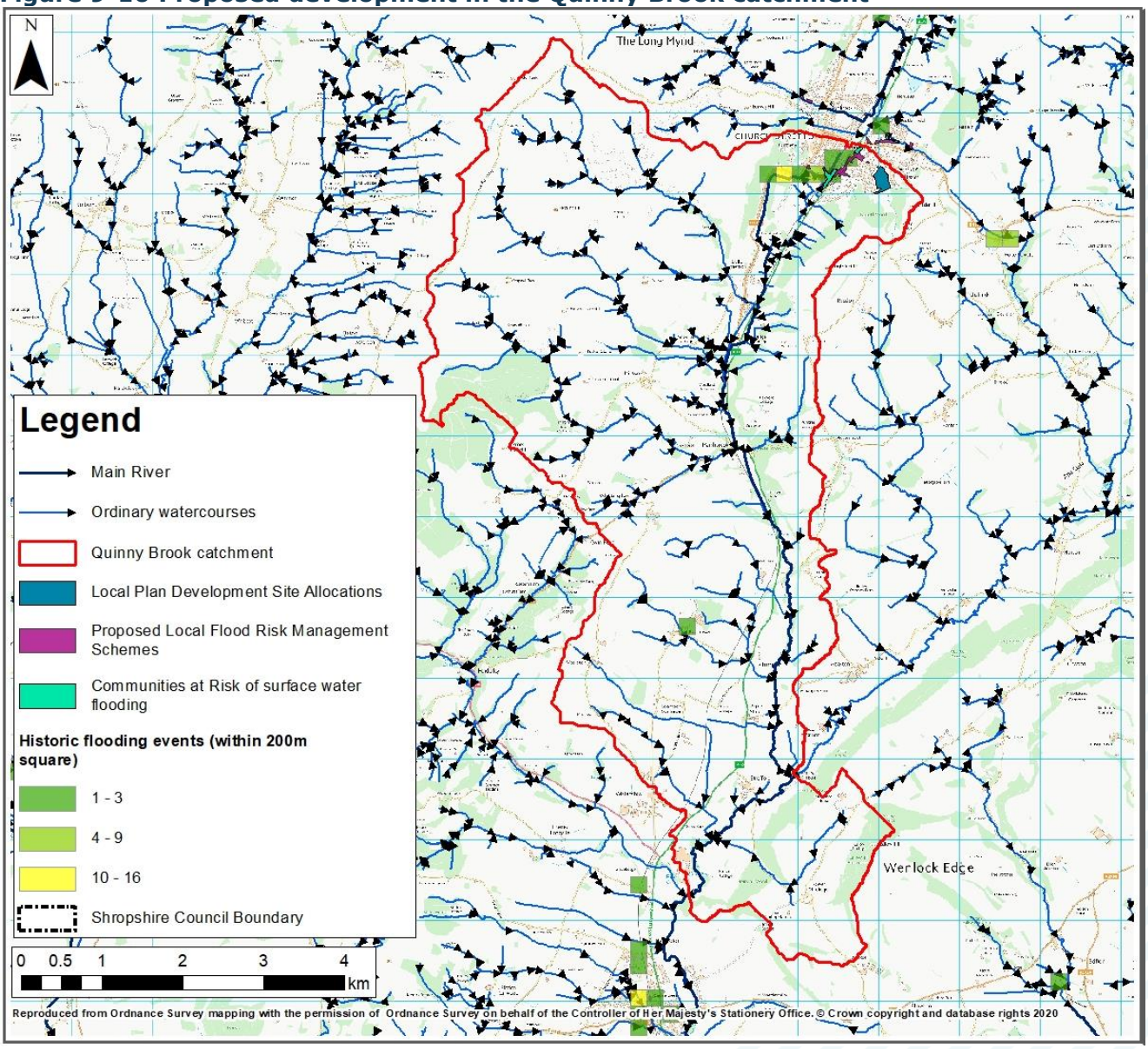
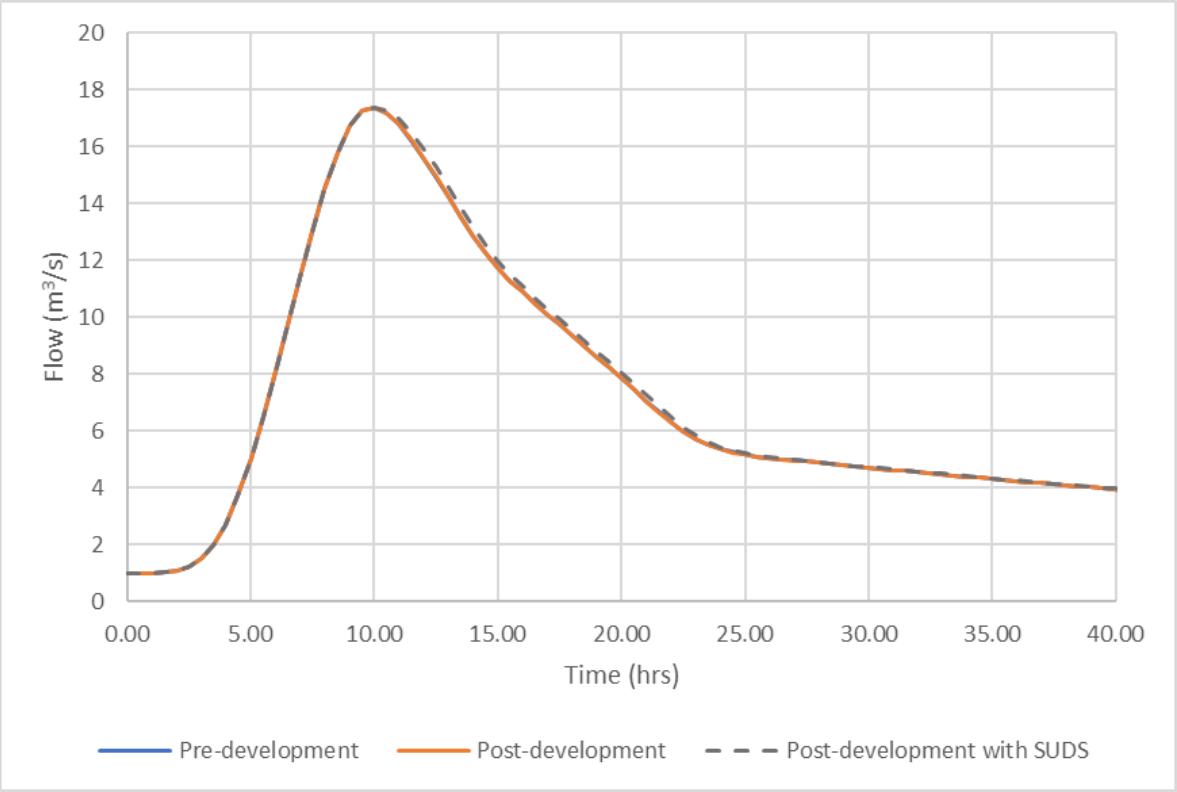


**Figure 9-11 Pre-development and post-development hydrographs in the Quinny Brook catchment**




At a site-specific scale, it is suggested that a long-term storage solution with a volume of 463[3] is used to attenuate surface water runoff to ensure that it remains at the current greenfield runoff level. The results from the UK SuDS tool can be seen in Table 9-6.

**Table 9-6 Estimated storage volumes required at sites in the Quinny Brook catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years ($m^3$) | Long term storage 1 in 100 years ($m^3$) | Total storage 1 in 100 years ($m^3$) |
|---|---|---|---|---|
| **Church Stretton** | CST021 | 1593 | 463 | 2056 |

### 9.5.6 Rad Brook

There are five proposed development sites that are partially or completely within the Rad Brook catchment (Figure 9-12). The sites lie close to one another in the central part of the catchment on the southwest borders of Shrewsbury, covering 8.75% of the entire catchment area. The Rad Brook catchment flows directly into the River Severn at its downstream extent.

**Figure 9-12 Proposed development in the Rad Brook catchment**

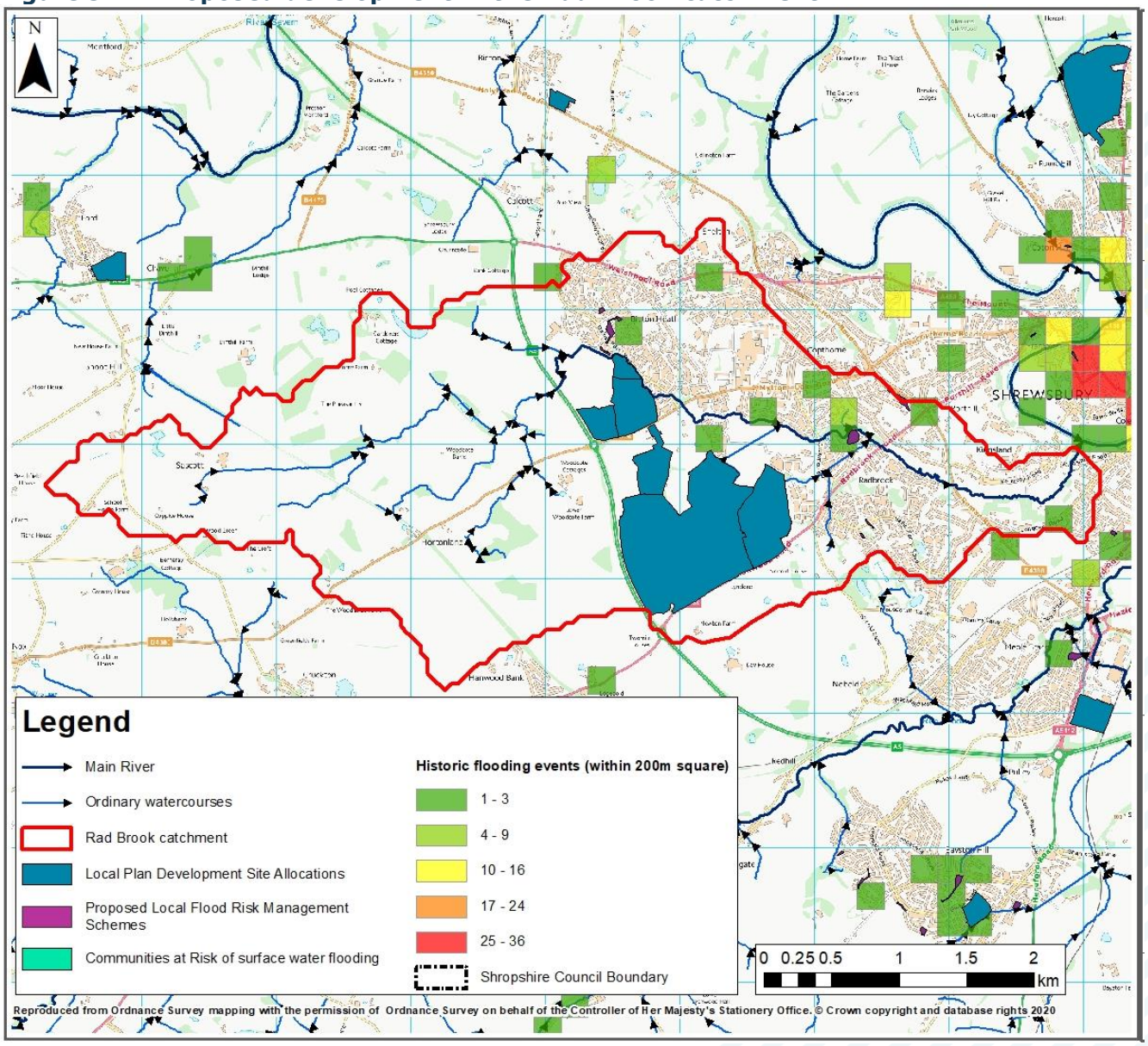



Figure 9-13 shows that proposed development in this catchment causes a higher peak flow in the 100-year storm hydrograph with an estimated volume increase of 13128.2m3 passing through the catchment in the post-development scenario. Additionally, the peak occurs earlier in the storm event and has a shorter duration showing that increased development in this catchment causes a flashier hydrograph response. To ensure that current greenfield flow rates are maintained, this excess volume would need to be stored or attenuated within the catchment.

Figure 9-13 also shows a representation of the potential post-development scenario with SuDS installed in the catchment. It shows that the hydrograph peak is limited to pre-development levels and that the excess stormflow volume generated by development is attenuated as it is slowly released to return to baseflow.

**Figure 9-13 Pre- and post-development hydrographs in the Rad Brook catchment**

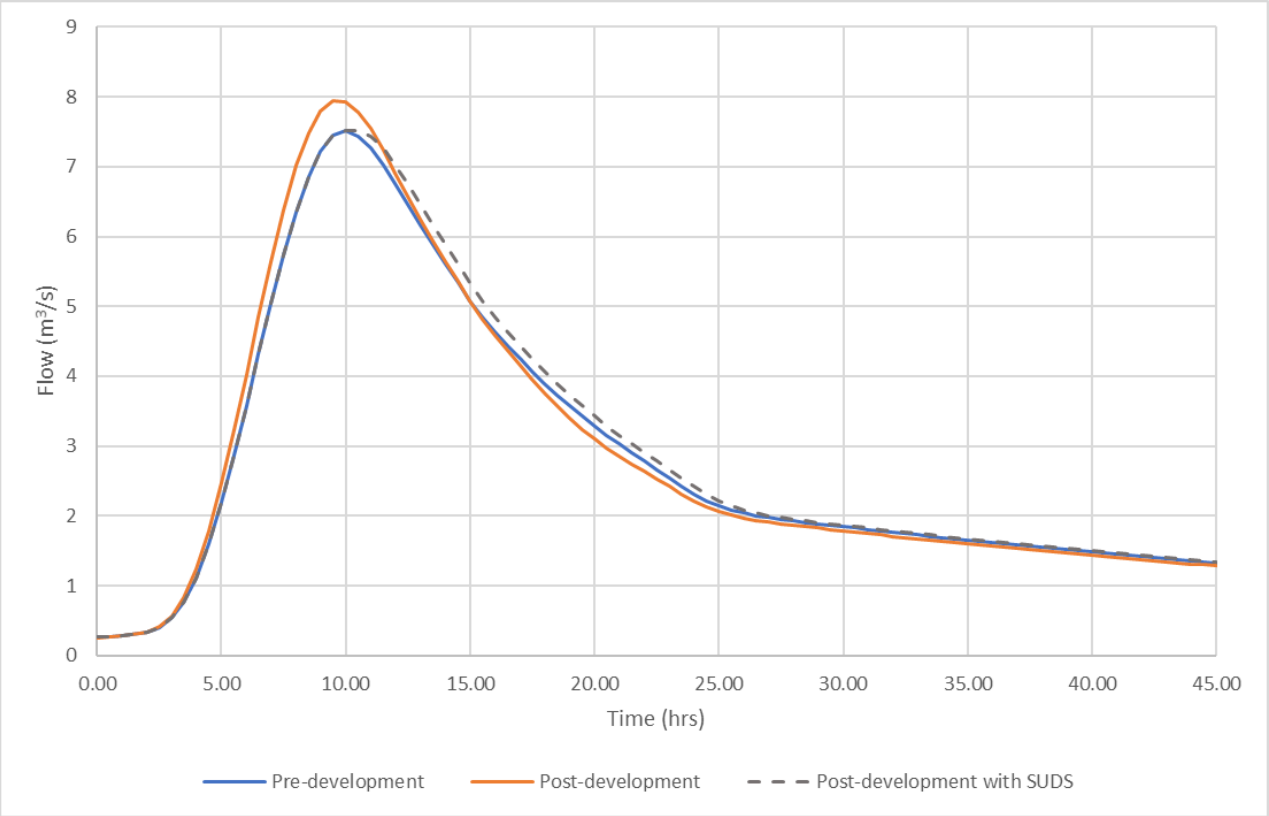



Table 9-7 suggests that at a site-specific scale a total of 13415m$^3$ is required in long-term storage in the Rad Brook catchment in order to ensure that surface water runoff rates remain at the same level as current greenfield runoff rates.

**Table 9-7 Estimated storage volumes required at sites in the Rad Brook catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years (m$^3$) | Long term storage 1 in 100 years (m$^3$) | Total storage 1 in 100 years (m$^3$) |
|---|---|---|---|---|
| **Shrewsbury** | SHR057 | 5446 | 1844 | 7290 |
| | SHR060 | 6592 | 2233 | 8825 |
| | SHR158 | 25052* | 8245* | 33537* |
| | | 24341** | 8245** | 32585** |
| | SHR161 | 2819 | 955 | 3774 |
| | SHR177 | 740 | 138 | 878 |

**Storage assuming entire site is discharged into the Rad Brook catchment*

***Storage assuming only site area within the Rad Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

### 9.5.7 Rea Brook

The Rea Brook catchment feeds into the River Severn at Shrewsbury and borders the Rad Brook catchment. This catchment is identified as high risk due to the high number of historic flooding incidents and due to risk of surface water flooding. There are 10 proposed development sites across this catchment both in the more

rural areas of the upper catchment and on the outskirts of more urbanised Shrewsbury closer to the catchment outlet (Figure 9-14).

**Figure 9-14 Map of the Rea Brook catchment and allocated development sites**

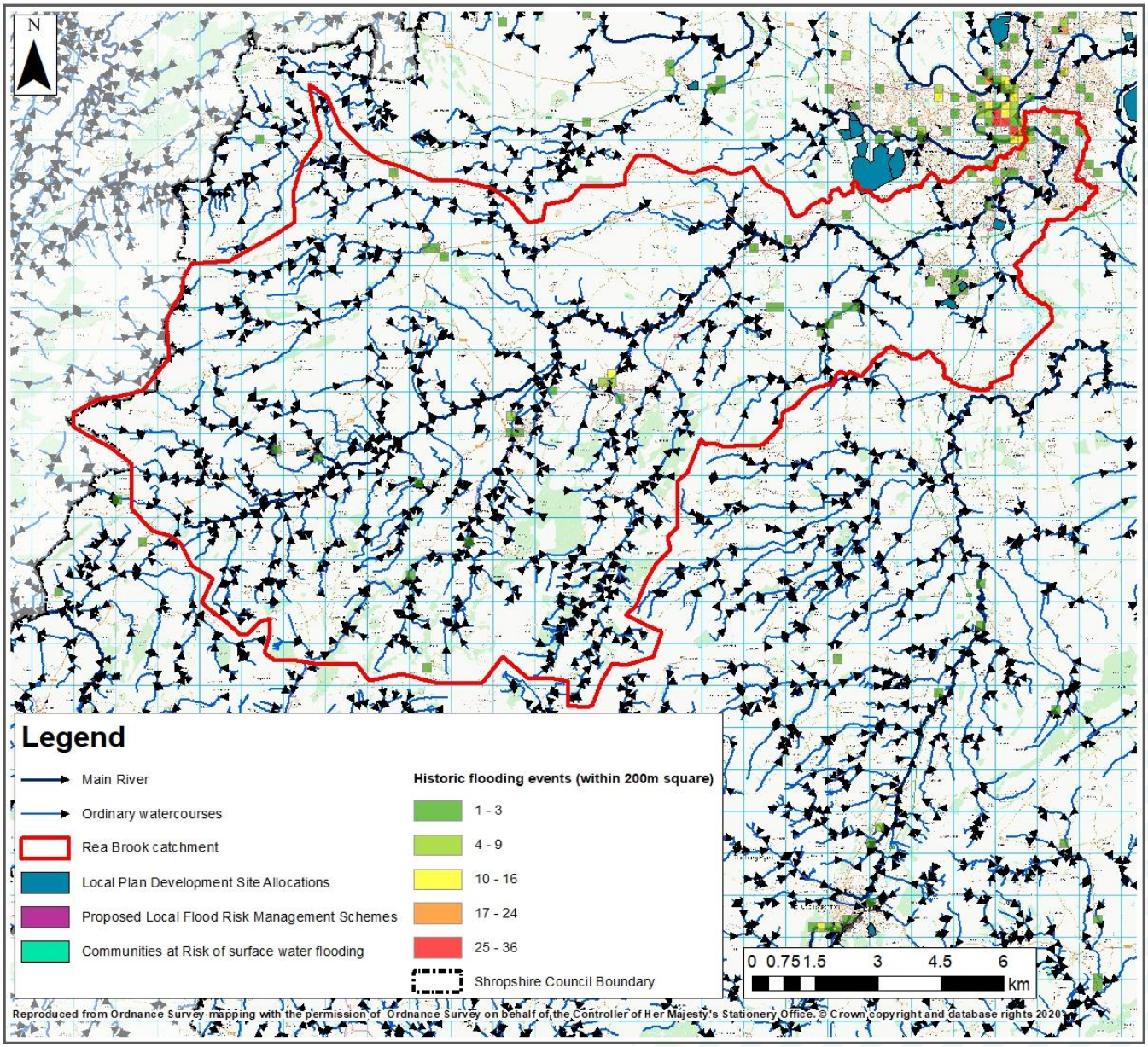



Figure 9-15 shows the change in the catchment response in a pre- and post-development scenario. In the post development scenario, there is an additional 2351.3m$^3$ of water moving through the catchment that would need to be stored as long-term storage. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-15 Pre- and post-development hydrographs in the Rea Brook catchment**

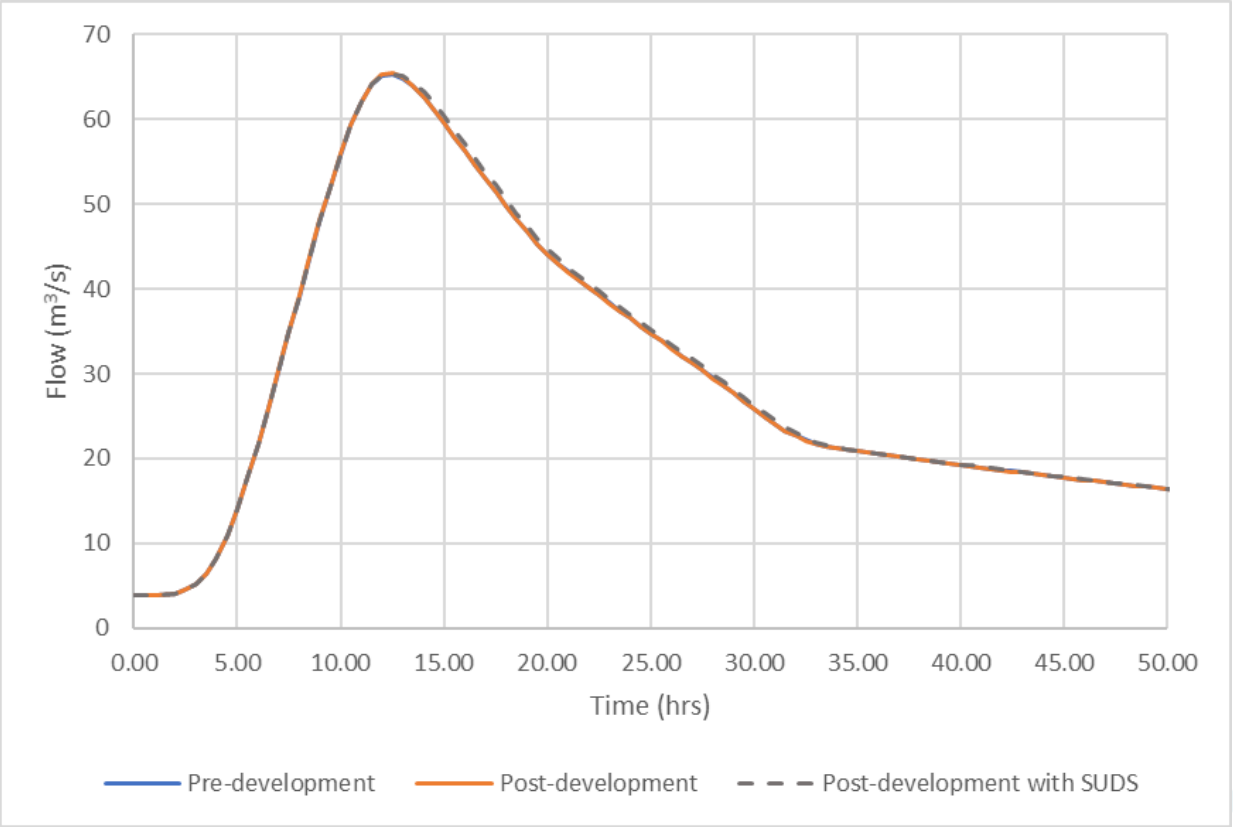



Table 9-8 shows the storage requirements at each proposed development site to ensure that surface water runoff rates are maintained at current greenfield levels. A total of 1084m$^3$ across the catchment is required to attenuate surface water runoff to greenfield rates.

**Table 9-8 Storage requirements at development sites in the Rea Brook catchment**

| Settlement | Site | Attenuation storage 1 in 100 years (m$^3$) | Long term storage 1 in 100 years (m$^3$) | Total storage 1 in 100 years (m$^3$) |
|---|---|---|---|---|
| **Bayston Hill** | BAY039 | 2242 | 438 | 2681 |
| | BAY050 | 1134 | 115 | 1249 |
| **Minsterley** | MIN018 | 330 | 0 | 330 |
| **Pontesbury** | PON008 | 760 | 0 | 760 |
| | PON017 | 77 | 0 | 77 |
| | PON030 | 44 | 0 | 44 |
| **Shrewsbury** | SHR158 | 27747* | 5423* | 33170* |
| | | 822** | 0** | 822** |
| | SHR145 | 2141 | 419 | 2560 |
| **Worthern** | WBR007&008 | 265 | 112 | 377 |
| | WBR010 | 868 | 0 | 868 |

**Storage assuming entire site is discharged into the Rea Brook catchment*

***Storage assuming only site area within the Rea Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

### 9.5.8 Sundorne Brook

There are three proposed development sites within the Sundorne Brook catchment. This catchment outlets directly into the River Severn on the eastern side of Shrewsbury (Figure 9-16). This catchment has been affected by historic flooding events and has high surface water flood risk. Figure 9-17 shows that an excess volume of 1102.6m$^3$ of flood waters moves through the catchment. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-16 Proposed development and flood alleviation schemes in the Sundorne Brook catchment**

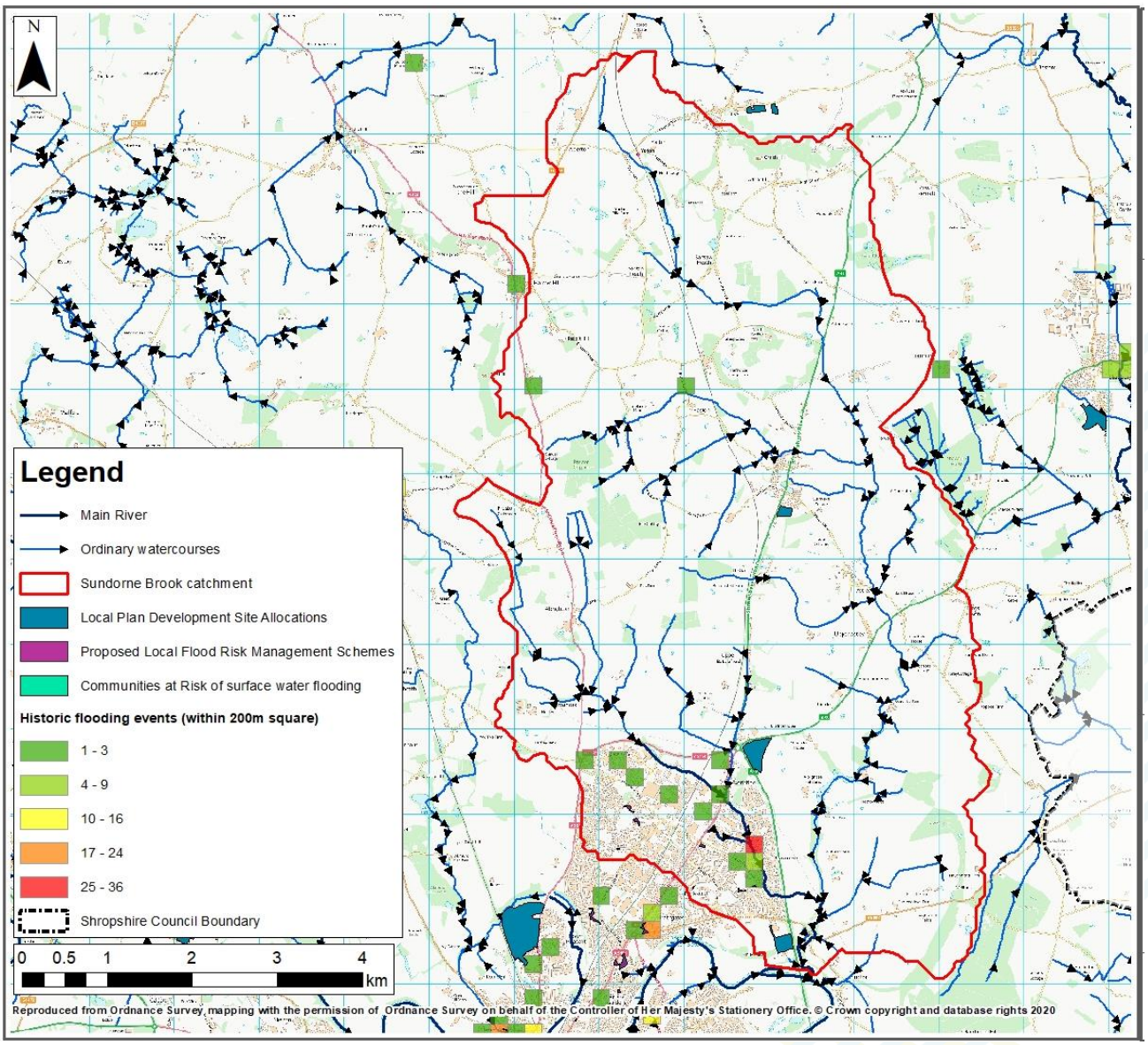


**Figure 9-17 Pre- and post-development hydrographs in the Sundorne Brook catchment**

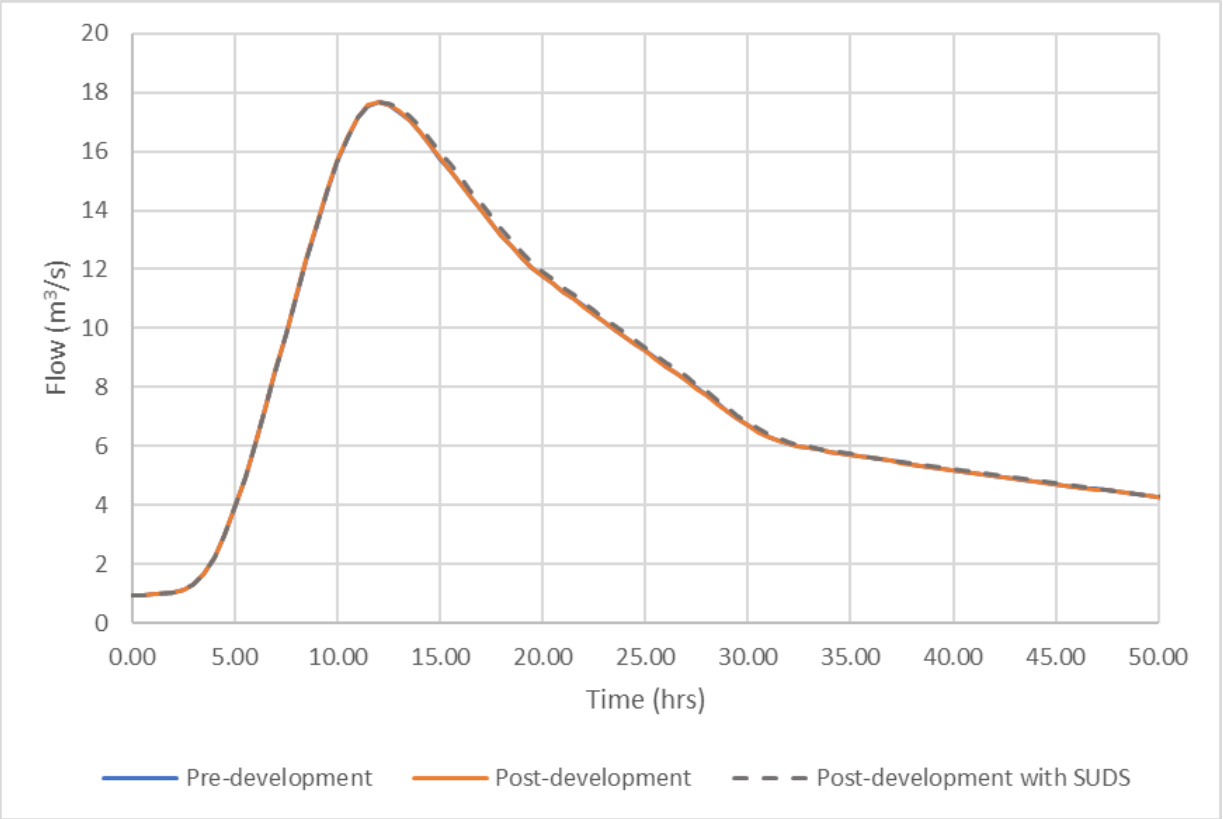



**Table 9-9 Storage requirements at development sites within the Sundorne Brook catchment**

| Settlement | Site | Attenuation storage 1 in 100 years ($m^3$) | Long term storage 1 in 100 years ($m^3$) | Total storage 1 in 100 years ($m^3$) |
|---|---|---|---|---|
| **Hadnall** | HDL006 | 562 | 0 | 562 |
| **Shrewsbury** | SHR054a | 1247 | 261 | 1508 |
| | SHR197VAR | 2241 | 468 | 2709 |

Table 9-9 shows that a total of 729$m^3$ is required in the Sundorne Brook catchment to ensure that surface water runoff rates are maintained at current greenfield runoff rates.

### 9.5.9 Wesley Brook

There are 5 sites that lie within or partially within the Wesley Brook catchment, shown in Figure 9-18. These are located in the east of the catchment in the settlement of Shifnal and cover 0.41% of the catchment area. There is also a high risk of surface water flooding in the Wesley Brook catchment. Part of the catchment lies within the Telford and Wrekin Council boundary, with potential for development in this area. Consequently, it is important to consider the impacts of upstream development from outside of the local authority in this catchment.

**Figure 9-18 Proposed development sites in the Wesley Brook catchment**

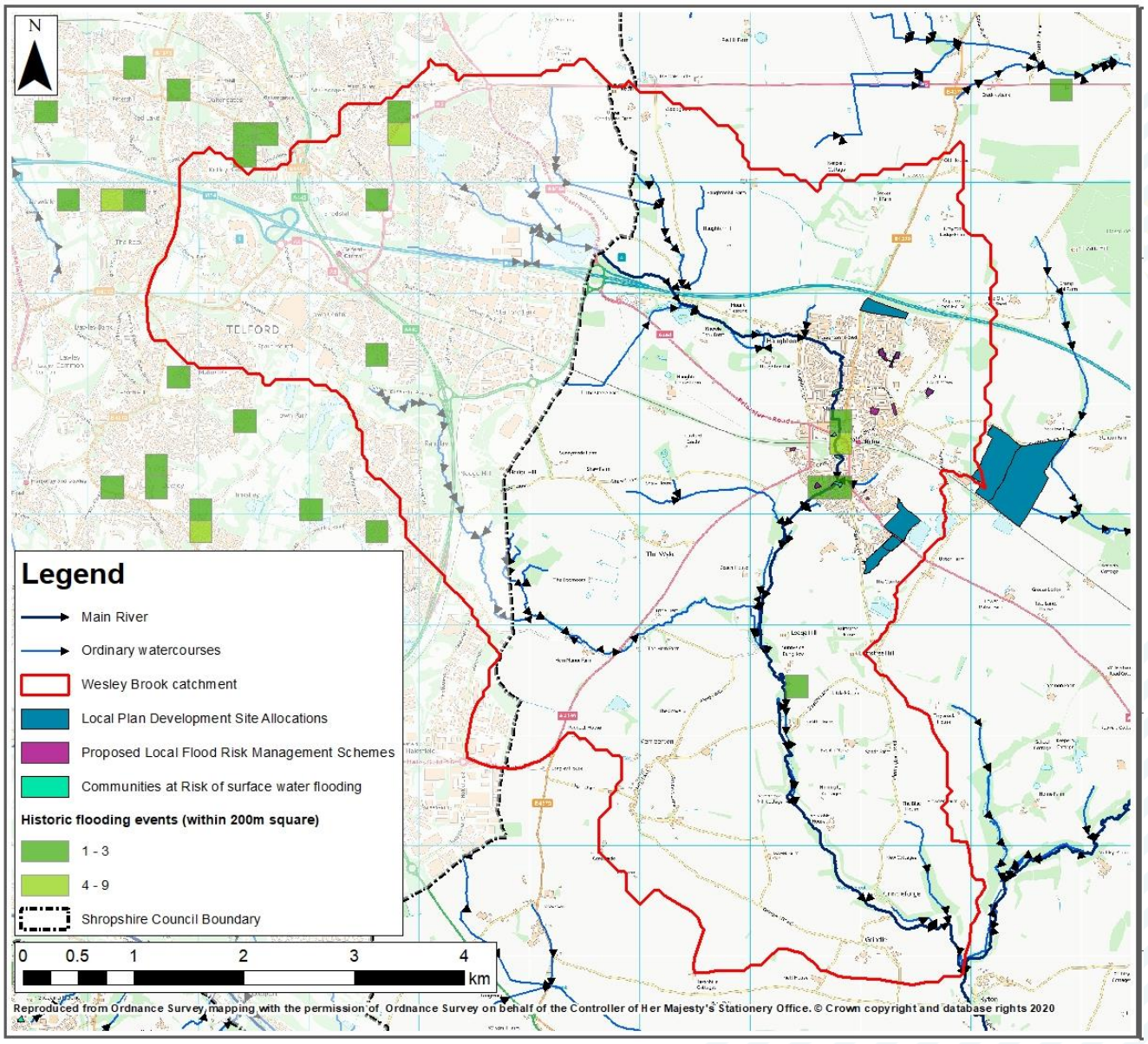
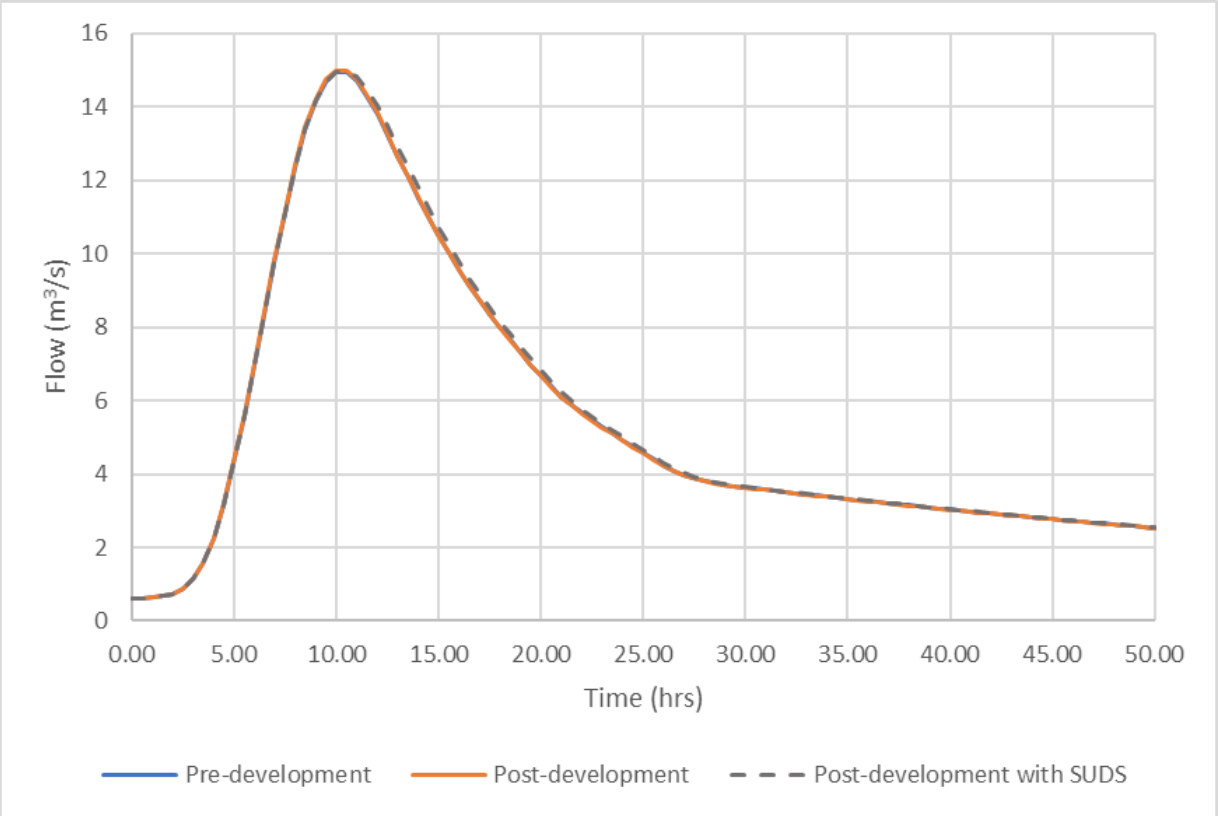



Figure 9-19 shows that with new development, the peak of the hydrograph is slightly higher, giving an estimated additional 1500.8m$^3$ volume of water moving through the catchment. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-19 Pre- and post-development hydrographs in the Wesley Brook catchment**




At the site-specific scale, results from the SuDS tool suggest that 1510m$^3$ of long-term storage volume is needed in the Wesley Brook catchment to reduce surface water runoff rates to current greenfield rates (Table 9-10).

**Table 9-10 Estimated storage volumes required at sites in the Wesley Brook catchment, taken from the UK SuDS website**

| Settlement | Site | Attenuation storage 1 in 100 years (m$^3$) | Long term storage 1 in 100 years (m$^3$) | Total storage 1 in 100 years (m$^3$) |
|---|---|---|---|---|
| **Shifnal** | SHF013 | 998 | 549 | 1547 |
| | SHF015 | 438 | 0 | 438 |
| | SHF018b | 3784* | 2079* | 5863* |
| | | 230** | 0** | 230** |
| | SHF022/3 | 1395 | 767 | 2162 |
| | SHF029 | 702 | 194 | 896 |

**Storage assuming entire site is discharged into the Wesley Brook catchment*

***Storage assuming only site area within the Wesley Brook catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

### 9.5.10 Worthernbury Brook (upper)

The Worthernbury Brook catchment drains out of Shropshire to the northeast into Cheshire. There are 4 proposed development sites within this catchment in Whitchurch and there is also evidence of historic flooding incidents in this catchment. Figure 9-1Figure 9-20 shows the proposed development sites within this catchment.

**Figure 9-20 Proposed development and flood management schemes in the Worthernbury Brook catchment**

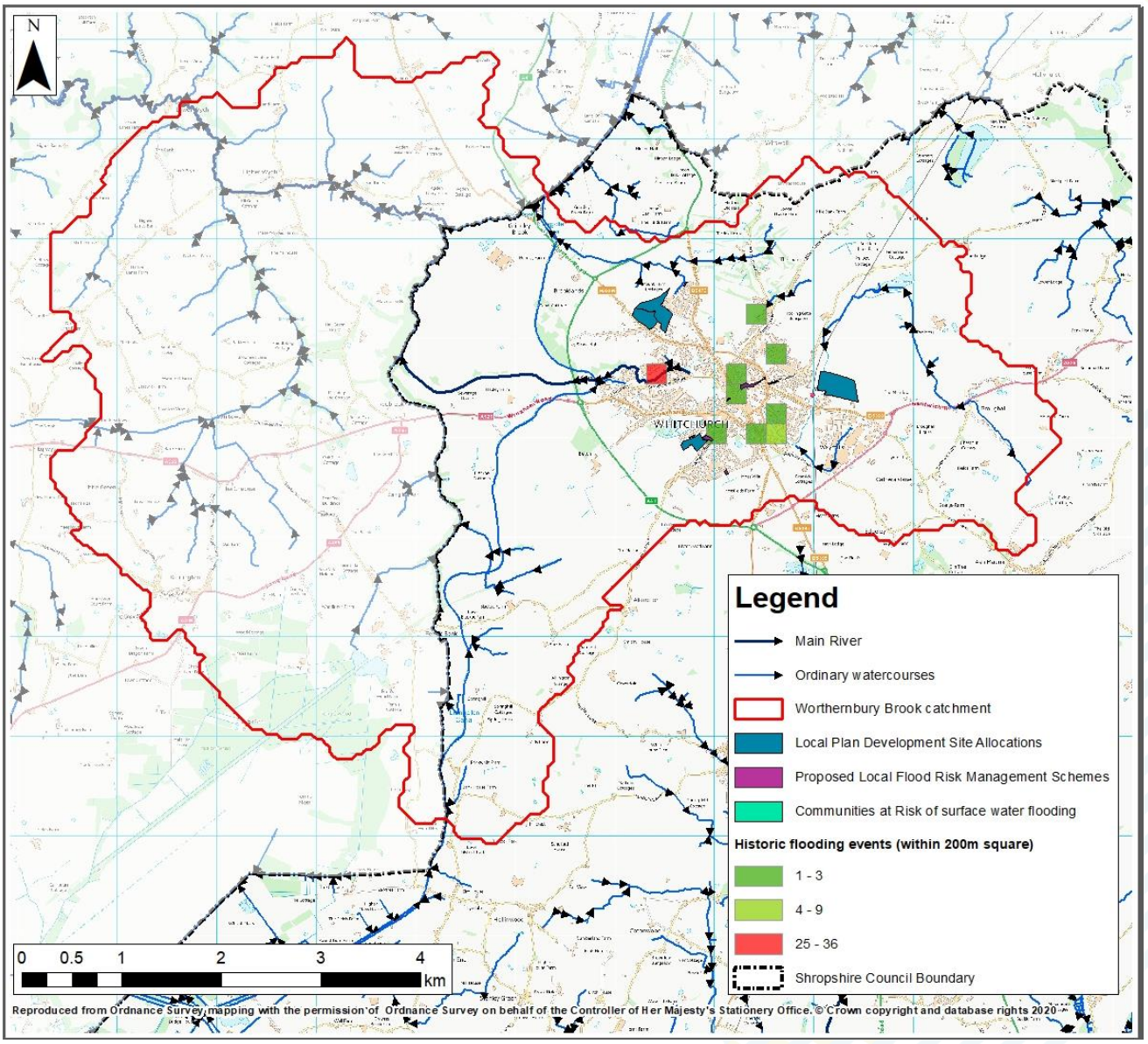



Figure 9-21 shows that the proposed development causes the peak flow to be slightly higher and to occur earlier in the storm event, indicating that development within this catchment could cause a flashier hydrograph response downstream. An additional 2110.5m$^3$ of water is estimated to move through this catchment in the post-development scenario.

**Figure 9-21 Pre- and post-development hydrographs in the Worthernbury Brook (upper) catchment**

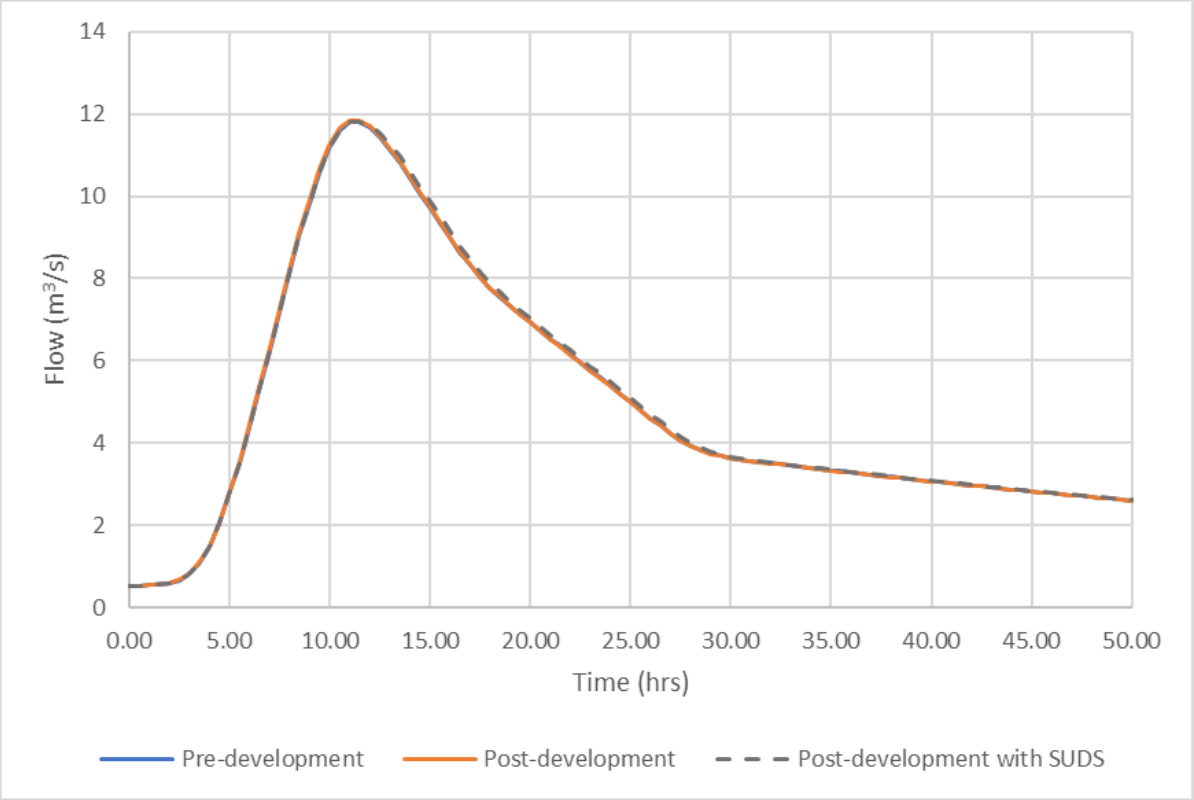



Table 9-11 shows that an estimated volume of 1244m$^3$ of long-term storage is required at the site scale within this catchment to ensure that surface water runoff rates remain below greenfield rates.

**Table 9-11 Storage requirements in the Worthernbury Brook catchment**

| Settlement | Site | Attenuation storage 1 in 100 years (m$^3$) | Long term storage 1 in 100 years (m$^3$) | Total storage 1 in 100 years (m$^3$) |
|---|---|---|---|---|
| **Whitchurch** | WHT014 | 915 | 0 | 915 |
| | WHT037 | 2067 | 436 | 2502 |
| | WHT042 | 3136 | 661 | 3797 |
| | WHT044 | 1304 | 147 | 1451 |

## 9.6 RAF Cosford Development Site

Figure 9-22 shows a large strategic development site proposed at RAF Cosford. This site spans three catchments in southeast Shropshire with the northern part of the site covering 4.25% of the Neachley Brook catchment and the southern part of the site covering 9.04% of the Albrighton Brook catchment. A small area at the western edge of the site falls within a sub-catchment of the River Worfe. None of these catchments have been identified as at a high risk due to the cumulative impacts of development, however both the Albrighton and Neachley Brook rank in the top 5 catchments for percentage of the catchment area covered by new

development. For this reason, in addition to the site being identified as a strategic development site, the cumulative impact of this development has been considered.

**Figure 9-22 Allocated development site at RAF Cosford**

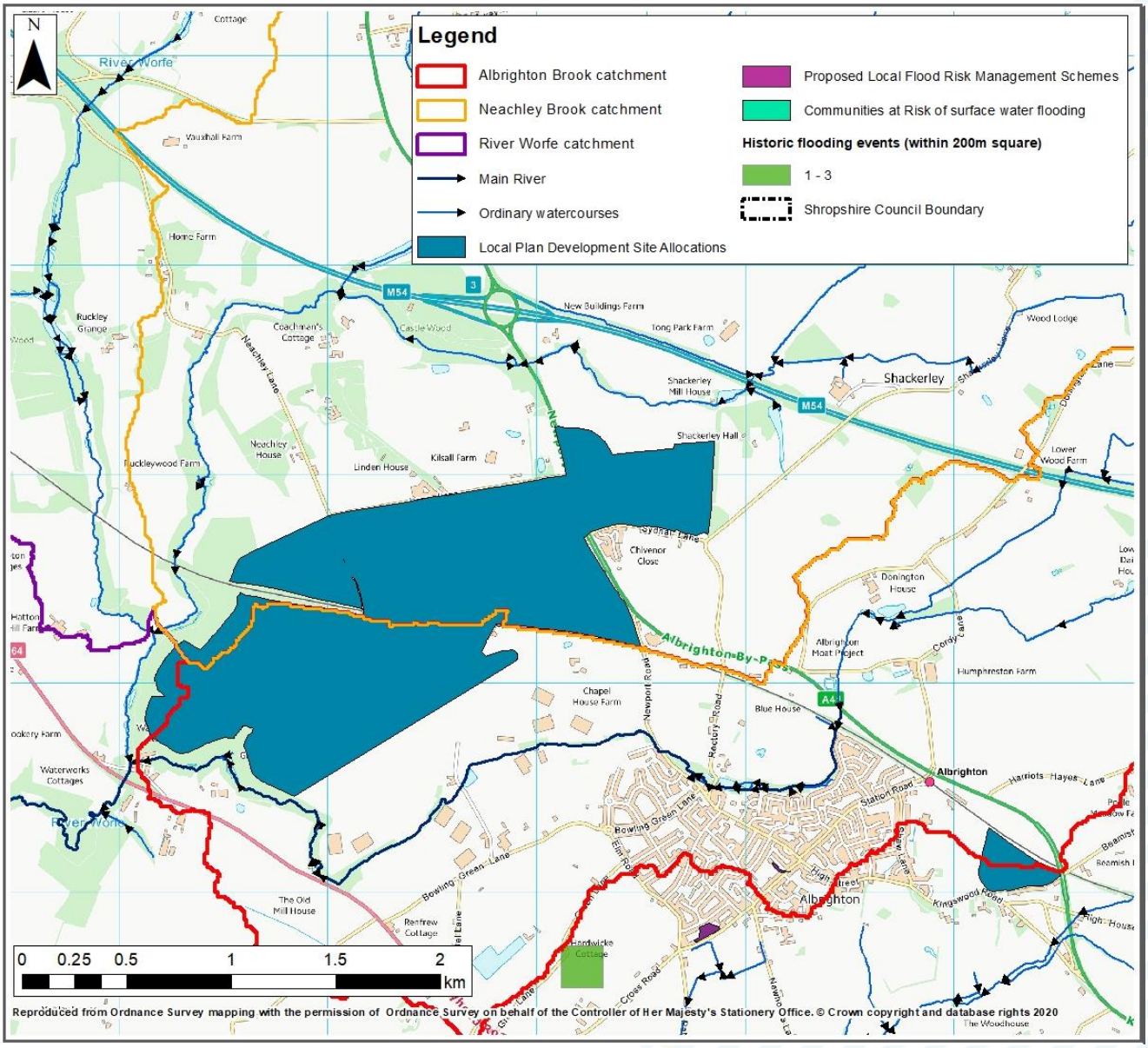



Figure 9-23 and Figure 9-24 show the change in the hydrograph response in the Albrighton Brook and the Neachley Brook respectively as a result of increased development at the site in RAF Cosford and the potential impact of installing SuDS alongside the proposed development. Both catchments display a flashier response in the post-development scenario with higher peaks that occur slightly earlier in the storm event. An additional 4364.8m$^3$ of water is estimated to be pass through the Albrighton Brook and an additional 11820.4m$^3$ through the Neachley Brook catchment. The implementation of SuDS helps to reduce the impact of new development.

**Figure 9-23 Pre- and post-development hydrographs in the Albrighton Brook catchment as a result of development at RAF Cosford**

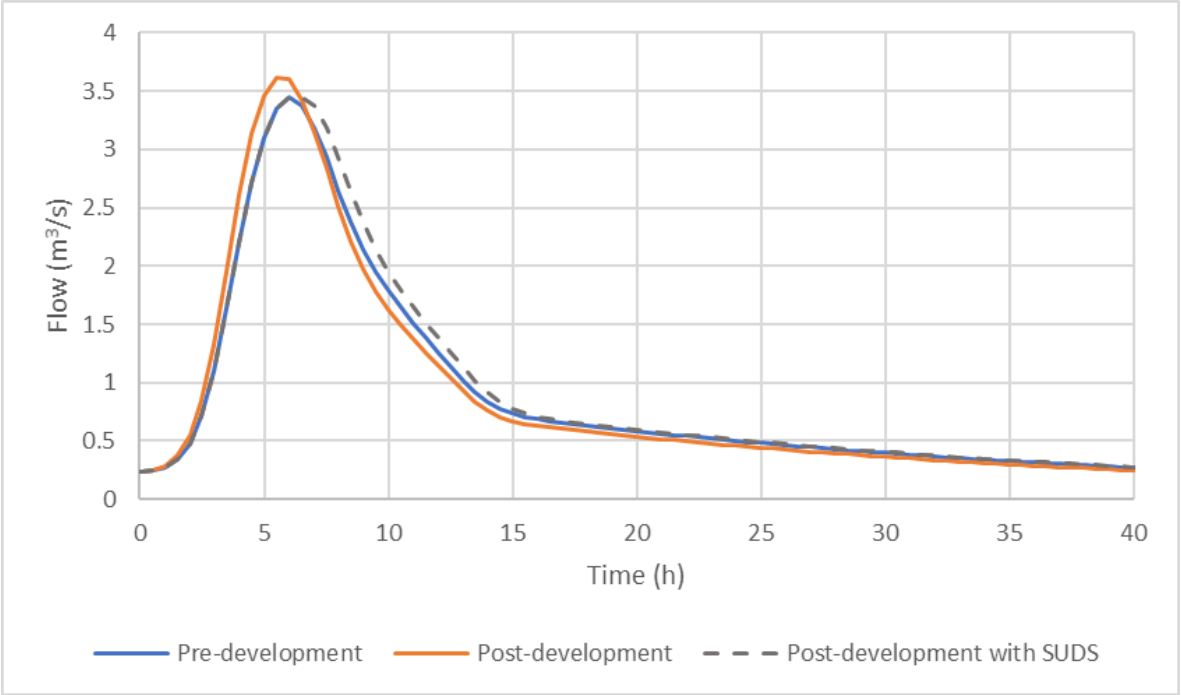



**Figure 9-24 Pre- and post-development hydrographs in the Neachley Brook catchment as a result of development at RAF Cosford**

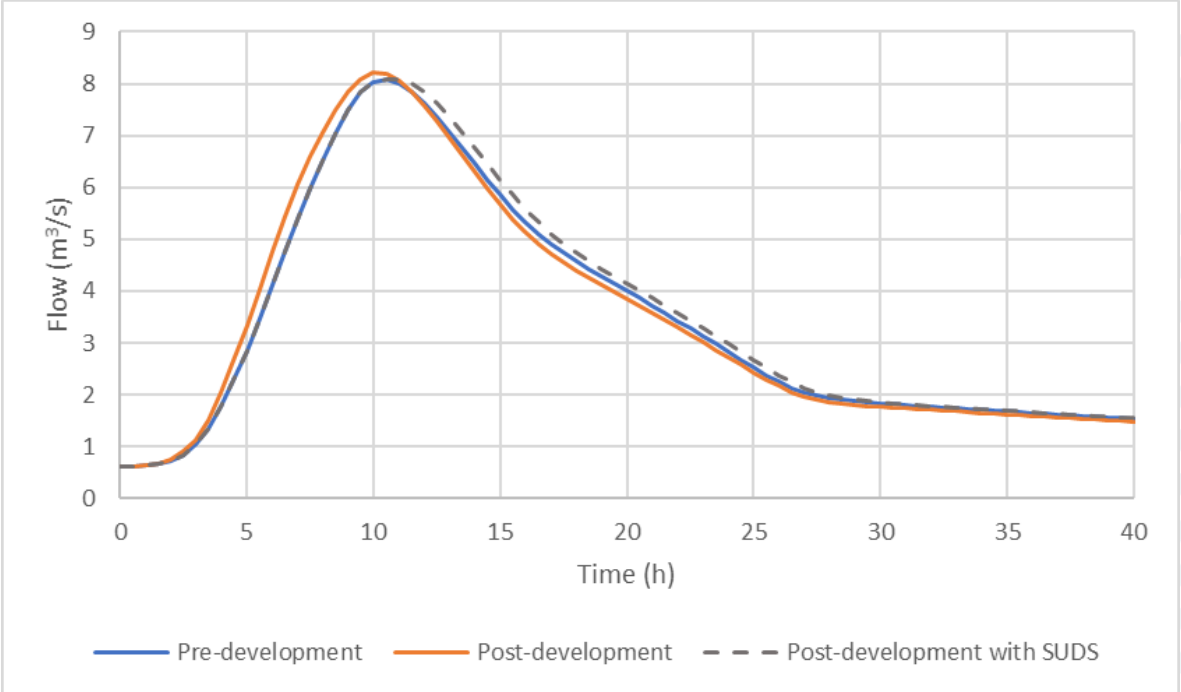


**Table 9-12: Storage requirements for the Albrighton Brook and Neachley Brook catchments**

| Catchment | Attenuation storage 1 in 100 years ($m^3$) | Long term storage 1 in 100 years ($m^3$) | Total storage 1 in 100 years ($m^3$) |
|---|---|---|---|
| **Albrighton Brook** | 45943* | 33722* | 79664* |
| | 18493** | 13574** | 32067** |
| **Neachley Brook** | 45969* | 30911* | 76880* |
| | 26555** | 17857** | 44412** |

**Storage assuming entire site (218ha) is discharged into the specified catchment*

***Storage assuming only site area within the specified catchment is being discharged to the catchment, with the remaining site area discharging to another catchment*

## 9.7 General approaches and policy recommendations for managing the excess storage needed to account for an increase in impervious area

The cumulative impact analysis has highlighted the importance of managing both the rate and volume of surface water runoff from new developments to mitigate the impact of flood risk along watercourses. Where reasonably practical, all new development should control both the rate and volume of runoff to greenfield characteristics. Where the developer can demonstrate it is not reasonably practical, runoff must be discharged at a rate that does not adversely affect flood risk. There are two general alternative approaches to meeting this requirement:

- Long Term Storage - the development should discharge surface water for the 1 in 1 year rainfall event and the 1 in 100-year rainfall event at peak greenfield runoff rates for the same event and discharge the difference in runoff volume pre- and post-development for the 100-year six hour event in long-term storage at a maximum rate of 2 l/s/ha.
- Restricted Discharge – the development shall discharge surface water at 2 l/s/ha or Qbar, whichever is greater, for all storms up to the critical 100-year event.

The size of development sites and their location within a catchment will impact the effect that it will have on catchment response to storm events. In line with national planning policy and the national requirements for SuDS, storage will always be required for the 100-year plus applicable climate change allowance event. Whether any additional storage would benefit downstream areas depends on where the site is located within the catchment and has been explored below.

## 9.8 Catchment specific policy recommendations for storage and betterment

From analysing the results produced above, high-level recommendations for flood storage and betterment have been proposed for sites in each of the high-risk catchments and for the large development site at RAF Cosford. These recommendations should be considered by developers as part of a site-specific assessment, but it is recommended that more detailed modelling is undertaken by the developer to ascertain in more detail the storage needs and potential at each site. This should refine the estimates of required storage taken from the UK SuDS Tool for each site. The policy considerations above should be applied to both allocated and windfall developments in these catchments.

### 9.8.1 River Corve

There is one development site located within this catchment, close to the outlet into the River Tern at Ludlow. Within Ludlow, there are a number of flood risk management schemes that have been proposed due to the number of communities at risk of surface water flooding.

Shropshire Council are working with the Shropshire Wildlife Trust to introduce Natural Flood Management (NFM) schemes in the upper catchment to slow the flow through Corvedale Brook and the wider River Corve catchment and reduce flood risk to Ludlow and other rural communities. Although the site lies at the downstream extent of the catchment, it is possible that the developers could contribute to the flood mitigation measures taking place across the catchment, to ensure that the impacts of any work to slow flow through the upper catchment is not counteracted by increased development in Ludlow.

### 9.8.2 Farley Brook

Much Wenlock is located in the upper area of this catchment and within this settlement there is evidence of historic flooding events and communities at risk of surface water risk. There are a number of flood alleviation schemes within Much Wenlock.

Site MUW012 is located upstream of communities identified as at risk of surface water flooding and of existing flood alleviation schemes.

It is recommended that at site MUW012:

- Long term storage is facilitated to ensure that the site does not contribute further surface water runoff to areas immediately downstream, and to ensure that surface water risk within Much Wenlock is not increased.
- Developers work collaboratively with the council to facilitate existing or proposed flood alleviation schemes

Site IRN001 is located at the lower end of the catchment. Only 15% of this site lies within the Farley Brook catchment with the remaining 85% in the River Severn catchment. There is minimal evidence of communities at risk from flooding or historic flooding events downstream of this site within the catchment. However, the River Severn catchment is likely to see less impact from a development site. The Shropshire Water Cycle Study (Halcrow, 2010) indicates that this site may be subject to risk of groundwater pollution from contaminated land. Infiltration and groundwater storage methods may not be suitable at this site.

Therefore, recommendations for storage and betterment at this site include:

- Directing surface water runoff into attenuation structures and drainage routes that are channelled and drained into the River Severn catchment, away from the downstream end of the Farley Brook catchment.

### 9.8.3 North Shrewsbury

Site SHR173 is the only development proposed in this catchment with 71% of the site within the lower part of the North Shrewsbury catchment. In the area directly to the southeast of the site and downstream at the catchment outlet, there is evidence of historic flooding. The topography of the site suggests that the site is likely to discharge into the watercourse along the northwest boundary of the site or into the neighbouring River Severn catchment, which has a lower sensitivity to the cumulative impacts of development.

Flood alleviation schemes in this catchment are located in the rural upper catchment. Development in this catchment should ensure that any benefits and attenuation from upstream alleviation schemes are not cancelled out by development in the lower catchment. If drainage control is to be implemented on

site SHR173 the timings of peak flows from upstream should be considered in drainage strategies. If flow is slowed in the predominantly rural upper catchment, it may not be sensible to install SuDS which attenuate flow onsite as peak flows moving through the catchment onto the site could synchronise with the release of SuDS storage, thereby increasing flood risk downstream of the site. To avoid the potential synchronisation of peak flows from the upper catchment coinciding with the release of water stored in SuDS structures on this site, SuDS techniques that reduce runoff such as impermeable paving may be a more viable option than storage areas at this site.

### 9.8.4 Oswestry Brook

Site OSW017 is located on the western edge of Oswestry, upstream of communities at risk of surface water flooding. The Oswestry Surface Water Management Plan (2013) highlights a number of flood alleviation and surface water management schemes that were proposed within Oswestry including the creation of storage areas, installation of permeable paving and overflow from storm system pipes. Developers at this site should contribute to these schemes.

Recommendations for development in the Oswestry Brook:

- Ensure that the Oswestry Surface Water Management Plan (2013) is adhered to and any action plan is followed. This includes limiting inappropriate increases of impermeable areas from development, supporting the development of community flood plans and recommendations that developers should contribute to funding for local flood risk reduction and implement measures to improve local surface water management.
- Any development upstream of Oswestry should ensure that overland flow is retained on site or drained appropriately to reduce risk to existing communities within Oswestry that are at risk of surface water flooding.

### 9.8.5 Quinny Brook

Development site CST021 is proposed at the upper end of this catchment in Church Stretton. Church Stretton is at notable flood risk with evidence of historic incidents and communities identified at risk of surface water flooding. Flood alleviation schemes have been proposed in Church Stretton and also immediately downstream of the site at the northwest boundary.

Recommendations for site CST021 include:

- Development should be designed to complement or to enhance the proposed flood alleviation schemes directly downstream of the site on The Bridleways. Developers should work collaboratively with the Council who are leasing the scheme.
- Strategic design of drainage systems on the site to ensure that greenfield runoff rates are retained
- Adhere to recommendations made in the Church Stretton Surface Water Management Plan (2011). This includes educating local residents about surface water flooding risks, minimising impermeable areas and improving storage and conveyance capacity in sewers and watercourses close to Church Stretton. Surface water management is highlighted as an important issue in Church Stretton and it is recommended that Shropshire Council and any potential developers adhere to up to date SuDS guidance.

### 9.8.6 Rad Brook

Proposed development sites which are located on the western edge of Shrewsbury cover 8.75% of this catchment. The upper catchment is predominantly rural whilst the lower reaches of the catchment pass through the Shrewsbury urban area. Downstream of these neighbouring development sites there are communities at risk of surface water flooding and evidence of historic flooding events.

A strategic drainage approach across all the sites should be considered due to their large total area and their close proximity to one another. Developers should contribute to existing flood alleviation schemes downstream of the sites.

Online storage ponds could be installed alongside these watercourses downstream of the sites to attenuate any additional surface water runoff and to protect existing communities at risk of surface water flooding downstream. However, the upper catchment is predominantly rural so is likely to have a slower hydrograph response to a storm event compared to the lower reaches of the catchment. Therefore, it is important that any drainage management systems installed at the sites ensure that the release of storm water from the development sites does not synchronise with the arrival of the flood peak from the upper catchment. Developers should consider whether SuDS methods that reduce runoff from the sites are more suitable than online attenuation features in order to best protect downstream communities in Shrewsbury by testing these alternatives in a detailed hydraulic model of the Rad and Bow Brooks.

If phasing of building is implemented, it will be necessary to ensure that drainage strategy remains viable for the full development period. As development will bring a large area of additional impermeable surfaces it will be necessary to a design drainage strategy or install long-term storage and attenuation features to ensure that greenfield runoff rates are retained through all phases of the development.

### 9.8.7 Rea Brook

Development sites are proposed across the Rea Brook catchment in both rural and more urbanised areas. The upper catchment is predominantly rural with more opportunity for the implementation and installation of flood attenuation structures along watercourses compared to the urban centre of Shrewsbury in the lower reaches of the catchment.

Sites WBR007, WBR008 and WBR010 are located in Worthern at the upper end of the catchment. There is a flood alleviation scheme in Worthern. Development at these sites should contribute to this scheme and ensure that benefits of the scheme are not affected by the addition of developed areas in this predominantly rural location.

Sites BAY039 and BAY050 are located in Bayston Hill where there is evidence of historic flooding incidents and surface water flood risk downstream. Both sites are likely to discharge into the unnamed ordinary watercourse which is culverted through much of the existing development. Online storage areas alongside this watercourse could provide storage to the minimum estimated requirements to limit greenfield runoff rates as well as providing a wider flood management benefit to the existing community. Development here should contribute to the provision of the proposed flood development schemes downstream in Bayston Hill to protect existing communities at risk of flooding.

Site MIN018 (Minsterley) will discharge into the unnamed watercourse running along its western boundary before shortly joining the Minsterley Brook. At this location there is opportunity to install online storage ponds along the downstream watercourses to ensure that any additional surface water runoff can be

accommodated as well as providing a wider flood management benefit to the existing community.

Three neighbouring sites are proposed in Pontesbury (PON008, PON017 and PON030). Local topographic elevation that bounds the site to the west and the south suggest that any surface water discharge will be impeded on the site, preventing it from discharging downstream into the lower catchment. However, this will still pose flood risk on the site. Long-term storage should be accommodated on this site or methods for drainage that utilise infiltration. A strategic approach should be taken for the implementation of suitable drainage provision if the three sites in Pontesbury are phased.

Ideally, attenuation of flood waters should be considered at a holistic, catchment wide scale to ensure that the movement of peak flows through the catchment do not coincide further downstream, close to communities at risk in Shrewsbury. This could be managed through a future catchment wide natural flood management scheme, which could be part funded by developers.

### 9.8.8 Sundorne Brook

Development in this catchment is proposed in the lower part of the catchment, on the northern edge of Shrewsbury. Sites HDL006 and SHR197VAR are located upstream of areas with evidence of a number of historic flooding incidents. At these sites it is recommended that greenfield rates are retained through the implementation of long-term storage. However, this storage should be considered at a catchment scale to ensure that the release of stored storm water does not result in an increased peak downstream due to coinciding flows.

Site SHR54a is located very close to the catchment outlet into the River Severn, with no existing communities downstream of this site within the Sundorne Brook catchment. Long-term storage could be implemented at this site to ensure that increased water is not discharged into the Severn catchment.

### 9.8.9 Wesley Brook

There are a number of development sites proposed within Shifnal in the northwest of the Wesley Brook catchment. There is evidence of communities at risk of surface water flooding and historic flood events in Shifnal. The lower reaches of the catchment are predominantly rural with minimal communities at risk of flooding from fluvial or surface water.

Developers should ensure that development around Shifnal does not contribute excess surface water runoff and that greenfield rates are retained. They should also work collaboratively with the Council to consider what contribution they could make to flood alleviation plans for the town.

A large proportion of this catchment lies within Telford and Wrekin local authority, where proposed development has not been considered in this SFRA. Shropshire Council should liaise with Telford and Wrekin council to ensure that provision and strategic drainage is implemented on any development site upstream within the Wesley Brook catchment to protect communities within Shropshire.

### 9.8.10 Worthernbury Brook

The Worthernbury Brook catchment drains out of Shropshire to the northwest into Cheshire and is a sub-catchment of the River Dee. Proposed development in this catchment is located within Whitchurch at the upper end of the catchment. With evidence of historic flooding incidents and communities at risk of surface water flooding close to and downstream of these sites, it is necessary to ensure that storage of excess volumes of water is implemented at these development sites.

Downstream of Whitchurch, the Worthernbury Brook passes through predominantly rural areas. Therefore, there is opportunity to develop online storage ponds and other storage and attenuation features alongside watercourses downstream within the catchment to ensure that runoff can be retained at greenfield rates through the catchment. There are a number of flood alleviation schemes proposed within Whitchurch due to existing communities at risk of surface water flooding. Promoters of any development upstream of these locations (WHT014, WHT042) should work collaboratively with the Council to consider what contribution they could make to flood alleviation plans for the town.

### 9.8.11 RAF Cosford strategic development site

This site is a very large strategic site (218ha) and therefore it is likely that development at this site will be phased, but a strategic drainage overview of the entire red line boundary should be considered at a site-specific stage. Approximately 40% of the site is within the Albrighton Brook catchment and 58% in the Neachley Brook catchment. The site lies on elevated ground above watercourses that are entrenched into the surrounding landscape. Runoff from this site is likely to discharge into these watercourses, particularly in the south and west of the site. To the north and east of the site it is likely to discharge into sewers.

As the site is large, there is opportunity to provide areas of storage across the site, particularly to the south of the railway line which is largely undeveloped. If the site is to be developed in phases, it will be necessary to ensure that drainage control features are designed so that they will perform appropriately at all stages of development.

# 10 Summary of Level 2 assessment and recommendations

## 10.1 Assessment methods

As part of the Level 2 SFRA, detailed site summary tables have been produced for the Level 2 sites assessed.

The summary tables set out the flood risk to each site, including Flood Zone coverage, maps of extent, depth and velocity of flooding as well as hazard mapping for the 100-year defended event, where available. Climate change mapping has also been produced (Level 1 SFRA) to indicate the impact which different climate change allowances may have on the site (where models are available) or using Flood Zone 2 as an indication of climate change. Each table also sets out the NPPF requirements for the site as well as guidance for site-specific FRAs. A broadscale assessment of suitable SuDS options has been provided giving an indication where there may be constraints to certain sets of SuDS techniques. This assessment is indicative and more detailed assessments should be carried out during the site planning stage to confirm the feasibility of different types of SuDS. It may be possible that those SuDS techniques highlighted as possibly not being suitable can be designed to overcome identified constraints. Where deemed required, culvert blockages were also presented to assess residual risk to sites.

Interactive mapping is shown in Appendix A and should be viewed alongside the detailed site summary tables. There are no detailed fluvial hydraulic models available, so the Environment Agency's Flood Zones and Risk of Flooding from Rivers and Sea datasets have been used. Also, where the watercourses are smaller and not represented in the Flood Zones, the Risk of Flooding from Surface Water mapping datasets have been used.

## 10.2 Summary of key site issues

- fluvial flood risk. The degree of flood risk varies, with some sites being only marginally affected along their boundaries, and other sites being more significantly affected within the site, such as SHR177 and IRN001, which will require more detailed investigations on sequential site layouts, SuDS possibilities, safe access and egress etc, as part of a site specific Flood Risk Assessment at a later stage. Whilst for sites such as these there are additional challenges to consider for developing the site safely (for example steering development and access away from highest risk areas), all sites should be able to pass the Exception Test if the advice provided in the site summary tables is followed.
- The majority of sites at fluvial risk are also at risk from surface water flooding, with more areas of ponding in the higher return period events. Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions. Some sites not at fluvial risk were subject to a Level 2 assessment where surface water risk was deemed to be significant from professional judgement (surface water should also be considered when assessing safe access and egress to and from the site). PON008 has the highest surface water flood risk out of all sites assessed.
- Climate change mapping indicates that flood extents will increase. As a result, the depths, velocities and hazard of flooding may also increase. The significance of the increase tends to depend on the topography of site and the percentage allowance used; extents would be larger than Flood Zone 3, but maximum extents are likely to be similar to Flood Zone 2. The Council and the Environment Agency require the 100-year plus 35% and 100-year plus 70% climate change scenarios to be considered in future

developments. Site-specific FRAs should confirm the impact of climate change using latest guidance.

- Blockage locations were determined by visual inspection of the OS mapping and ground topography in the vicinity of the site, to determine whether a structure upstream, downstream, or within the site could have an impact on the site. These would need to be considered further as part of a site-specific assessment.
- Sites which have areas designated by the Environment Agency as being a historic landfill site may require site ground investigations to determine the extent of the contamination and the impact this may have on SuDS.
- A strategic assessment was conducted of SuDS options using regional datasets. A detailed site-specific assessment of suitable SuDS techniques would need to be undertaken at site-specific level to understand which SuDS option would be best.
- For some sites, there is the potential for safe access and egress to be impacted by fluvial or surface water flooding. Consideration should be made to these sites as to how safe access and egress can be provided during flood events, both to people and emergency vehicles.
- In respect of cumulative impact assessment, there are a number of development sites proposed that have the potential to provide a betterment to existing communities downstream within the catchment. However, all of these developments also have the potential to increase flood risk offsite if both National and Local SuDS Standards are not applied. They also offer a great potential to enhance the wider Green and Blue Infrastructure of the local area through integrated planning for flood risk, sustainable drainage, biodiversity, amenity and sustainable transport provision.
- Developers proposing windfall sites in the high risk Cumulative Impact Assessment catchments should demonstrate through a site-specific FRA how SuDS and surface water mitigation techniques will ensure that development does not increase flood risk elsewhere and seeks to reduce flood risk to existing communities. The catchment based Cumulative Impact Assessment has been updated using the latest available data for the Level 2 SFRA and supersedes the catchment-based assessment in the Level 1 SFRA.

### 10.2.1 Considering the Exception Test for the proposed sites in Shropshire

In principle, it is possible for all sites assessed in the Level 2 SFRA to pass the flood risk element of the Exception Test, for example by:

- siting development away from the highest areas of risk into Flood Zone 1 (in the majority of sites assessed, the risk is along a site boundary, so steering away from this is advised),
- considering safe access/ egress in the event of a flood (from all parts of the site, if say the site is severed by a flood flow path),
- using areas in Flood Zone 2 for the least vulnerable parts of the development in accordance with Table 2 in the NPPF. Residential development should not be permitted in Flood Zone 3 and no development at all should be permitted in Flood Zone 3b (aside from essential infrastructure, such as a bridge crossing the lowest points of a site),
- testing flood mitigation measures if these are to be implemented, to ensure that they will not displace water elsewhere (for example, if land is

raised to permit development on one area, compensatory flood storage will be required in another),

- considering space for green infrastructure in the areas of highest flood risk.

If the strategic sites are split in future into smaller land parcels for development, and some of those parcels are in areas of flood risk, the Exception Test may need to be re-applied by the Developer at the planning application stage.

## 10.3 Planning Policy recommendations

The Planning Policy recommendations in Chapter 13 of the Level 1 SFRA still stand for the site allocations and any windfall development that comes forward. Recommendations in the L1 are made on:

- Site-specific Flood Risk Assessments
- Windfall sites
- Drainage assessments and promotion of SuDS
- Strategic solutions
- Cumulative impacts of development

Further site-specific recommendations have been made in the Level 2 regarding Cumulative Impact Assessment. These are made in Chapter 9.

## 10.4 Use of SFRA data and future updates

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

The SFRA should be a 'living document', and as a result should be updated when new information on flood risk, flood warning or new planning guidance or legislation becomes available. New information on flood risk may be provided by Shropshire Council, the Highways Authority, Canal and River Trust, Severn Trent Water, Welsh Water, United Utilities and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results (for example 2020 Environment Agency River Severn Modelling Study Phase 1)
- Flood event information following a future flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes, or alleviation schemes.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated (more accurate) information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the SFRA is reviewed in line with the Environment Agency's Flood Zone map updates to ensure latest data is still represented in the SFRA, allowing a cycle of review and a review of any updated data by checking with the above bodies for any new information.

# Appendices

## A Level 2 Assessment

### A.1 Site summary tables

### A.2 GeoPDF mapping

Offices at

Coleshill
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Edinburgh
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Registered Office
1 Broughton Park
Old Lane North
Broughton
SKIPTON
North Yorkshire
BD23 3FD
United Kingdom

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