Blaby District Council Level 2 Strategic Flood Risk Assessment

Final Report

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This report describes work commissioned by Blaby District Council by an email dated 14 May 2021. Dan Bloomfield, Adam Wood, Charlotte Lickman, Gwyn Jones and Alex Clark of JBA Consulting carried out this work.

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Purpose

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Executive summary

Introduction and context

This Level 2 Strategic Flood Risk Assessment (SFRA) document was created with the purpose of supporting the production of the Blaby District Council Local Plan. It follows on from the Level 1 SFRA completed in 2020 and assesses sites identified by Blaby District Council.

It involves the assessment of a wide range of proposed development sites of which there are 42 being assessed in this Level 2 assessment. This 2021 Level 2 SFRA has updated information on flood data and recommendations for the cumulative impact of development.

The 2020 Level 1 SFRA should be consulted for Planning Framework and Flood Risk policy, and Planning Policy for Flood Risk Management.

SFRA objectives

The Government's Planning Practice Guidance (PPG) on Flood Risk and Coastal Change advocates a tiered approach to risk assessment and identifies the following Level 1 and Level 2 assessments.

The aim of the Level 2 assessment is to build on identified risks from Level 1 for proposed development sites, to provide a greater understanding of fluvial, surface water, groundwater, and reservoir related flooding risks to the site. From this the Local Council and Developers can make more informed decisions and pursue development in an effective and efficient manner. The Level 2 assessment also identifies sites for further risk analysis at the site-specific Flood Risk Assessment (FRA) stage.

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

The Blaby District Council provided 125 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, 42 sites were carried forward to a Level 2 assessment, and lower risk sites are also flagged in this report with general recommendations for developers. 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. 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. Some sites are only affected in Flood Zone 2 and other sites are at risk in Flood Zone 3a/3b also. 17 sites were located where 1D-2D hydraulic models were available to assess depth, velocity and hazard at sites.
- Sites with the highest fluvial risk are: LIT008, LIT009, KMU022, WHE026, GPA024 CRO006 and HUN013, these sites 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.
- Most sites at fluvial risk are also at risk from surface water flooding; however, there is not always a direct correlation between fluvial and surface water risk. For example, LIT008 has a higher fluvial risk than KIL006, but the latter is at a higher risk from surface water flooding, with more areas of ponding in the higher return period events. As a result, 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); sites STO025, ELM010, WHE027 and BLA031 for example, have significant surface water risk.
- Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions.
- 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 37% and 100-year plus 60% 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.

- Any sites located where there is Main River (including culverted reaches of Main River) will require an easement of 8m either side. This may have constraints regarding what development will be possible on top of the culvert. Developers will be required to apply for a permit and ensure the activity being carried out over this easement would not increase flood risk.
- Residual risk was considered at the sites. 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. There are some sites in the vicinity of Whetstone Embankment however these are located outside the Area Benefitting from Defences as it has a standard of 25-year protection. These risks of potential blockage and overtopping of flood defences 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. Also, consideration should be given to whether the risk forms a flow path or bisects the site where access from one side to another may be compromised.
- A number of Specific Sites Proposals have also been assessed; flood risk may appear lower at these sites due to their size, but consideration should be given to how these sites are split into development parcels in future, in that areas of low flood risk could pose a higher risk in future if a site boundary is smaller and more localised around that area of risk.
- In respect of the 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 and, if suitable storage facilities are implemented have the potential to complement existing flood alleviation schemes within their respective catchments. However, all of these developments also have the potential to increase flood risk offsite if both National and Local SuDS Standards are not applied.
- 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 (https://www.gov.uk/guidance/flood-risk-assessments-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 Sequential Test followed by the Exception Test (if required) 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
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.
CIRIA	Construction Industry Research and Information Association
Defra	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EDLAA	Employment Development Land Availability Assessment
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.
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).
FWMA	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.
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
Greenfield	Undeveloped parcel of land
Ha	Hectare
JBA	Jeremy Benn Associates
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
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

Term	Definition
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.
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.
SFRA	Strategic Flood Risk Assessment
SHELAA	Strategic Housing and Economic Land Availability Assessment
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 2019, paragraph 156)

This Level 2 Strategic Flood Risk Assessment (SFRA) 2021 document provides a Level 2 assessment of sites and Specific Site Proposals identified as potential sites allocated within the Blaby District Council's **Local Plan** (https://www.blaby.gov.uk/planning-and-building/local-plan) and was prepared in accordance with the 2019 NPPF and PPG which was in place at the time of writing the Level 1 and Level 2 SFRA.

1.2 Levels of SFRA

The **Planning Practice Guidance**[1] (PPG) (Flood risk and coastal change - GOV.UK (www.gov.uk)) 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 report fulfils the requirements of a **Level 2** SFRA.

1.3 SFRA objectives

The objectives of this 2021 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 their proposed site options in preparation of their 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

JBA Consulting were commissioned by Blaby District Council to prepare a Level 2 Strategic Flood Risk Assessment (SFRA), following on from the Level 1 SFRA completed in 2020. The purpose of this study is to provide a comprehensive and robust evidence base to inform the preparation of the **Local Plan** (https://www.blaby.gov.uk/planning-and-building/local-plan).

This 2021 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.

This Level 2 SFRA directly follows the Level 1 assessment published in 2020 and is written in accordance with the 2019 NPPF and PPG. Due to this, there have been no updates to the Planning Framework and Flood Risk policy, or the Planning Policy for Flood Risk Management. Users should refer to Chapters 2 and 3 of the Level 1 SFRA **for information regarding local and national policy and legislation, application and approaches of the Sequential and Exception Tests.**

1.5 Consultation

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

- Leicestershire County Council
- Environment Agency
- Severn Trent Water
- Leicestershire Fire and Rescue Service
- Canal and Rivers Trust
- Neighbouring Authorities
    - Leicester City
    - Oadby and Wigston
    - Harborough
    - Rugby
    - Hinckley and Bosworth
    - Charnwood

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. 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. Developers should refer back to this section when understanding requirements for a site-specific FRA.
3. Impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA Sets out how developers should apply the guidance to inform site specific Flood Risk Assessments	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.
4. 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.
5. Flood risk management requirements for developers	Identifies the scope of the assessments that must be submitted in FRAs supporting applications for new development. 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.
6. 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. 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. Developers should also refer to the L1 SFRA for further information on types of SuDS, the hierarchy and management trains information.

Section	Contents	How to use
7. 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. Developers should use this section to understand the potential storage requirements and betterment opportunities for the sites assessed.
8. 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 see a summary of the Level 2 assessment and understand the key messages from the site summary tables. Developers should refer to the Level 1 SFRA recommendations when considering requirements for site-specific assessments.
Appendix A: 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. Provides interactive PDF mapping for each Level 2 assessed site showing flood risk at and around the site.	Planners should use this section to inform the application of the Sequential and Exception Tests, as relevant. Developers should use these tables to understand flood risk, access and egress requirements, climate change, SuDS, and FRA requirements for site-specific assessments. 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 **purple** throughout the SFRA.

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

2 Sources of information used in preparing the Level 2 SFRA

This chapter outlines the datasets used in assessing the sites in the Level 2 SFRA.

2.1 Data used to inform the SFRA

Table 2-1 provides an overview of the supplied data, used to inform the appraisal of flood risk for Blaby District Council.

Table 2-1 Overview of supplied data for Blaby District Council 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 Hydraulic Modelling Reports, where provided	Environment Agency
Historic (all sources)	2020 L1 SFRA Update	Blaby District Council
Historic (all sources)	Historic flood incidents/records, from 2012-2021	Blaby District Council
Fluvial (including climate change)	Hydraulic models from the Level 1 SFRA, for example 2012 River Soar and tributaries model. Flood Zones Risk of Flooding from Rivers and Sea	Environment Agency
Surface Water	Risk of Flooding from Surface Water dataset Local Flood Risk Management Strategy Communities at Risk	Environment Agency JBA Consulting
Groundwater	Areas Susceptible to Groundwater Flooding dataset Bedrock geology/superficial deposits dataset JBA's Groundwater Mapping	Environment Agency JBA Consulting
Sewer	At Risk Register Historic flooding records	Severn Trent Water
Reservoir	National Inundation Reservoir Mapping	Environment Agency
Canal	Description of flood incidences	Canal and Rivers Trust

2.2 Flood Zones 2 and 3a

Flood Zones 2 and 3a have been taken from the Flood Zones derived in the Level 1 SFRA, which incorporated the Environment Agency's Flood Map for Planning and all latest modelled Flood Zones, which were not all reflected 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 (EA's Flood Map for Planning).

2.2.1 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.

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 Soar catchment) 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. In this area, the Flood Map for Planning does not include all modelled outputs, hence the Level 1 SFRA derived its own Flood Zones based on latest available data.

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.

2.3 Climate change

For this Level 2 SFRA, the model outputs were used from the hydraulic models provided by the Environment Agency, which were run in 2020 for climate change allowances. This includes the 2012 River Soar and Tributaries Model.

Where detailed hydraulic models were present at sites, the Level 1 SFRA modelled climate change flood extents were used. Environment Agency climate change allowances were updated during the course of this study (20th July 2021). The previous allowances for upper end and higher central cover conservatively the new higher central and central, but to ensure representation of the new higher % upper end allowance, the River Soar and Tributaries model was run for the 100-year +60%. This approach was agreed with Blaby District Council and the Environment Agency and is outlined in Table 2-2.

Table 2-2: Representation of updated climate change scenarios for the 2080s epoch

	Central	Higher Central	Upper End
July 2021 updated allowance	28%	37%	60%
Allowance used from previous scenarios	20%	30%	50%

Site LFE018 is located in the area of the Lubbesthorpe Brook, which has previously been modelled in 1D only. The 1,000 fluvial flood extent was used to represent the Upper End climate change scenario as the flood risk is very low and topographically confined. The suitability of this was verified by calculating the flow of a 100-year with (+60%) uplift event at a cross section close to the site, based on the 100-year modelled event, and comparing it to the 1,000-year event. The calculated flow for the 100-year with (+60%) uplift event was lower than that of the 1,000-year event so it was considered a conservative approach.

For any sites not covered by the EA's detailed modelling, Flood Zone 2 was used as a conservative indication of climate change extent, and the 1,000-year surface water extent as an indication for smaller watercourses not shown to be in the Flood Zones.

Developers may need to undertake detailed modelling of climate change allowances as part of a site-specific FRA, following the **climate change guidance** (https://www.gov.uk/government/publications/peak-river-flow-climate-change-allowances-by-management-catchment) set out by the Environment Agency. They should also contact the Environment Agency to determine the latest models publicly available, given the ongoing phased modelling studies (e.g. River Sence and Rothley Brook).

2.4 Surface Water

Mapping of surface water flood risk in Blaby has been taken from the Environment Agency's Risk of Flooding from Surface Water (RoFfSW) mapping. 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 (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 illustrate the flood risk more accurately 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.

2.5 Groundwater

In comparison to fluvial flooding, current understanding of the risks posed by groundwater flooding is limited and mapping of flood risk from groundwater sources is in its infancy. Groundwater level monitoring records are available for areas on Major Aquifers; however, for lower lying valley areas, which can be susceptible to groundwater flooding caused by a high-water table in mudstones, clays, and superficial alluvial deposits, very few records are available. Additionally, there is increased risk of groundwater flooding where long reaches of watercourse are culverted as a result of elevated groundwater levels not being able to naturally pass into watercourses and be conveyed to less susceptible areas.

Mapping of groundwater flood risk has been based on the Areas Susceptible to Groundwater Flooding (AStGWF) dataset and a 5m resolution JBA Groundwater map. The modelling for JBA's mapping involves simulating groundwater levels for a range of return periods (including 75, 100 and 200-years). Groundwater levels are then compared to ground surface levels to determine the head difference in metres. The JBA Groundwater Map categorises the head difference (m) into five feature classes based on the 100-year model outputs which are outlined in Table 2-3.

Table 2-3 JBA Groundwater flood risk map categories

Flood depth range during a 1% AEP flood event	Groundwater flood risk
Groundwater levels are either at or very near (within 0.025m of) the ground surface	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. Groundwater may emerge at significant rates and has the capacity to flow overland and/or pond within any topographic low spots.
Groundwater levels are between 0.025m and 0.5m below the ground surface	Within this zone there is a risk of groundwater flooding to both surface and subsurface assets. There is the possibility of groundwater emerging at the surface locally.
Groundwater levels are between 0.5m and 5m below the ground surface	There is a risk of flooding to subsurface assets, but surface manifestation of groundwater is unlikely.
Groundwater levels are at least 5m below the ground surface	Flooding from groundwater is not likely.
No risk	This zone is deemed as having a negligible risk from groundwater flooding due to the nature of the local geological deposits.

It is important to note that the modelled groundwater levels are not predictions of typical groundwater levels. Rather they are flood levels i.e. groundwater levels that might be expected after a winter recharge season with 1% AEP, so would represent an extreme scenario.

It should be noted that the JBA Groundwater Flood Map is suitable for general broad-scale assessment of the groundwater flood hazard in an area but is not explicitly designed for the assessment of flood hazard at the scale of a single property. In high-risk areas a site-specific risk assessment for groundwater flooding is recommended to fully inform the likelihood of flooding.

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

2.6 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 (DRN) 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 Leicestershire County Council Local Flood Risk Management Strategy requires culverts to be opened up as part of redevelopments. Developers should seek to open-up existing old culverts and should not construct new culverts on site, except for short lengths to allow essential infrastructure crossings. Evidence would need to be provided showing there is no other economically viable alternative and that appropriate mitigation measures are being implemented to offset any ecological or flood risk impacts. Permission from the EA is unlikely to be granted without these requirements.

2.7 Flood warning

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

2.8 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** (https://flood-warning-information.service.gov.uk/long-term-flood-risk/map).

2.9 Sewer flooding

Historical incidents of flooding are detailed by Severn Trent 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.

2.10 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 Leicestershire County Council as LLFA.

2.11 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. Chapter 6 of the Level 1 SFRA details all the formal flood defences in Blaby district. The Council's asset register was also obtained in the Level 1 SFRA.

2.12 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, for example within the vicinity of the Environment Agency's embankment within Whetstone, to understand the level of assessment required and to agree the approach for the breach assessment, if required.

2.13 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).

Where detailed model outputs were available, i.e. along the River Soar, Cosby Brook, Broughton Brook, and the Whetstone Brook, the 100-year plus climate change depth, velocity and hazard data has been used. This data is only present where models have a 2D element, representing the floodplain in detail. In the absence of detailed hydraulic models (or models with detailed 1D-2D outputs), 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. Developers should also test the impact of climate change depths, velocities, and hazard on the site, at Flood Risk Assessment stage.

Table 2-4 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 this information is known at the strategic scale.

2.14 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, JBA's Groundwater Mapping 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 Table 2-5. 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 2-5 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. Leicestershire County 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 Blaby must be designed so that they are in accordance the **Leicestershire Local Flood Risk Management Strategy** (https://www.leicestershire.gov.uk/sites/default/files/field/pdf/2015/12/8/flooding_strategy_plan.pdf).

3 Impact of Climate Change

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

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.

3.1 Revised climate change guidance

The Environment Agency published **updated climate change guidance** (https://www.gov.uk/government/publications/peak-river-flow-climate-change-allowances-by-management-catchment) 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.

In 2018, the government published new UK Climate Projections (UKCP18).

The Environment Agency have used these to further update their climate change guidance for new developments with regards to updated fluvial and rainfall allowances. The **new climate change allowances** (https://www.gov.uk/government/publications/peak-river-flow-climate-change-allowances-by-management-catchment) were released in July 2021 and should be used when undertaking a detailed Flood Risk Assessment.

3.2 Applying the climate change guidance

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

- The vulnerability of the development.
- The likely lifetime of the development – in general 60 years is used for commercial development and 100 for residential, but this needs to be confirmed in an FRA.
- The River Basin that the site is in – Blaby District is primarily situated within River Soar and River Sence 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.

3.3 Relevant allowances for Blaby District

Table 3-1 shows the peak river flow allowances that apply to Blaby District for fluvial flood risk, and Table 3-2 shows the peak rainfall intensity allowances that apply in Blaby District when considering surface water flood risk. For large catchments (more than 5km^2) and rural catchments, the allowances in Table 3-2 are used for peak rainfall intensity. Both the central and upper end allowances should be considered to understand the range of impact.

Table 3-1 2021 Peak river flow allowances for the Soar Management Catchment

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)
	Upper end	28%	35%	60%
	Higher central	18%	21%	37%
	Central	14%	16%	28%

Table 3-2 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%

3.4 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 Soar Catchment based on previous climate change allowances (before updated allowances were released in July 2021). The existing higher central and upper end scenarios were used to conservatively represent the new central and higher central allowances. The new higher upper end allowance was run as part of the L2 assessment on the Soar and Tributaries models where sites were located, using the method outlined in Section 2.3, therefore.

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 +60% 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 may 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': Where detailed hydraulic models exist and were run for the EA allowances in the Level 1 SFRA.

It is important to note that although the flood extent may not increase noticeably on some watercourses, the flood depth, velocity, and hazard may increase compared to the 100-year current-day event. 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. The Environment Agency should be consulted to provide further advice for developers on how best to apply the new climate change guidance.

When undertaking a site-specific Flood Risk Assessment, developers should:

- Confirm which national guidance on climate change and new development applies by visiting **GOV.uk** (https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances)
- Apply this guidance when deciding the allowances to be made for climate change, having considered the potential sources of flood risk to the site (using this SFRA), the vulnerability of the development to flooding and the proposed lifetime of the development. If the site is just outside the indicative climate change extents in this SFRA, the impact of climate change should still be considered because these may get affected should the more extreme climate change scenarios materialise.
- Refer to **Chapter 5** which provides further details on climate change for developers, as part of the FRA guidance.

3.5 Impact of climate change on groundwater flood risk

The effect of climate change on groundwater flooding, and those watercourses where groundwater has a large influence on winter flood flows, is more uncertain. There is no technical modelling data available to assess climate change impacts on groundwater. It would depend on the flooding mechanism, historic evidence of known flooding and geological characteristics, for example prolonged rainfall in a chalk catchment. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

Milder wetter winters may increase the frequency of groundwater flooding incidents in areas that are already susceptible, but warmer drier summers may counteract this effect by drawing down groundwater levels to a greater extent during the summer months.

A high likelihood of groundwater flooding may mean infiltration SuDS are not appropriate and groundwater monitoring may be recommended.

3.6 Impact of climate change on the functional floodplain

The potential impacts from Flood Zone 3b (20-year modelled extent) plus climate change may need to be considered at site-specific assessment stage. If this is not explicitly modelled, the modelled 20-year output could be compared against a return period similar to that expected if the 20-year flow was to be uplifted by say 37% or 60% as per the EA's guidance. This may equate to a 75-year or 100-year flood event (possibly higher in some locations). Elsewhere, it could be assumed that FZ3a could be considered an indicative extent for FZ3b with climate change.

3.7 Impact of climate change on sewers

Surface water and fluvial flooding with climate change have the potential to impact on the sewerage system, so careful management of these is needed for development. Due to differing ages of settlements, there will be drainage systems consisting of different types of sewers. Increasing pressures from climate change, urban creep and infill development could impact on the performance of the sewerage system.

Severn Trent Water advise that surface water is to be kept separate from foul sewerage wherever possible, as this will result in a more resilient sewerage system.

3.8 Adapting to climate change

The NPPG Climate Change guidance contains 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.
- Considering the standard of protection of defences and sites for future development, in relation to sensitivity to climate change. The Council and developers will need to work with RMAs and use the SFRA datasets to understand whether development is affordable or deliverable. Locating development in such areas of risk may not be a sustainable long-term option.

It is recommended that the differences in flood extents from climate change are compared by the Council when allocating sites, to understand how much additional risk there could be, where this risk is in the site, whether the increase is marginal or activates new flow paths, whether it affects access/ egress and how much land could still be developable overall.

4 Level 2 assessment methodology

This chapter outlines how sites were screened against flood risk datasets to determine which sites needed a Level 2 assessment. It also identifies other sites at lower risk with general recommendations for developers.

4.1 Site screening

Blaby District Council provided 125 sites for assessment. These sites were screened against a suite of available flood risk information and spatial data to provide a summary of risk to each site, including:

- The proportion of the site in each Flood Zone derived from the Level 1 SFRA, which includes modelling data
- 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
- Whether the site is within 100m of a detailed river network.

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 Blaby District 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 may show to be 100% in Flood Zone 1, but upon visual inspection in GIS, 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.

4.2 Sites taken forward to a Level 2 assessment

Out of the 125 sites provided by the Blaby District Council, 42 sites were carried forward to a Level 2 assessment.

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 lower flood risk but are flagged in this report for developer considerations (recommendations provided in section 4.3), and green sites that had no/ negligible risk.

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 4-2 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 4-1 summarises the sites which have been taken forward to the Level 2 assessment on this basis.

Table 4-1 Sites[1] carried forward to a Level 2 assessment

Site Code	Reason for Level 2*	Updated Flood Zones %** FZ3b	Updated Flood Zones %** FZ3a	Updated Flood Zones %** FZ2	Updated Flood Zones %** FZ1	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
BLA031	Fluvial	0%	0%	<1%	99%	4%	10%	22%
BLA034	Fluvial	<1%	17%	18%	82%	3%	8%	19%
COS009	Fluvial	0%	1%	2%	98%	2%	3%	7%
COS013	Fluvial	<1%	7%	12%	88%	<1%	3%	11%
COU042	Surface Water	0%	0%	0%	100%	2%	6%	13%
CRO007	Surface Water	2%	3%	5%	95%	2%	2%	5%
CRO006	Fluvial	14%	16%	19%	81%	2%	5%	20%
ELM001	Fluvial	0%	27%	30%	70%	7%	13%	30%
ELM008	Fluvial	<1%	4%	5%	95%	2%	4%	14%
ELM009	Surface Water	0%	12%	14%	86%	6%	8%	12%
ELM010	Fluvial	0%	8%	10%	90%	8%	16%	34%
GLE030	Surface Water	0%	0%	0%	100%	2%	4%	10%
GLE032	Historic	3%	5%	6%	94%	3%	4%	7%
GPA024	Historic	7%	7%	50%	50%	<1%	<1%	1%
GPA025	Fluvial	6%	7%	11%	89%	1%	4%	11%
GPA026	Fluvial	4%	4%	5%	95%	2%	4%	8%
HUN013	Fluvial	23%	25%	33%	67%	11%	15%	25%
HUN018	Fluvial	<1%	0%	23%	77%	0%	1%	5%
KIL006	Fluvial	9%	11%	16%	84%	19%	22%	45%
KMU021	Fluvial	1%	2%	3%	97%	2%	3%	8%
KMU022	Fluvial	27%	52%	57%	43%	74%	78%	94%
KMU024	Fluvial	6%	13%	16%	84%	9%	11%	19%

Site Code	Reason for Level 2*	Updated Flood Zones %** FZ3b	Updated Flood Zones %** FZ3a	Updated Flood Zones %** FZ2	Updated Flood Zones %** FZ1	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
LFE018	Fluvial	<1%	<1%	1%	99%	2%	4%	12%
LIT008	Fluvial	35%	37%	44%	56%	4%	6%	24%
LIT009	Fluvial	45%	46%	58%	42%	7%	14%	42%
LIT022	Fluvial	0%	0%	10%	90%	9%	11%	18%
LIT023	Fluvial	1%	1%	3%	97%	<1%	1%	2%
LUB002	Surface Water	0%	0%	0%	100%	3%	5%	10%
NAR008	Fluvial	<1%	<1%	5%	95%	7%	18%	35%
NAR019	Fluvial	0%	5%	5%	95%	9%	13%	21%
STO025	Surface water	0%	0%	0%	100%	15%	21%	27%
STO029	Surface Water	0%	0%	0%	100%	1%	2%	9%
WHE019	Fluvial	0%	6%	44%	56%	<1%	<1%	9%
WHE027	Fluvial	0%	5%	6%	94%	6%	9%	19%
WHE031	Fluvial	2%	3%	4%	96%	2%	3%	11%
WHE032	Historic	0%	0%	16%	84%	0%	0%	9%
EAST001	Surface Water	0%	0%	0%	100%	4%	5%	11%
EBLA002	Surface Water	0%	0%	0%	100%	<1%	2%	22%
ECRO002	Fluvial and Surface Water	7%	9%	25%	75%	4%	7%	24%
EELM001	Fluvial and Surface Water	0%	1%	1%	99%	2%	3%	10%
ELUB002	Surface Water	0%	0%	0%	100%	0%	<1%	3%
ESHA001	Surface Water	0%	0%	0%	100%	<1%	2%	8%

***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%.

4.3 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 4-2 below. These pose a risk from surface water flooding only, or an ordinary watercourse does not present in the EA's Flood Zones due to catchment size. Surface water mapping at these sites is presented in Appendix B.

Table 4-2 Sites[1] flagged at lower flood risk

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
BLA033	The risk of surface water flooding is located mostly within the eastern boundary of the site, flowing south to north through the site. The 30-year surface water flooding event covers only 1% of the site. Surface water ponding is also located across the northern boundary of the site. The 100-year event covers 3% of the site and is similarly located along the south-eastern boundary of the site, with a small area of surface water ponding in the central western area of the site and a new surface water flow path flowing west to east to the ordinary watercourse. A small surface water pond is located at the north-eastern boundary of the site. The 1,000-year event covers 11% of the site and shows a surface water flow path north along the eastern boundary of the site, creating a large dry island along the boundary of the site. The surface water flow path located along the northern boundary of the site has increased in size, flowing to the confluence of the ordinary watercourse. Further surface water ponding is located within the central western and north-western areas of the site.	1%	3%	11%
COS014	The 100 and 1000-year surface water flooding events are located within the site, with the 1,000-year surface water flooding event bisecting the site north from south. The 100-year surface water event covers 3% of the site and shows the source of a surface water branch flowing west out of the site and a surface water pond located within the site along the eastern boundary of the site. The 1,000-year event shows the surface water flow path bisecting the site from north from south, covering 13% of the site.	0%	3%	13%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
COU022	The site is bisected west from east across all three surface water flooding events. The risk of surface water flooding is located in the eastern portion of the site where an ordinary watercourse is located, flowing from south to north. Within the 1 in 30-year risk of surface water flooding is located just west of the ordinary watercourse, covering 1% of the site area. Within the 1 in 100-year surface water flooding event, the surface water branch is located adjacent to the ordinary watercourse, with small areas of dry land between the surface water and ordinary watercourse. The 1 in 1,000-year surface water flooding event covers 9% of the site and shows a small surface water pond in the central western area of the site. The surface water flow path shows a secondary flow channel which flows around two small dry spots located within the center of the site.	1%	4%	9%
COU046	All three-surface water flooding events are located within this site. Within the 30-year surface water event, three small surface water ponds are located within the central area of the site and one surface water pond along the eastern boundary of the site, covering 1% of the site. The 100-year surface water flooding event identifies multiple surface water ponds located within the central area of the site, covering 3% of the site. A surface water branch bisects the north-eastern area of the site from the southern area of the site. The 1,000-year surface water event covers 16% of the site and shows a surface water channel flowing east through the site, bisecting the site north from south. Large surface water ponds are in the south-eastern corner of the site as well as along the southern boundary of the site. A large surface water pond is located within the central area of the site, just north of the surface water channel.	1%	3%	16%
END024	All three-surface water flooding events are located within the site. The 30-year event identifies a large area of surface water ponding in the northern area of the site, covering 4% of the site. The 100-year surface water event covers 7% of the site and shows a further increase in area coverage of the surface water pond in the northern area of the site. The 1,000-year surface water event covers 17% of the site and shows a surface water flow path flowing north through the site, bisecting the site from north west from south east.	4%	7%	17%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
HUN016	All three-surface water flooding events are located within this site. The 30-year surface water flooding event covers 5% of the site, a large area of surface water ponding is located along the eastern boundary of the site, with a surface water pond further north along the north-eastern boundary of the site. The 100-year surface water flooding event covers 8% of the site, with flow channels flowing east and south into the large surface water pond along the eastern boundary of the site. The 1,000-year surface water event covers 17% of the site with a surface water branch flowing east along the northern boundary of the site, then flowing south along the eastern boundary of the site into the surface water pond. A small surface water pond located in the south-western corner and central-western area of the site.	5%	8%	17%
KMU020	All three surface water flooding events are located within this site. The 30-year surface water flooding event covers 6% of the site, with a surface water pond located within the central area of the site. The 100-year surface water event covers 8% of the site and shows a further increase in the size of the surface water pond, with further area coverage extending south through the site. There is an additional surface water pond located along the northern boundary of the site. The 1,000-yeear event covers 18% of the site, with a surface water flow path flowing north along the eastern boundary of the site and west through the center of the site, bisecting the site north from south. A small surface water pond is in the central western area of the site.	6%	8%	18%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
KMU025	All three surface water flooding events are located within the site, with surface water flooding located within the area of the ordinary watercourse flowing north out of the center of the site, the 30-year surface water flooding event covers 1% of the site with a small surface water flow path flowing north from the central area of the site along the ordinary watercourse. The 100-year surface water flooding event covers 2% of the site and shows 3 surface water ponds within the central area of the site. The 1,000-year event covers 15% of the site, identifying numerous flow branches flowing to the central channel within the site. Additionally, there are additional surface water ponds identified along the eastern area, south-eastern and central area of the site. There is also further surface water flooding in the central area of the site, flowing into the ordinary watercourse channel.	1%	2%	15%
LIT024	This site is not at risk of surface water flooding, but Flood Zone 2 is located very close to the boundary of the site. It was not deemed to require a L2 assessment.	0%	0%	0%
SAP013	The risk of surface water flooding is located along the northern boundary of the site, adjacent to the ordinary watercourse flowing from west to east of the site. Within the 30-year event, risk from surface water flooding is located along the north boundary of the site, covering 4% of the site. Within the 100-year event, surface water flooding covers 6% of the site, with a small surface water pond located in the western area of the site, adjacent to the western site boundary. The 1,000-year event covers 14% of the site with a small surface water flow branch flows north to the main flow channel in the western area of the site. Further surface water ponding is located along the southern boundary of the site, with surface water ponding in the north-eastern area of the site. A large area of surface water coverage is in the northern central area of the site.	4%	6%	14%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
SAP032	The risk of surface water flooding is located along the western and southern boundaries of the site, with three surface water ponds in the center of the site. The 1 in 30-year surface water flooding event is located along the southern boundary of the site flowing east out of the site, with small area of surface water ponding adjacent to the north-western boundary of the site. The 1 in 100-year flooding event is located within the same area of the 1 in 30-year event, but with a greater area coverage of 7%. The surface water flow meanders less than the 30-year event channel and shows a small portion of a surface water pond located along the north-western boundary of the site. The 1 in 1,000-year surface water flooding event covers 12% of the site, predominantly along the southern border of the site, with a new surface water flow path flows south along the western boundary of the site to the confluence with the larger surface water flow path. There are three surface water ponds located within the center of the site and a small area of surface water flooding along the northern boundary of the site.	4%	7%	12%
STO023	All three risk of surface water flooding events are observed within the site and bisect the site from the north-west to north-east of the site. The 1 in 30-year event covers 1% of the site and bisects the site from the north-eastern of the site to the south of the site and is located along the ordinary watercourse within the site. The 1 in 100-year surface water flooding event covers 1% of the site, with similar flood characteristics as the 1 in 30-year event but shows a small increase in area coverage along the ordinary watercourse and a small area of surface water ponding in the north-western area of the site, just south of the ordinary watercourse in the north-western boundary of the site. The 1,000-year surface water flooding event flows east along the ordinary watercourse, bisecting the site from north to south, covering 15% of the site. There are two surface flow paths flowing into the site from the north-western site boundary. The greatest area of surface water coverage is located south of the ordinary watercourse, with further surface water flooding in the northern portion of the site.	1%	1%	15%

Site Code	Nature of low flood risk/ considerations for the developer	Risk of Flooding from Surface Water % 30 yr	Risk of Flooding from Surface Water % 100 yr	Risk of Flooding from Surface Water % 1000 yr
STO024	Within this site, all three surface water flooding events are observed flowing north out of the site in the north-western portion of the site, bisecting the site from north west to south east. The 1 in 30-year flooding event shows that 6% of the site is at risk of surface water flooding, located in the western portion of the site. The 1 in 100-year surface water flooding event covers 9%, with similar flooding characteristics as the 1 in 30-year event. The 1 in 100-year event shows a small area of surface water ponding on the north-western boundary of the site. The 1 in 1,000-year event covers 15% of the site, predominantly located in the north-western area of the site, with a small area of surface water ponding along the southern area of the site, adjacent to Broughton Road.	6%	9%	15%

Some recommendations are stated in Chapter 7 for consideration at the site-specific Flood Risk Assessment stage.

4.4 Site summary tables

As part of the Level 2 SFRA, detailed site summary tables have been produced for the sites listed above in Table 4-1. 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 Soar).

Approximately half of the sites were located within the area covered by the 'River Soar and tributaries' hydraulic model, this includes the following sites:LIT009, LIT008, NAR008, BLA031, BLA034, COS013, CRO006, LIT023, WHE031, WHE019, CRO007, WHE032, GPA024, GPA025, GPA026, ECRO002 and LFE018.

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
- Location of site in the catchment
- 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
- 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
  - JBA's groundwater mapping
- NPPF Planning implications
  - Exception Test requirements
- 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
  - Fluvial depth, velocity, and hazard mapping
  - Surface water
  - Surface water depth velocity and hazard mapping

4.4.1 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 plus climate change fluvial depth, velocity, and hazard rating (where affects sites – e.g., River Soar and Tributaries)
- 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)
- Surface water 30-year, 100-year and 1,000-year depth, velocity, and hazard rating
- Areas Susceptible to Groundwater Flooding
- JBA's Groundwater Levels Risk Mapping
- Flood Warning and Flood Alert Areas
- Historic Landfill
- Historic Flood Map
- Defences (embankment and wall)
- Main Rivers/ Ordinary watercourses

5 Flood risk management requirements for developers

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

The report provides a strategic assessment of flood risk in Blaby District. 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 undertaken for a windfall site[2] may find that the site is entirely inappropriate for development of a particular vulnerability, or even at all.

5.1 Principles for new developments

Apply the Sequential and Exception Tests

Developers should refer to the Level 1 SFRA for more information on how to consider the Sequential and Exception Tests. For allocated sites, the Blaby District Council have 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, Leicestershire County Council as LLFA and Severn Trent Water as the water and sewerage company, 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

[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.

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

Chapter 7 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 Blaby 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.

5.2 Requirements for site-specific Flood Risk Assessments

5.2.1 When is an FRA required?

Site-specific FRAs are required in the following circumstances:

- Proposals of 1 hectare or greater in Flood Zone 1.
- Proposals for new development (including minor development such as non-residential extensions, alterations which do not increase the size of the building or householder developments and change of use) in Flood Zones 2 and 3.
- 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.

5.2.2 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 Leicestershire County Council. Guidance and advice for developers on the preparation of site-specific FRAs include:

- **Standing Advice on Flood Risk** (https://www.gov.uk/guidance/flood-risk-assessment-standing-advice)(Environment Agency).
- **Flood Risk Assessment for Planning Applications** (https://www.gov.uk/guidance/flood-risk-assessment-for-planning-applications)(Environment Agency);
- FRA Guidance Note (Environment Agency SHWG area);
- **Site-specific Flood Risk Assessment: CHECKLIST** (https://www.gov.uk/guidance/flood-risk-and-coastal-change#Site-Specific-Flood-Risk-Assessment-checklist-section)(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** (https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities).

5.3 Local requirements for mitigation measures

The Level 1 SFRA provides details on the following mitigation measures in Section 8.3, and should be referred to alongside this report:

- Site layout and design (8.3.1)
- Modification of ground levels (8.3.2)
- Raised floor levels (8.3.3)
- Development and raised defences (8.3.4)
- Developer contributions (8.3.5)

5.4 Flood warning and emergency planning

Section 3 of the Level 1 SFRA discusses NPPF requirements and what an Emergency Plan will need to consider and other relevant information on emergency planning. Further information is provided by the **Leicestershire Local Resilience Forum** (https://www.llrprepared.org.uk/) in reducing flood risk from other sources

Section 8.5 of the Level 1 SFRA discusses how to reduce flood risk from other sources, such as groundwater, surface water and sewer flooding.

5.5 Reservoirs

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

- Developers should contact the reservoir owner for information on:
- the Reservoir Risk Designation
- reservoir characteristics: type, dam height at outlet, area/volume, overflow location
- operation: discharge rates/maximum discharge
- discharge during emergency drawdown; and
- inspection/maintenance regime.
- The EA and NRW online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). Consideration should be given to the extent, depths and velocities shown in these online maps.
- The GOV.UK website on **Reservoirs: owner and operator requirements** (https://www.gov.uk/guidance/reservoirs-owner-and-operator-requirements) provides information on how to register reservoirs, appoint a panel engineer, produce a flood plan and report and incident.

Developers should consult the **Leicestershire Local Resilience Forum** (https://www.llrprepared.org.uk/) about emergency plans for reservoir breach.

Developers should use the above information to:

- Apply the sequential approach to locating development within the site.
- Consider the impact of a breach and overtopping, particularly for sites proposed to be located immediately downstream of a reservoir. This should consider whether there is sufficient time to respond, and whether in fact it is appropriate to place development immediately on the downstream side of a reservoir.
- Assess the potential hydraulic forces imposed by sudden reservoir failure event and check that that the proposed infrastructure fabric could withstand the structural loads.
- Develop site-specific Emergency Plans and/ or Off-site Plans if necessary and ensure the future users of the development are aware of these plans. This may need to consider emergency drawdown and the movement of people beforehand, similar to the response to the Toddbrook Reservoir incident in Whaley Bridge, Derbyshire, 2019.

5.6 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 Soar drains a large area of the Midlands. Upstream reservoirs in these catchments will provide some online flood storage that reduce the flood risk downstream and delays the onset of flooding. At the confluence of the larger watercourses and smaller tributaries, there may be different timings of peak flows, for example smaller tributaries would peak much earlier than the larger catchments.
- 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 is one site assessed in the Level 2(WHE019) which could be affected by a breach in flood defences within the Council area; however, future developments located near flood defences, such as those along the Whetstone Brook embankment around Brook Street, should consider the potential risk from a breach.
- Catchment geology, for example chalk catchments take longer to respond than typical clay catchments.

Table 5-1 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 (e.g. small tributaries), and slower responding and longer in duration in the lower catchment (e.g. River Soar).*

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

6 Surface water management and SuDS

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

The Level 1 SFRA summarises guidance and advice on managing surface water runoff and flooding in Chapter 9. Below is a guide to what is included in sections not expanded on here, for reference alongside this Level 2 SFRA:

- Section 9.1 – Role of the LLFA and LPA in surface water management
- Section 9.2 – Sustainable Drainage Systems (SuDS)

6.1 Sources of SuDS guidance

6.1.1 C753 CIRIA SuDS Manual (2015)

The **C753 CIRIA SuDS Manual** (2015) (https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspxhttps:/www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx) 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.

6.1.2 Non-statutory Technical Guidance, Defra (March 2015)

Non-Statutory Technical guidance (https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards) 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.

6.1.3 Non-statutory Technical Guidance for Sustainable Drainage Practice Guidance, LASOO (2016)

The Local Authority SuDS Officer Organisation produced their **Practice guidance** (https://www.susdrain.org/files/resources/other-guidance/lasoo_non_statutory_suds_technical_standards_guidance_2016_.pdf) in 2016 to give further detail to the Non-statutory technical guidance.

6.1.4 Leicestershire SuDS Handbook

Leicestershire County Council have not yet published a comprehensive SuDS Handbook which includes county-specific guidance for the design and implementation of SuDS in new developments. There is limited SuDS guidance pertaining to Leicestershire itself within the **Environmental Best Practice document** (https://www.leicestershire.gov.uk/sites/default/files/field/pdf/2018/11/15/Environmental-Best-Practice.pdf). This document uses a number of examples from various sources including the River Restoration Centre and Susdrain to illustrate a number of techniques that can be incorporated into SuDS designs. Additional information can be found environment and planning section of Leicestershire County Council's website (https://www.leicestershire.gov.uk/environment-and-planning/floodingand-drainage/surface-water-drainage-for-developments).

6.1.5 Groundwater Vulnerability Zones

The Environment Agency have published new groundwater vulnerability maps in 2015. These maps provide a separate assessment of the vulnerability of groundwater in overlying superficial rocks and those that comprise 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** (https://magic.defra.gov.uk/MagicMap.aspx).

6.1.6 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** (https://magic.defra.gov.uk/MagicMap.aspx).

Blaby District is located outside of a Groundwater Source Protection Zone.

6.1.7 Nitrate Vulnerable Zones

Nitrate Vulnerable Zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate levels in waterbodies are affected by surface water runoff from surrounding agricultural land entering receiving waterbodies. The level of nitrate contamination will potentially influence the choice of SuDS and should be assessed as part of the design process. The NVZ coverage can be viewed on **Defra's interactive mapping** (https://magic.defra.gov.uk/MagicMap.aspx). The entirety of Blaby District is not located within a surface water NVZ.

6.2 SuDS suitability across the study area

The suitability of SuDS techniques is dependent upon many variables, including the hydraulic and geological characteristics of the catchment.

The permeability of the underlying soils can determine the infiltration capacity and percolation capacities. As such, a high-level review of the soil characteristics has been undertaken using BGS soil maps of England and Wales which allow for a basic assessment of the soil characteristics and infiltration capacity. The results of the assessment and mapping of the soil characteristics are shown in the Level 1 SFRA.

This strategic assessment should not be used as a definitive site guide as to which SuDS would be suitable but rather as an indicative guide of general suitability based solely on soil type. Several other factors can determine the suitability of SuDS techniques including land contamination, the depth and fluctuation of the water table, the gradient of local topography and primary source of runoff etc. When considering NVZs and if areas have pollutants, infiltration may only be suitable where treatment measures are provided, prior to any discharge to surface or groundwaters.

Further site-specific investigation should be conducted to determine what SuDS techniques could be utilised at a particular development. The result of this assessment does not remove the requirements for geotechnical investigation or detailed infiltration testing and does not substitute the results of site-specific assessments and investigations. The LLFA should be consulted at an early stage to ensure SuDS are implemented and designed in response to site characteristics and policy factors.

7 Cumulative impact of development, schemes and strategic solutions

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

7.1 Introduction

Under the revised 2019 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).

When allocating land for development, consideration should be given to the potential cumulative impact of the loss of floodplain storage volume. Whilst the loss of storage for individual developments may only have minimal impact on flood risk, the cumulative effect of multiple developments may be more severe.

Conditions imposed by Blaby DC should allow for mitigation measures so any increase in runoff as a result of development is properly managed and should not exacerbate flood risk issues, either within, or outside of the Council's administrative areas.

The cumulative impact of development should be considered at the planning application and development design stages and the appropriate mitigation measures undertaken to ensure flood risk is not exacerbated, and where possible the development should be used to improve flood risk management.

7.2 Cross-boundary issues

The topography of Blaby District directs many smaller rivers into the River Soar that flows into and through the study area, and into neighbouring authorities. As such, future development both within and outside Blaby District can have the potential to affect flood risk to development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. Blaby District has boundaries with the following Local Authorities, which can be seen in Figure 7-1:

- Charnwood Borough
- City of Leicester
- Harborough District
- Hinckley and Bosworth Borough
- Oadby and Wigston Borough
- Rugby Borough

GIS data provided for the Level 2 SFRA was used to consider the effect of proposed development in neighbouring authorities on flood risk in Blaby District. This data showed development in neighbouring authorities on catchments draining into Blaby District from neighbouring authorities, namely Harborough District and Hinckley & Bosworth Borough. Harborough DC poses the most significant impact as development is likely to flow into the River Soar or its tributaries.

Although the 'Soar Brook from Source to Soar' catchment has not been identified as high risk in this assessment due to its rural nature, it was ranked as Medium risk for developed area in the Level 1 assessment when considering neighbouring proposed development in assessment sensitivity tests. It should be ensured that any development which occurs within Hinckley and Bosworth Borough considers the cumulative impact of all proposed development across this administrative border into Blaby District. This catchment will also be included in model re-runs as part of this assessment.

7.3 Level 2 Cumulative Impact Assessment

For the purposes of the Level 2 SFRA, which considers the cumulative impact of development at a more detailed level, proposed development sites across the study area were assessed. The area of proposed development within each catchment was calculated as a percentage of the total catchment area and the catchments were ranked accordingly. The five highest ranking catchments based on proposed area of development are identified in Table 7-1.

Table 7-1 Catchments with the highest percentage area covered by proposed development.

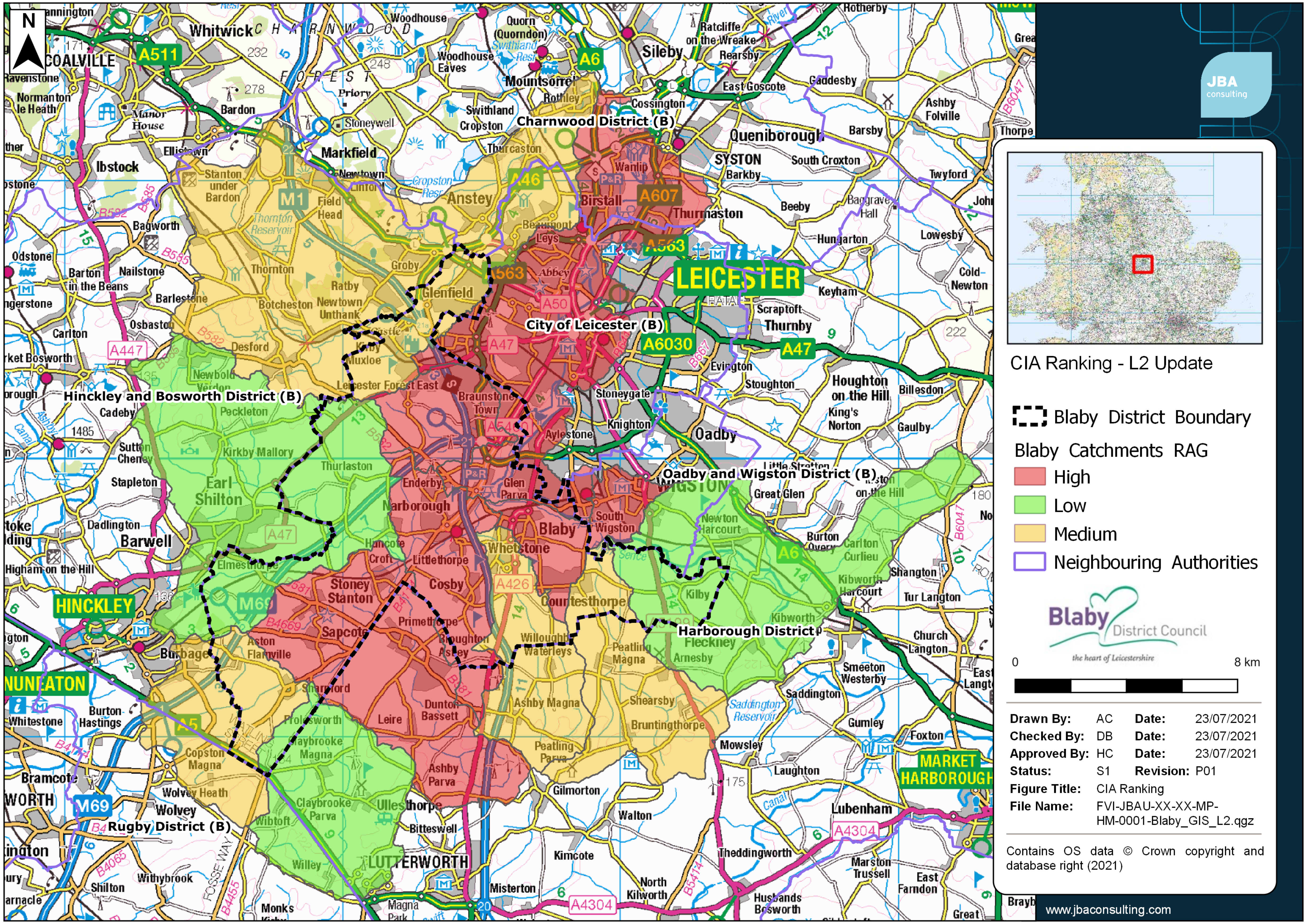
Catchment	Catchment Area (ha)	Percentage of catchment covered by proposed development (%)
Sence from Countesthorpe Brook to Soar	1293.9	16
Soar from Thurlaston Brook to Sence	2054.1	7
Soar from Sence to Rothley Brook	5915.5	8
Lubbesthorpe Brook catchment (trib of Soar)	1261.7	8
Soar from Soar Brook to Thurlaston Brook	4355.1	10

An assessment of the high-risk catchments identified in the Level 1 assessment alongside the percentage of each catchment covered by proposed development was carried out. This overview also considered the nature and location of the proposed development within each catchment and the catchment characteristics such as topography, location of conurbations in relation to watercourses and the predominant land-use.

This provides a strategic indication of the storage and mitigation measures that could be implemented to ensure that flood risk is not increased downstream as a result of the proposed development. This confirmed the High-risk catchments to be the same as those identified in the RAG assessment, and ultimately those that were selected to carry out a Level 2 assessment to understand the effect of proposed development. These catchments are the Sence (from Countesthorpe Brook to Soar); Soar (from Thurlaston Brook to Sence); Soar (from Sence to Rothley Brook); and Soar (from Soar Brook to Thurlaston Brook).

The Lubbesthorpe Brook Catchment has also been included in this L2 assessment as although ranked Medium in the L1, it scored highest for historic flood incidents. To reflect this, the Level 1 CIA Red-Amber-Green (RAG) assessment map has been updated to show the Lubbesthorpe Brook as High risk for the purpose of this L2 assessment (Figure 7-1 below).

Figure 7-1 Final Ranking of catchments in Blaby



7.4 Proposed development in Blaby District

Of the 125 sites identified in Blaby District, 89 of these sites fall within the high-risk catchment boundaries. Seventy of these sites lie wholly within a single catchment whilst 23 sites extend across multiple catchment boundaries.

Site EELM001 is displayed twice in this table as it crosses the point where 3 catchments meet. A very small proportion is within the Soar (from Soar Brook to Thurlaston Brook) catchment, 1%, whilst 8% is within the Soar Brook (from Source to Soar) catchment, and the remaining 91% within the Thurlaston Brook catchment.

Table 7-2 displays the proposed development sites, and the catchments that cross-boundary sites falls within. To avoid duplicating calculations, site LIT024 has not been included in this assessment as it is half formed from site LIT008 and half from LIT009. Table 7-2 below summarises the cross-catchment sites.

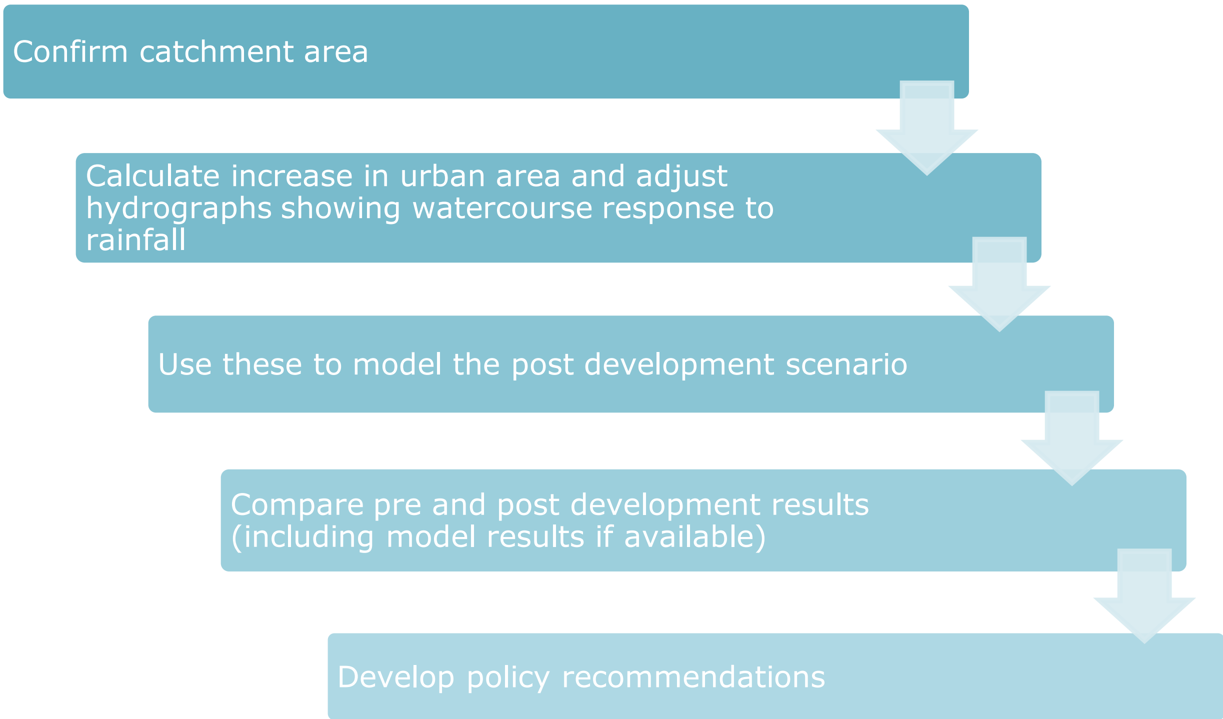
Table 7-2: Site areas within high-risk catchments (cross-boundary sites only).

Site	Catchment 1	Area within catchment (ha)	% site within catchment	Catchment 2	Area within catchment (ha)	% within catchment
BLA007	Sence (from Countesthorpe Brook to Soar)	0.10	12%	Whetstone Brook Catchment	0.74	88%
BLA032	Sence (from Countesthorpe Brook to Soar)	13.14	80%	Whetstone Brook Catchment	3.20	20%
COS010	Soar (from Thurlaston Brook to Sence)	1.84	71%	Whetstone Brook Catchment	0.75	29%
COU037	Sence (from Countesthorpe Brook to Soar)	0.00	0.005%	Whetstone Brook Catchment	1.62	99.995%
COU044	Sence (from Countesthorpe Brook to Soar)	2.02	4%	Countesthorpe Brook (from Source to Sence)	50.38	96%
COU047	Sence (from Countesthorpe Brook to Soar)	3.54	69%	Countesthorpe Brook (from Source to Sence)	1.61	31%
EELM001	Soar (from Soar Brook to Thurlaston Brook)	2.37	1%	Soar Brook from Source to Soar	18.22	8%
EELM001	Soar (from Soar Brook to Thurlaston Brook)	2.37	1%	Thurlaston Brook catchment	205.80	91%
GLE031	Soar (from Sence to Rothley Brook)	7.74	11%	Rothley Brook	65.37	89%
GPA010	Sence (from Countesthorpe Brook to Soar)	0.45	61%	Soar (from Sence to Rothley Brook)	0.28	39%
GPA025	Sence (from Countesthorpe Brook to Soar)	0.71	48%	Soar (from Sence to Rothley Brook)	0.77	52%
GPA026	Sence (from Countesthorpe Brook to Soar)	2.55	60%	Soar (from Sence to Rothley Brook)	1.71	40%
HUN013	Soar (from Thurlaston Brook to Sence)	0.89	7%	Thurlaston Brook Catchment	12.06	93%
HUN017	Soar (from Thurlaston Brook to Sence)	0.26	12%	Thurlaston Brook Catchment	1.93	88%
KMU026	Soar (from Sence to Rothley Brook)	16.88	58%	Rothley Brook	12.34	42%
LFE019	Lubbesthorpe Brook Catchment (Trib of Soar)	6.36	80%	Rothley Brook	1.63	20%
LFE020	Lubbesthorpe Brook Catchment (Trib of Soar)	11.83	89%	Rothley Brook	1.53	11%
LFE021	Lubbesthorpe Brook Catchment (Trib of Soar)	8.60	16%	Rothley Brook	45.25	84%
NAR018	Soar (from Thurlaston Brook to Sence)	11.05	85%	Lubbesthorpe Brook Catchment (Trib of Soar)	1.95	15%
STO019	Soar (from Soar Brook to Thurlaston Brook)	3.10	86%	Thurlaston Brook Catchment	0.50	14%
STO026	Soar (from Soar Brook to Thurlaston Brook)	245.89	64%	Thurlaston Brook Catchment	140.25	36%
STO029	Soar (from Soar Brook to Thurlaston Brook)	186.46	65%	Thurlaston Brook Catchment	98.97	35%
WHE027	Soar (from Thurlaston Brook to Sence)	28.96	6%	Whetstone Brook Catchment	419.87	94%

7.5 Methodology

Figure 7-2 shows an overview of the methodology for the cumulative impact assessment.

Figure 7-2 Cumulative impact assessment methodology



7.5.1 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 urban areas identified across the catchment are covered by impermeable surfaces such as rooftops, roadways or other paved surfaces and represents the degree of urbanisation within a catchment. It is a general factor applied at a catchment wide scale and does not always reflect site level characteristics.

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 from 6.5-hour storm durations. 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 and therefore this is an indicative assessment.

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.

Jacobs' 2018 River Soar model represents the River Soar and the River Sence as well as tributaries including the Cosby Brook, Whetstone Brook and Broughton Astley Brook. The interactions between these watercourses are shown in Figure 7-3. For these catchments, modelling data was used to assess the potential impacts of the proposed development with model inflows downstream of the proposed sites modified. These models were re-run using updated post-development data generated using ReFH1 within Flood Modeller in order to maintain consistency with the initial model. These were run using the FEH generated catchment boundaries used in the 2018 model, which differ from the Level 1 and 2 High-Risk boundaries.

Additional hydrographs showing catchment flood response were generated in ReFH2 using the High-Risk catchment boundaries and using storm durations that were chosen so that the peak flow occurred at the same time as the existing hydrology in the model in the same catchments. Any additional volume generated due to development was added onto the falling limb of the baseline model inflow hydrograph to represent a post-development model scenario where peak flows were limited to existing levels (representing the necessary mitigation measures that would be required for development).

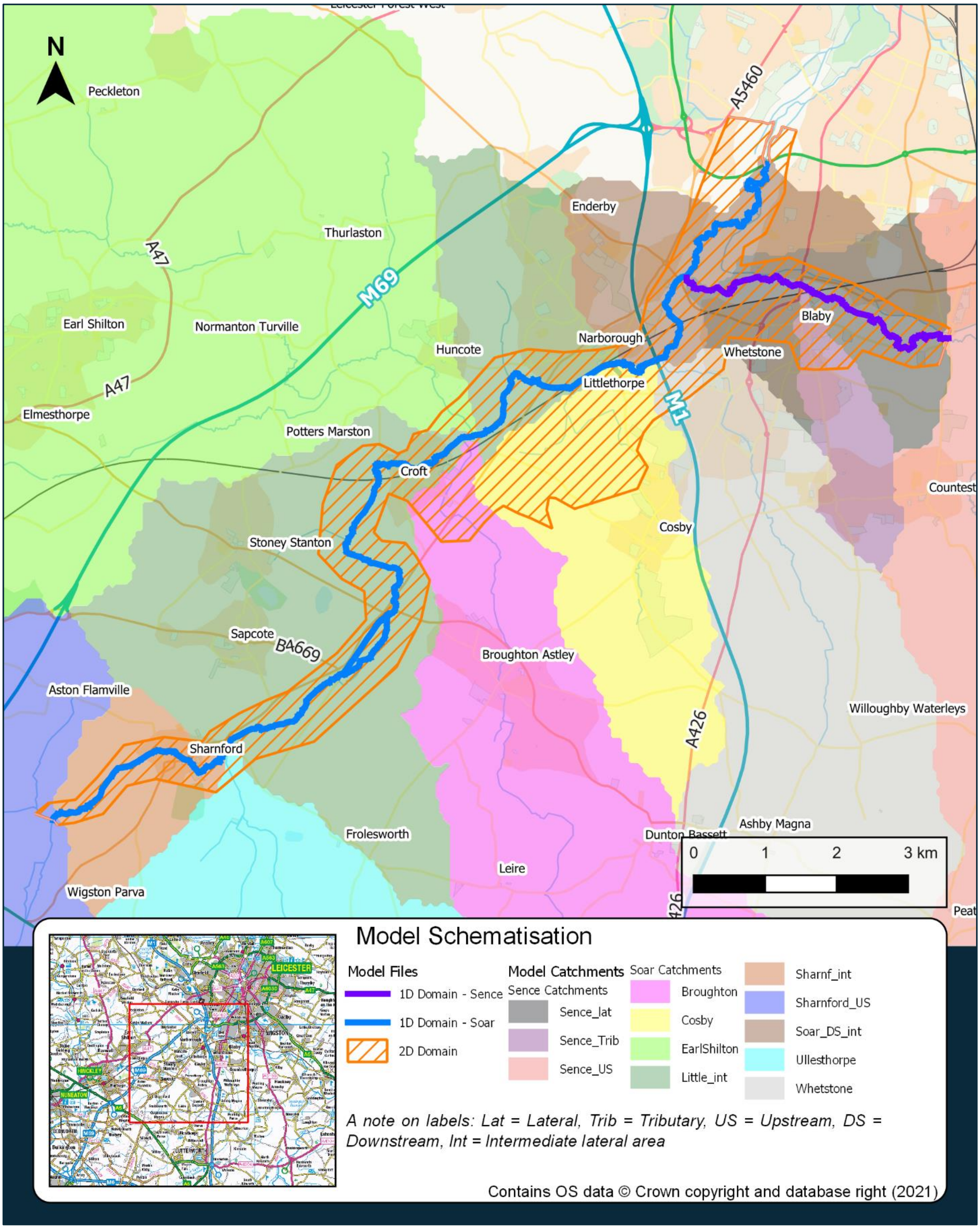


Figure 7-3: Jacobs' River Soar 2018 Model

7.5.2 Assumptions of method

There are a number of assumptions that were made in the methodology. This includes that the flows generated in ReFH1 for pre- and post-development are representative of the hydrology, as a full hydrological assessment has not been undertaken. It has also been assumed that the difference in volume in the ReFH1 hydrograph can be added onto the model inflow. The cumulative impact assessment has assumed that the existing models and hydrology are fit for purpose; a detailed hydrological assessment has not been undertaken for this study and therefore this provides a strategic assessment.

The formula used in ReFH2 to estimate parameters on urban catchments are calibrated to real urban catchments, which include mitigation measures. Therefore, it is important to note that the urban adjustment represents the net effect of urbanisation, i.e. it includes the consequences of flood mitigation works. This is because it is developed from flood peak data recorded from real urban catchments, which will include an amount of SuDS features, flood storage ponds, etc. For this reason, the model must not be used to project the runoff from future developments at the plot scale; it could substantially underestimate the scale of alleviation works required.

The changes to the results between the scenarios are generally small, with a maximum calculated increase of 8cm in the post-development scenario when compared to the pre-development. In general changes in flood depths are less than 1cm which is likely to be in the range of model uncertainty. The method used to generate a post-development runoff hydrograph only provides a strategic assessment of how much more flow there might be from sites despite the efforts of developers to mitigate it. It includes the assumption that some mitigation measures, such as SuDS, are in place in the new developed areas through limiting peak flow to existing levels.

This assessment has been carried out using one return period and one storm duration to give an indication of the potential impact of development from the proposed site allocations. As this is only a strategic assessment, more detailed assessments would need to be undertaken on a site-by-site basis as part of site-specific flood risk assessments. The assumptions are considered appropriate as this assessment is only providing a strategic assessment of cumulative impact in Blaby District.

7.5.3 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. The impermeable area of the site was assumed to be 60% of the total site area for both residential and employment sites. The value of 60% represents the developable/impermeable area assumed at a site-specific level based on a range of local council SHLAA methodologies across England as no specific data was available for Blaby District Council at the time of writing.

All other variables in the tool were left as default, to avoid a large number of assumptions. The FEH method was used in this assessment to allow for comparison with existing models.

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 by 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.

7.6 Cumulative impact within high-risk catchments

7.6.1 Sence (from Countesthorpe Brook to Soar)

There are 19 sites that lie within, or partially within the Sence catchment, shown in Figure 7-4. These sites are located primarily in the area east of Blaby District itself and along the banks of the Sence. Two sections of site BLA034 (which is comprised of 6 areas) are however located across the district boundary in Oadby and Wigston District. There are 2 recorded historic flooding events in the catchment, and a series of small neighbouring landfill sites within the Oadby and Wigston District section of the catchment, and three within/ partially within Blaby District. Three small sites lie within the wider catchment in Kilby, which is not covered by the hydrological assessment but included in the modelling and UK SuDS Tool assessment.

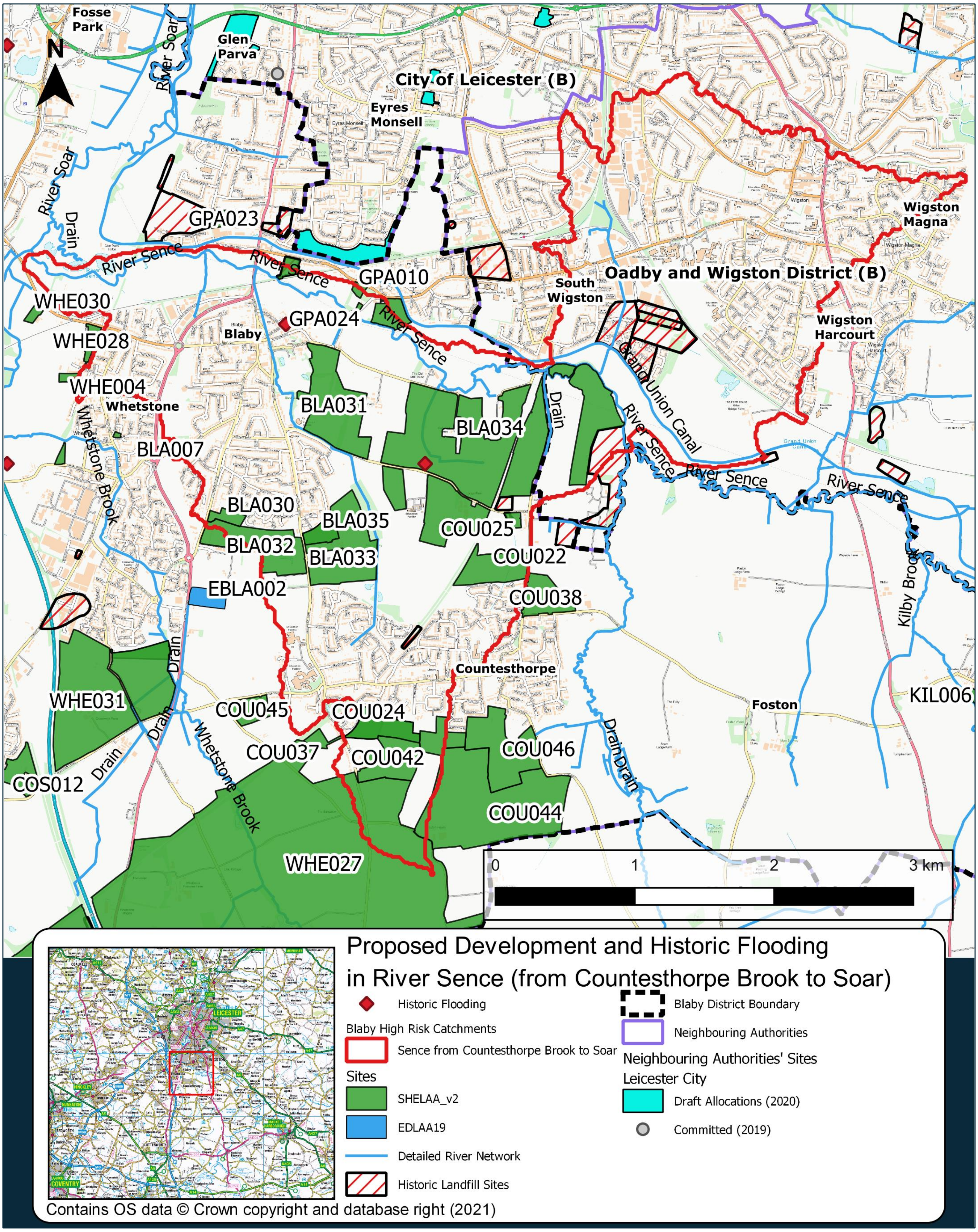


Figure 7-4: Proposed development and historic flooding in the Sence (from Countesthorpe Brook to Soar) catchment

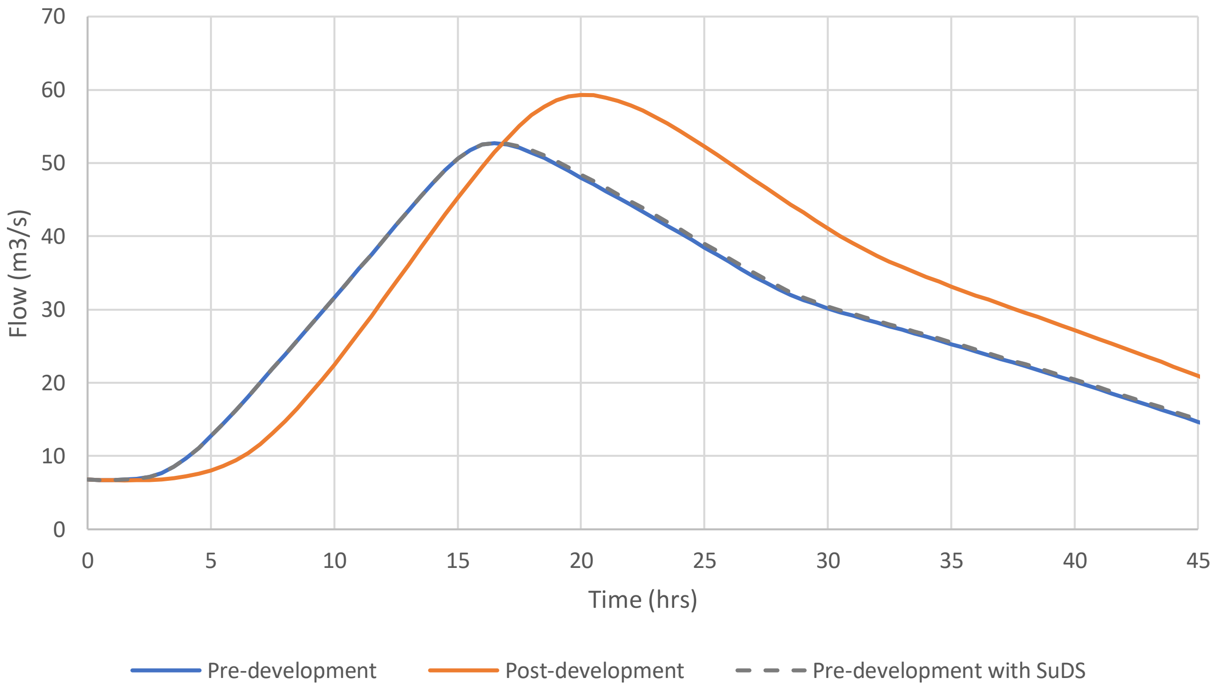


Figure 7-5: Pre- and post-development and SuDS hydrographs in the Sence catchment (ReFH2 method calculation)

Table 7-3 suggests that at a site-specific scale a total of 162,494m^3* is required in total attenuation storage in the Sence catchment in order to ensure that surface water runoff rates remain at the same level as current greenfield runoff rates. These results indicate a slightly delayed response, peaking ~4 hours later with a greater volume and flow rate in the River Sence catchment.

**Volume assumes site areas within the Sence catchment only.*

Table 7-3: Estimated storage volumes required at sites in the Sence catchment, taken from the UK SUDS website

Settlement	Site	Attenuation Storage 1 in 100 years (m^3)
Blaby	BLA030	1505
Blaby	BLA031	17259
Blaby	BLA032*	12198*
Blaby	BLA032**	9532**
Blaby	BLA033	17082
Blaby	BLA034	75030
Blaby	BLA035	2295
Countesthorpe	COU022	7133
Countesthorpe	COU024	3020
Countesthorpe	COU025	753
Countesthorpe	COU038	5756
Countesthorpe	COU042	13156
Countesthorpe	COU043	5765
Glen Parva	GPA010*	458*
Glen Parva	GPA010**	244**
Glen Parva	GPA024	46
Glen Parva	GPA025*	1119*
Glen Parva	GPA025**	445**
Glen Parva	GPA026*	3161*
Glen Parva	GPA026**	1901**
Kilby	KIL002	931
Kilby	KIL006	526
Kilby	KIL008	114

**Storage assuming entire site is discharged into the Sence catchment*

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

7.6.2 Soar (from Thurlaston Brook to Sence)

This short section of the River Soar includes a significant number of drains as well as the Cosby brook from the south within its catchment area. Although there is little proposed development along the River Soar itself, the wider tributaries contain a larger number of proposed sites.

There are 30 sites that lie within, or partially within this section of the River Soar, shown in Figure 7-6, which cover >9% of the catchment area. Five sites cross into neighbouring catchments: 2 into both the Thurlaston and Whetstone Brooks, and one into the Lubbesthorpe Brook.

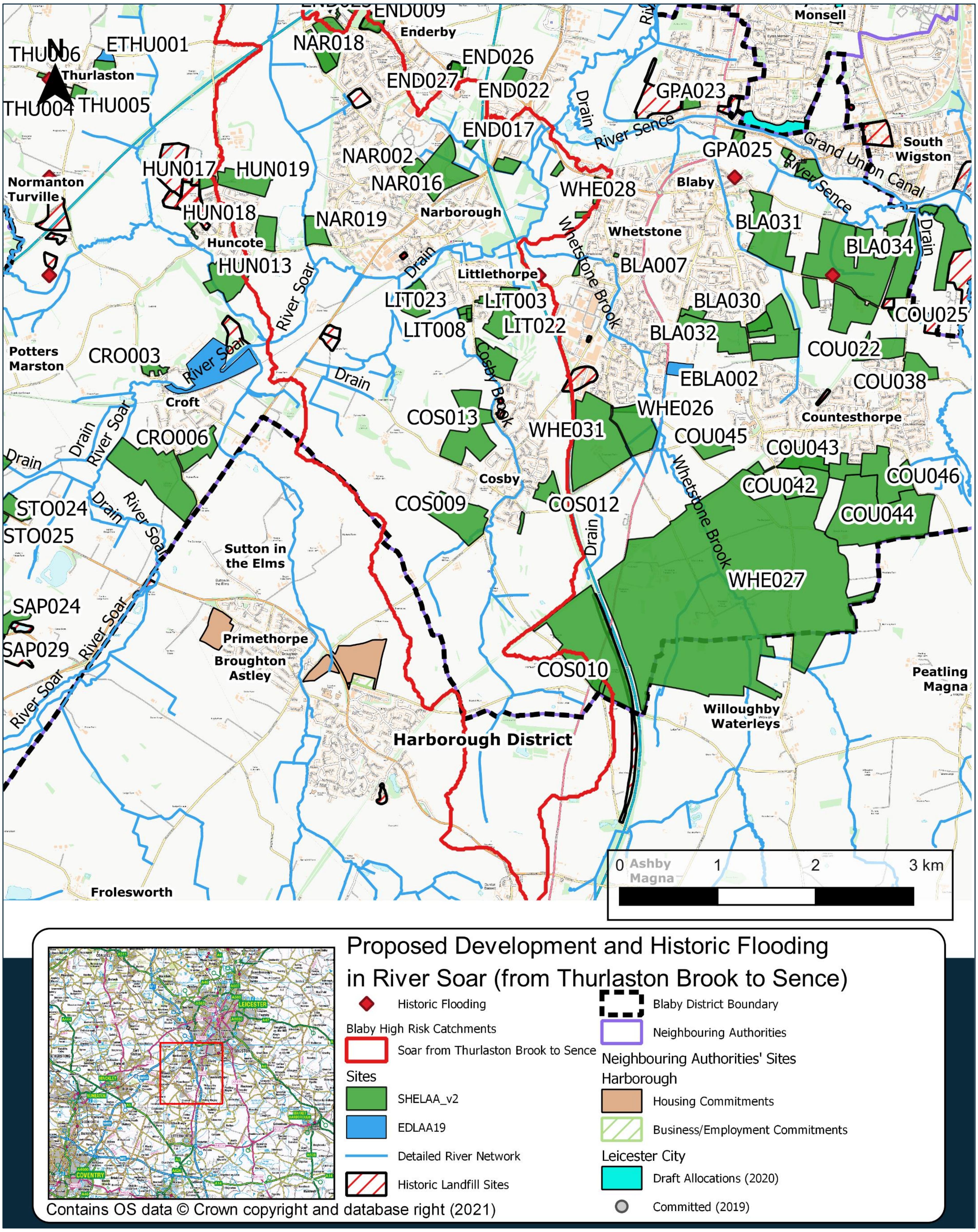


Figure 7-6: Proposed development and historic flooding in the Soar (from Thurlaston Brook to Sence) catchment

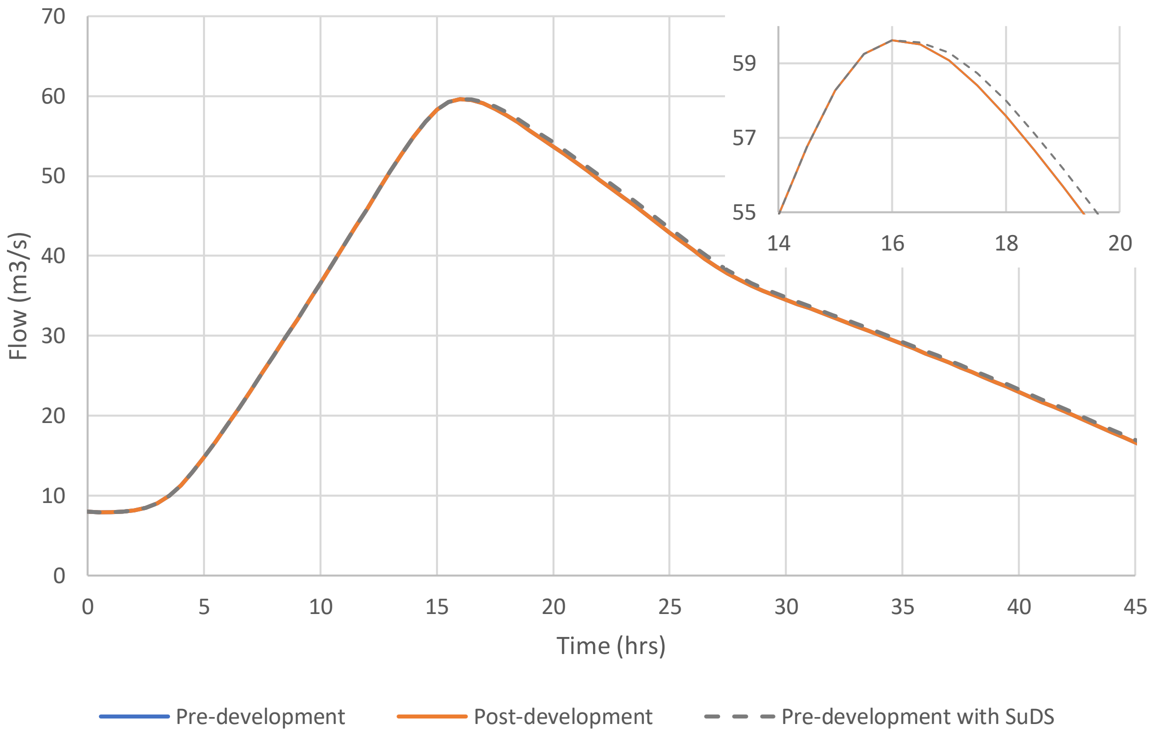


Figure 7-7: Pre- and post-development and SuDS hydrographs in the Soar (Thurlaston Brook to Sence) catchment

Table 7-4 suggests that at a site-specific scale a total of 467,265m^3* is required in total attenuation storage in this section of the Soar catchment in order to ensure that surface water runoff rates remain at the same level as current greenfield runoff rates. This impacts upon the Cosby Brook sub-catchment more significantly than the River Soar, shown in Figure 7-14. It should be noted that site WHE027 contributes >76% of the total attenuation storage requirements in this catchment of the River Soar. Consideration should be made to this site in a similar manner to larger strategic development sites, and further site-specific assessments carried out.

Table 7-4: Estimated storage volumes required at sites in the Soar (from Thurlaston Brook to Sence) catchment, taken from the UK SUDS website

Settlement	Site	Attenuation Storage 1 in 100 years (m^3)
Cosby	COS009	14838
Cosby	COS010*	1972*
Cosby	COS010**	1343**
Cosby	COS011	6936
Cosby	COS012	4163

**Volume assumes site areas within the Soar catchment only.*

Settlement	Site	Attenuation Storage 1 in 100 years (m^3)
Cosby	COS013	17445
Cosby	COS014	420
Enderby	END009*	2544*
Enderby	END009**	1342**
Enderby	END024	2126
Enderby	NAR018	9445
Enderby	NAR020	4051
Enderby	NAR021*	4489*
Enderby	NAR021**	1397**
Huncote	HUN013*	9066*
Huncote	HUN013**	549**
Huncote	HUN016	4714
Huncote	HUN017*	1527*
Huncote	HUN017**	113**
Huncote	HUN019	7388
Littlethorpe	LIT003	605
Littlethorpe	LIT008	627
Littlethorpe	LIT009	741
Littlethorpe	LIT022	7620
Littlethorpe	LIT023	5728
Narborough	END017	883
Narborough	NAR002	1742
Narborough	NAR008	2393
Narborough	NAR016	13024
Narborough	NAR019	4565
Whetstone	WHE004*	583*
Whetstone	WHE004**	470**
Whetstone	WHE027	355871
Whetstone	WHE028	1291
Whetstone	WHE030	649

**Storage assuming entire site is discharged into the Soar catchment*

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

7.6.3 Soar (Sence to Rothley Brook)

The Soar (Sence to Rothley Brook) drains a large area north-east of Blaby District, including a significant portion of the City of Leicester and Charnwood Borough beyond. The majority of development in this catchment is associated with the City of Leicester, though there are 9 sites proposed within/ partially within Blaby District located in the catchment. There are 2 sites partially within the Soar catchment and partially within the Rothley Brook catchment to the north-west, shown in Figure 7-8. Three historic flooding events are recorded within the Blaby District in this catchment, with ~7 more in neighbouring catchments to the west and one to the south.

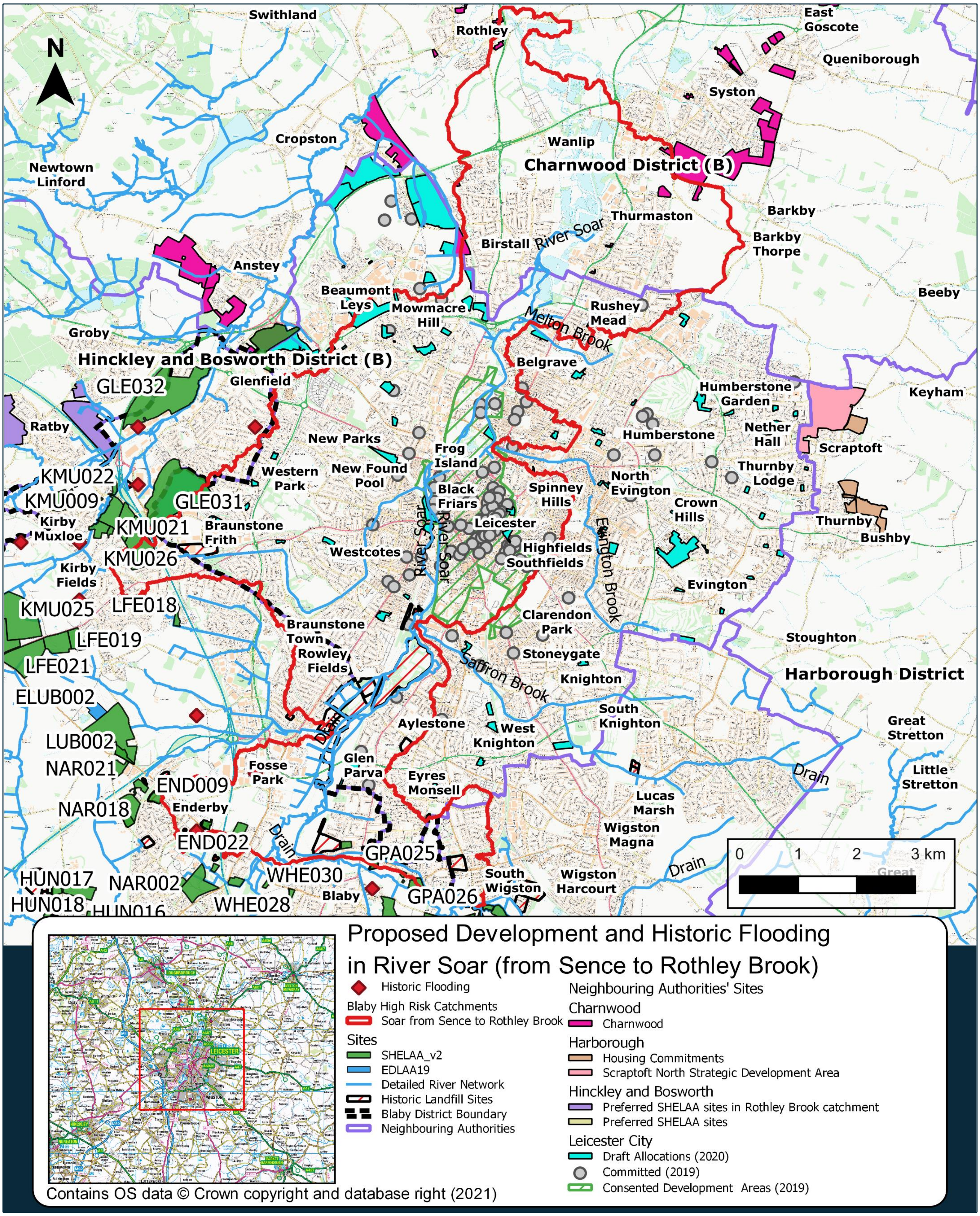


Figure 7-8: Proposed development and historic flooding in the Soar (Sence to Rothley Brook) catchment

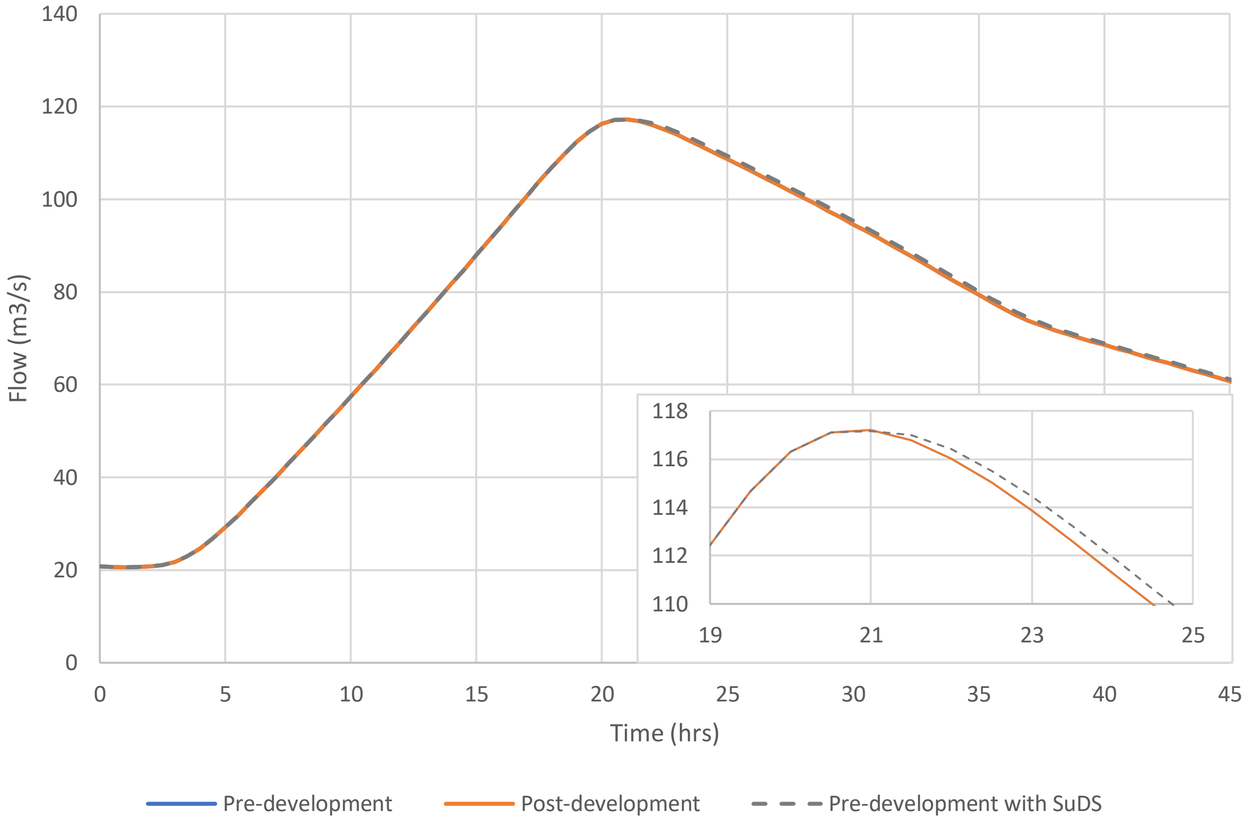


Figure 7-9: Pre- and post-development and SuDs hydrographs in the Soar (from Sence to Rothley Brook) catchment

Due to the scale of the River Soar through this catchment, and the relatively small area proposed for development, the modelling and hydrological assessments indicate a minimal impact on the main watercourse, more-so the tributaries that flow into it as shown in section 7.7. This means that the Pre- and Post-development datasets contain the same flow rates and thus only the post-development hydrograph appears to be shown in Figure 7-9.

Table 7-5 suggests that at a site-specific scale a minimum of 17,978m^3* is required in total attenuation storage in this large upper section of the Soar catchment in order to ensure that surface water runoff rates remain at the same level as current greenfield runoff rates. The significant number of proposed development sites in neighbouring Leicester City, and potential cumulative impact from them, and to them from upstream developments in Blaby DC, should be taken into consideration when planning development in this catchment. These have not been included in this assessment.

**Volume assumes site areas within the Soar catchment only.*

Table 7-5: Estimated storage volumes required at sites in the Soar (from Sence to Rothley Brook) catchment, taken from the UK SUDS website

Settlement	Site	Attenuation Storage 1 in 100 years (m^3)
Enderby	END022	3297
Enderby	END026	527
Enderby	END027	1283
Glen Parva	GPA010*	458*
Glen Parva	GPA010**	134**
Glen Parva	GPA023	1494
Glen Parva	GPA025*	1119*
Glen Parva	GPA025**	488**
Glen Parva	GPA026*	3161*
Glen Parva	GPA026**	1291**
Glenfield	GLE031*	49565*
Glenfield	GLE031**	4993**
Kirby Fields	KMU026*	19461*
Kirby Fields	KMU026**	11377**

**Storage assuming entire site is discharged into the Soar catchment*

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

7.6.4 Lubbesthorpe Brook

The Lubbesthorpe Brook is the smallest catchment in this assessment by area, and contains 12 sites that lie within, or partially within the catchment, shown in Figure 7-10. All of the proposed development sites are within the headwaters of the catchment along drainage channels. Four landfill sites lie within or partially within the catchment, one small one close to the border of a site END024 in the south of the catchment.

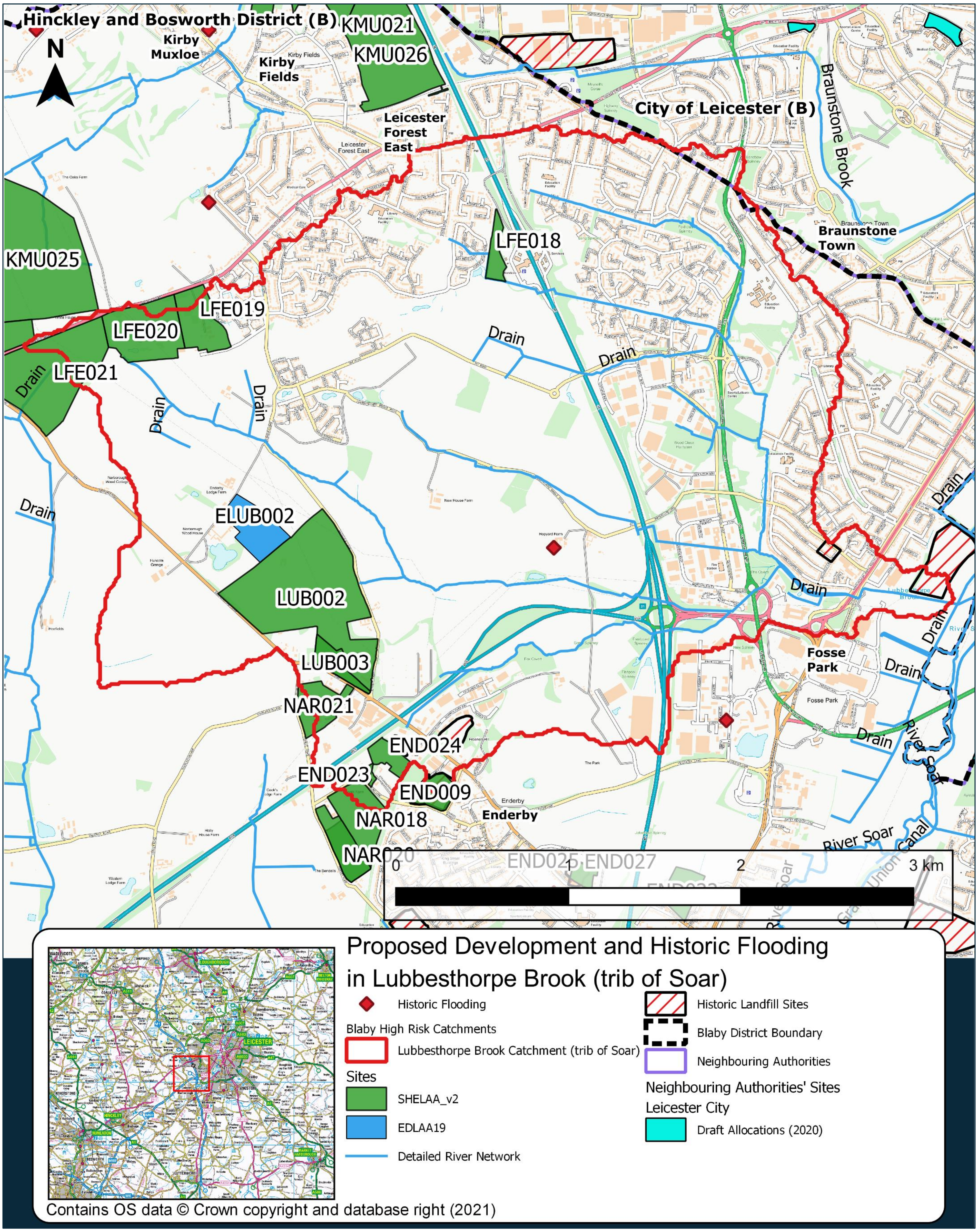


Figure 7-10: Proposed development and historic flooding in the Lubbesthorpe Brook catchmen

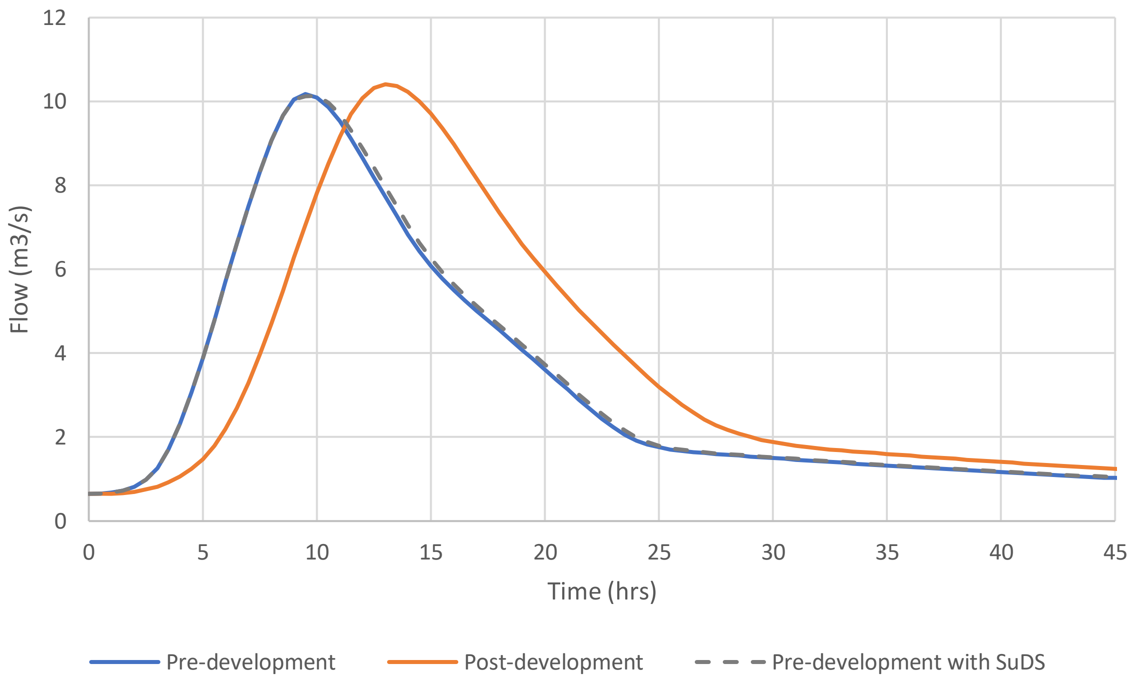


Figure 7-11: Pre- and post-development and SuDS hydrographs in the Lubbesthorpe Brook catchment

Table 7-6 suggests that at a site-specific scale a minimum of 43,533m^3* is required in total attenuation storage in the Lubbesthorpe Brook catchment in order to ensure that surface water runoff rates remain at the same level as current greenfield runoff rates. The catchment shows delayed response relative to Pre-development flows, with the slightly elevated peak occurring approximately 3.5 hours later.

**Volume assumes site areas within the Lubbesthorpe Brook catchment only.*

Table 7-6: Estimated storage volumes required at sites in the Lubbesthorpe Brook catchment, taken from the UK SUDS website

Settlement	Site	Attenuation Storage 1 in 100 years (m^3)
Enderby	END009*	2544*
Enderby	END009**	1211**
Enderby	END023	190
Enderby	END024	2126
Enderby	ELUB002	5224
Enderby	LUB002	31674
Enderby	LUB003	2505
Enderby	NAR018*	9445*
Enderby	NAR018**	1403**
Enderby	NAR021*	4489*
Enderby	NAR021**	3093**
Leicester Forest East	LFE018	1814
Leicester Forest East	LFE019*	5433*
Leicester Forest East	LFE019**	4312**
Leicester Forest East	LFE020*	9078*
Leicester Forest East	LFE020**	4392**
Leicester Forest East	LFE021*	36333*
Leicester Forest East	LFE021**	5833**

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

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

7.6.5 Soar (from Soar Brook to Thurlaston Brook)

This short upper section of the River Soar includes a number of drains and the Broughton Astley Brook within its catchment area. All proposed development sites in Blaby DC in this catchment are along the River Soar. The Broughton Astley Brook contains proposed development sites within the neighbouring Harborough District. There are 6 historic landfill sites within the catchment, four of which are near/ bordering development sites. There are 24 sites that lie within, or partially within this section of the River Soar, shown in Figure 7-12, which cover ~14% of the catchment area. Five sites cross into neighbouring catchments; 4 into the Thurlaston Brook, and one into the Soar Brook (from Source to Soar).

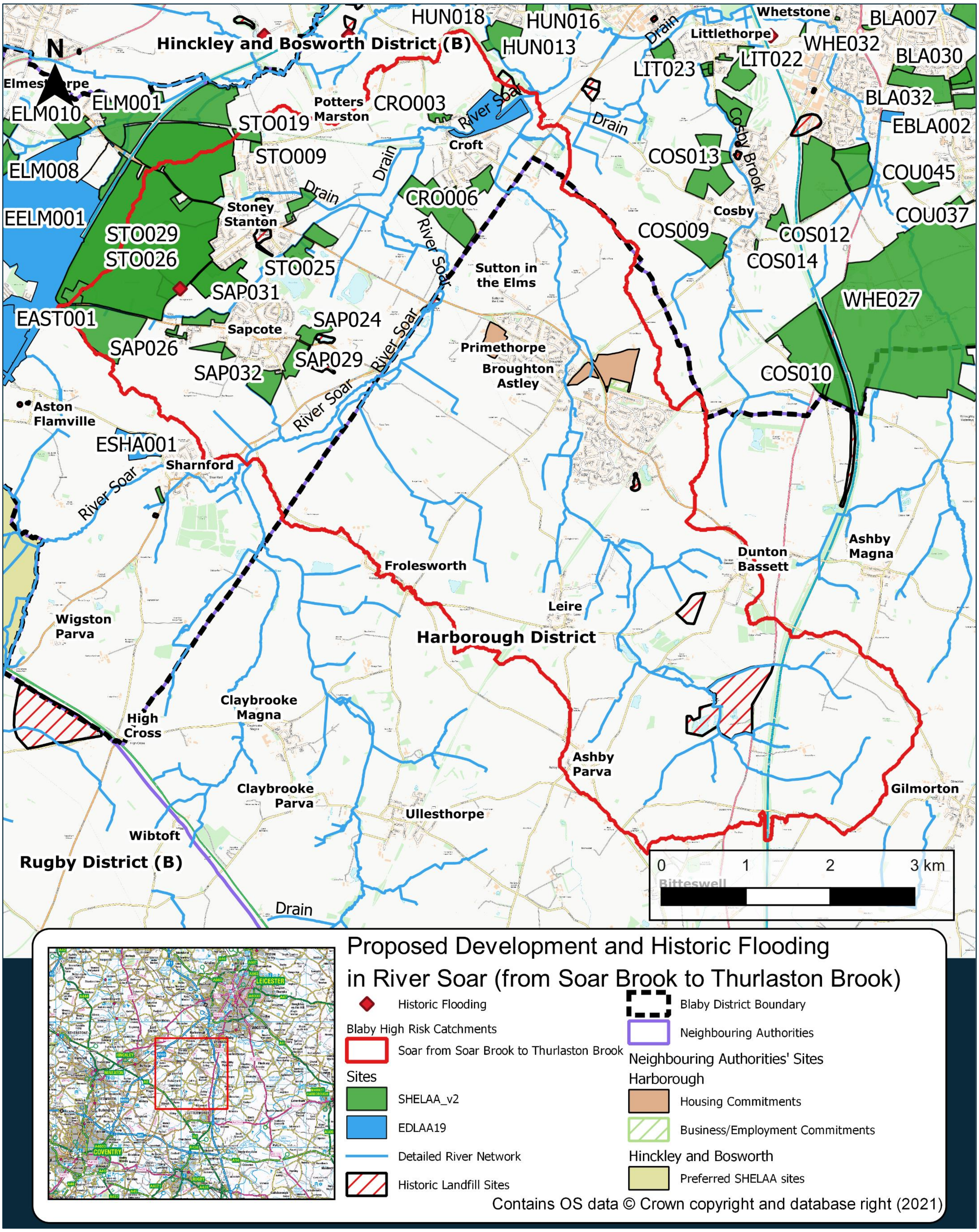


Figure 7-12: Proposed development and historic flooding in the Soar (from Soar Brook to Thurlaston Brook) catchment.

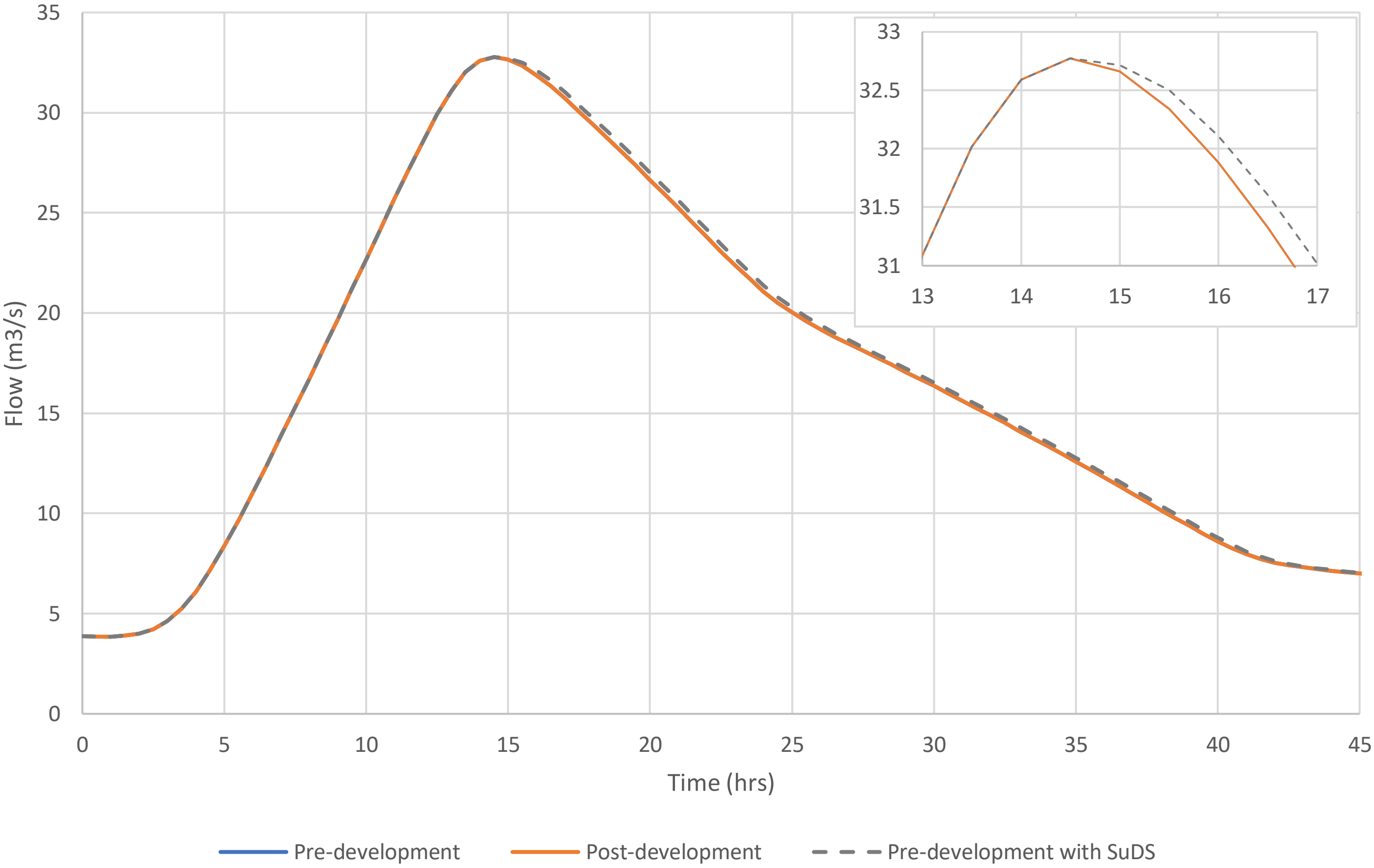


Figure 7-13: Pre- and post-development and SuDS hydrographs in the Soar (from Soar Brook to Thurlaston Brook) catchment

Table 7-7 suggests that at a site-specific scale a minimum of 348,347m^3* is required in total attenuation storage in this section of the river Soar catchment in order to ensure that surface water runoff rates remain at the same level as current greenfield runoff rates. This impacts the Broughton-Astley Brook sub-catchment more significantly that the River Soar, as shown in Figure 7-15.

It should be noted however that site STO026 contributes 49.9% of the total attenuation storage requirements in this catchment of the River Soar. Consideration should be made to this site in a similar manner to large strategic development sites, and further site-specific assessments carried out.

**Volume assumes site areas within the Soar Brook catchment only.*

Table 7-7: Estimated storage volumes required at sites in the River Soar (from Soar Brook to Thurlaston Brook) catchment, taken from the UK SUDS website

Settlement	Site	Attenuation Storage 1 in 100 years (m³)
Croft	ECRO002	14287
Croft	CRO003	5656
Croft	CRO006	7945
Croft	CRO007	23695
Sapcote	SAP013	4267
Sapcote	SAP019	1009
Sapcote	SAP023	494
Sapcote	SAP024	4055
Sapcote	SAP025	2077
Sapcote	SAP026	522
Sapcote	SAP028	3021
Sapcote	SAP029	5178
Sapcote	SAP031	12263
Sapcote	SAP032	8580
Stoney Stanton	STO002	6435
Stoney Stanton	STO009	1042
Stoney Stanton	STO016	1511
Stoney Stanton	STO019	2421
Stoney Stanton	STO023	3692
Stoney Stanton	STO024	4020
Stoney Stanton	STO025	6117
Stoney Stanton	STO026*	277007*
Stoney Stanton	STO026**	173959**
Stoney Stanton	STO028	27461
Stoney Stanton	STO029	202599

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

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

7.7 Impacts on hydraulic modelling results

The ReFH1 feature within Flood Modeller was used to generate pre- and post-development scenarios to adapt the existing hydraulic model inflow hydrographs. Figure 7-14, Figure 7-15, Figure 7-16 and Figure 7-17 shows the ReFH1 pre- and post-development hydrographs generated for the 100-year event in the Cosby Brook, Broughton-Astley Brook, River Sence and River Soar (full river system through Blaby District) catchments respectively. The excess volume passing through the catchments due to development was added onto model inflows situated downstream of the development sites. The post-development model inflow has been adjusted to account for the implementation of SuDS at the proposed development sites to limit the peak flow to existing levels, which is included in the figures.

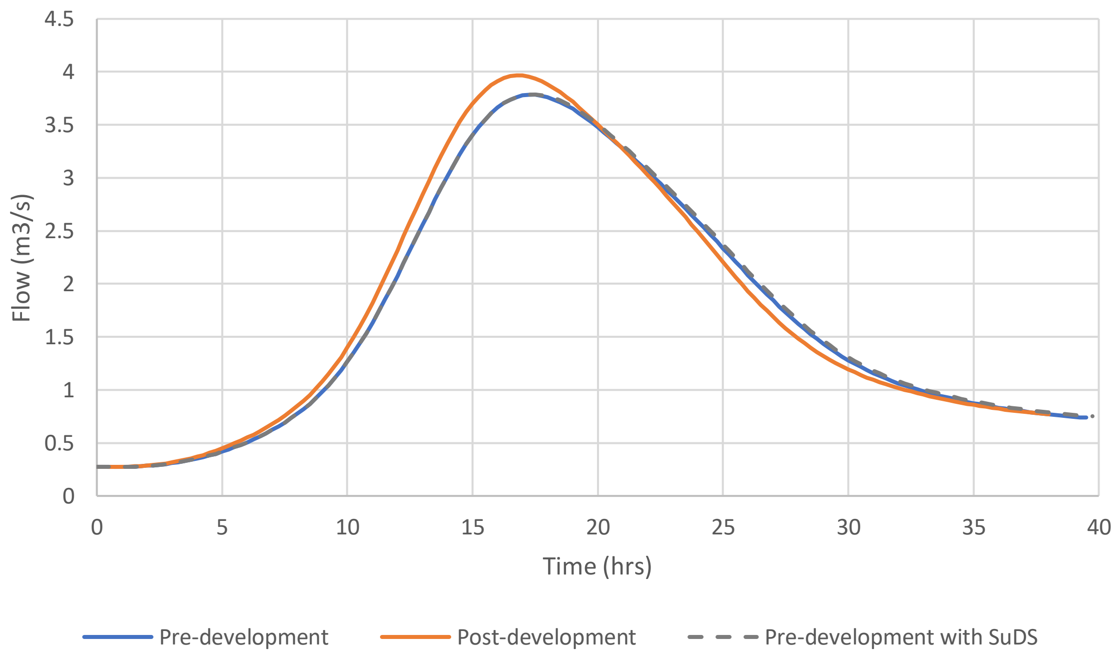


Figure 7-14: Pre- and post-development and SuDS hydrographs in the Cosby Brook*.

**Hydrological model results for the whole tributary to the Soar catchment (Thurlaston Brook to Sence).*

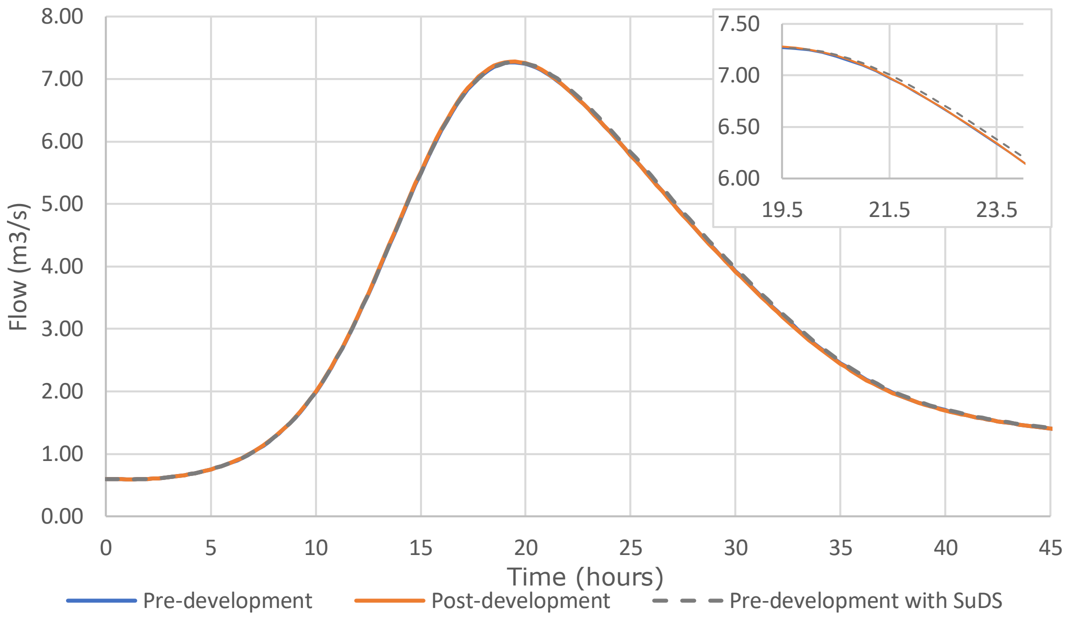


Figure 7-15: Pre-, Post, and SuDS hydrographs in the Broughton-Astley Brook hydrological model results.

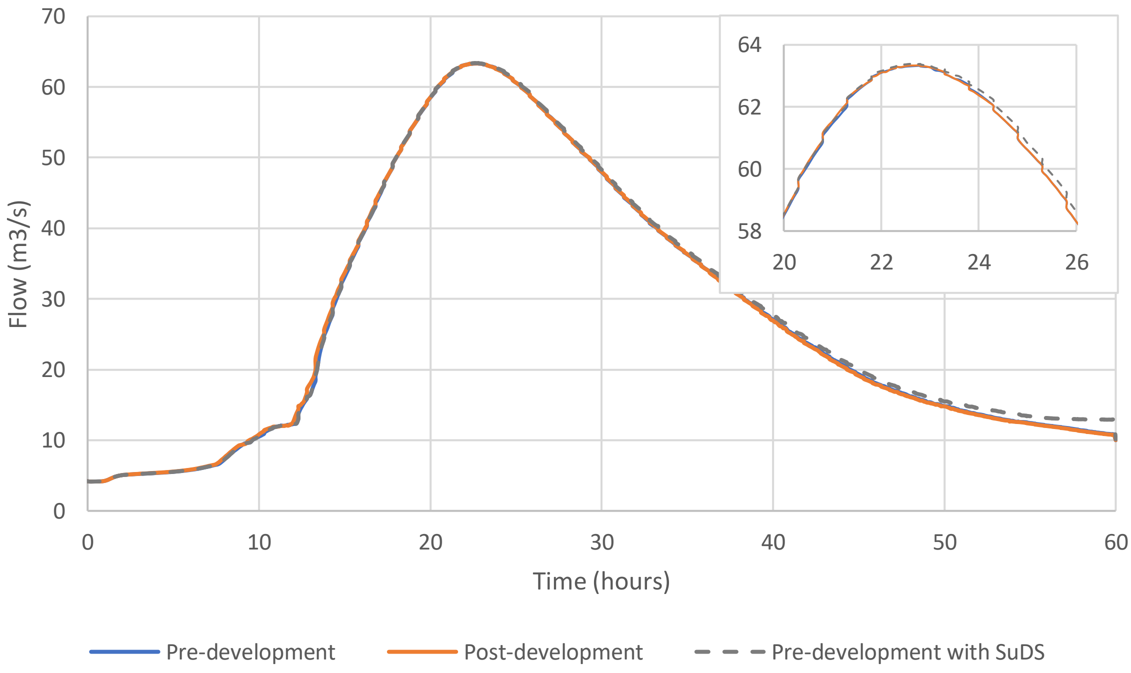


Figure 7-16: Pre-, Post-development and SuDS Hydrographs in the Sence catchment hydrological model results.

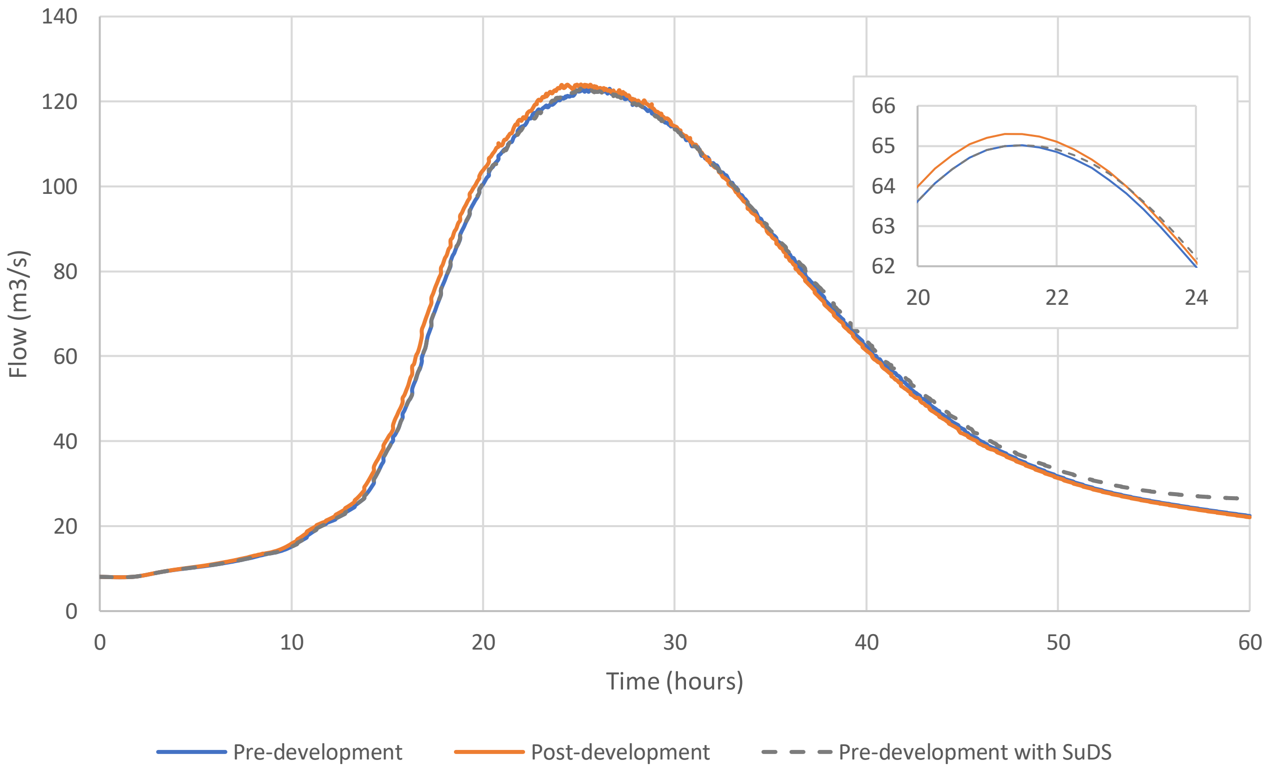


Figure 7-17: Pre-, Post-Development and SuDS hydrographs in the Soar catchment*.

* *Hydrological model results for the Main River catchment inclusive of all sub-catchments*.

Figures 7-16 and 7-17 show model output hydrographs that include lateral out-of-bank flows (floodplain flows) to indicate the full volume of water passing through the system.

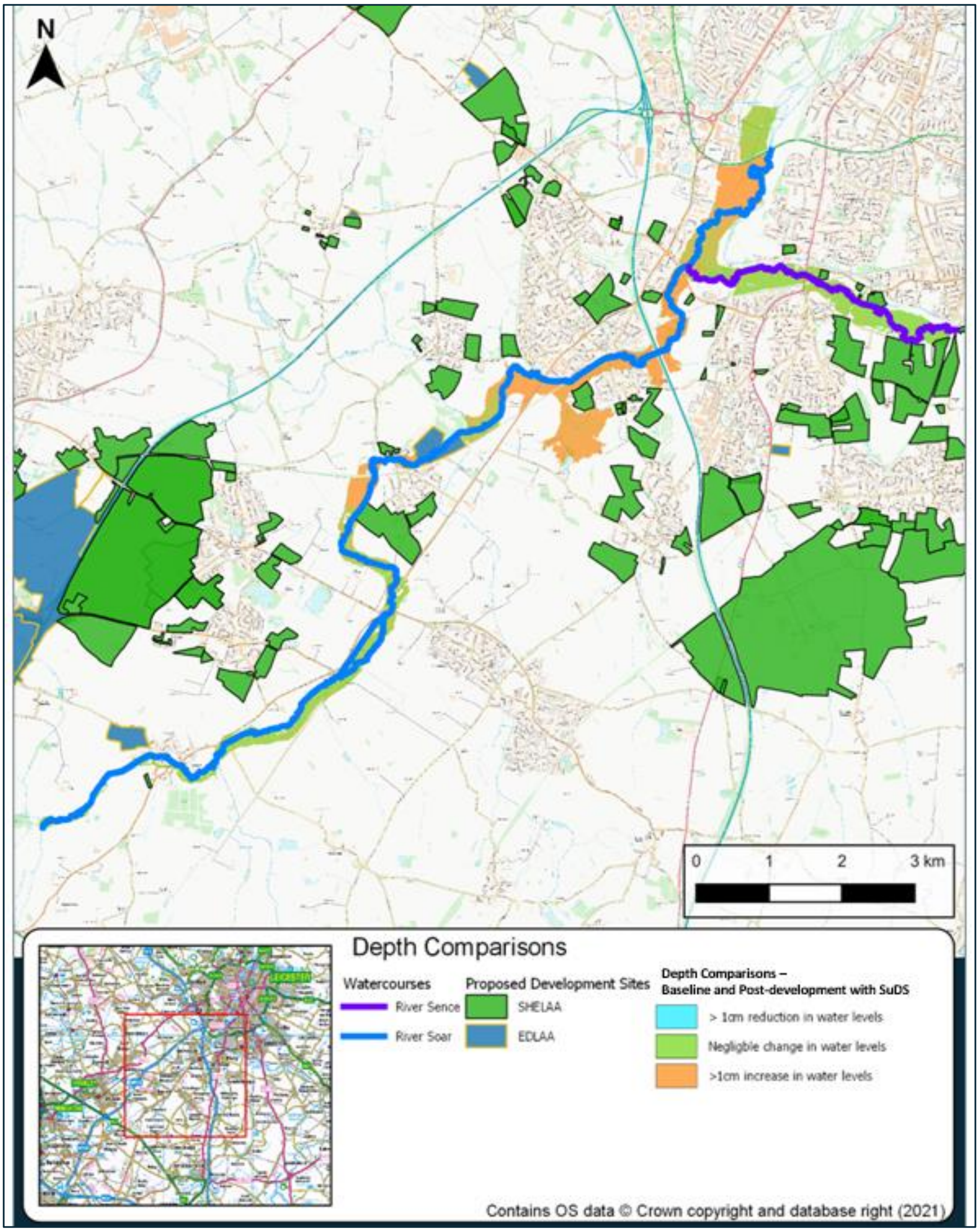


Figure 7-18 below shows that the impact on flood flows in the River Soar and River Sence model as a result of the proposed development in Blaby district. With the implementation of necessary SuDS mitigations to maintain the peak discharges at existing levels, most of the model domain shows no significant changes in flood extent and depth (± 1cm), and large parts of the results outside this bracket shows no more than a 5cm increase in flood depths.

Any such small changes are considered to be within the bounds of model tolerances. Isolated increases in flood depth of up to 80cm are recorded in the model domain, although these are likely a product of model instability rather than any real increase in flood risk. Model results also indicated that there was minimal change to magnitude or timing of peak flows in the pre-development compared to the post-development scenario with SuDS.

It is therefore recommended that the downstream impacts of development in these catchments should be investigated further at site-specific Flood Risk Assessment stage once more detail is known about the amount and form of the development and hence the impact of any additional surface water runoff. However, based on the assumptions of developable area for the SFRA, the analysis shows that any changes in flood risk are in the main likely to be negligible and within model tolerances.

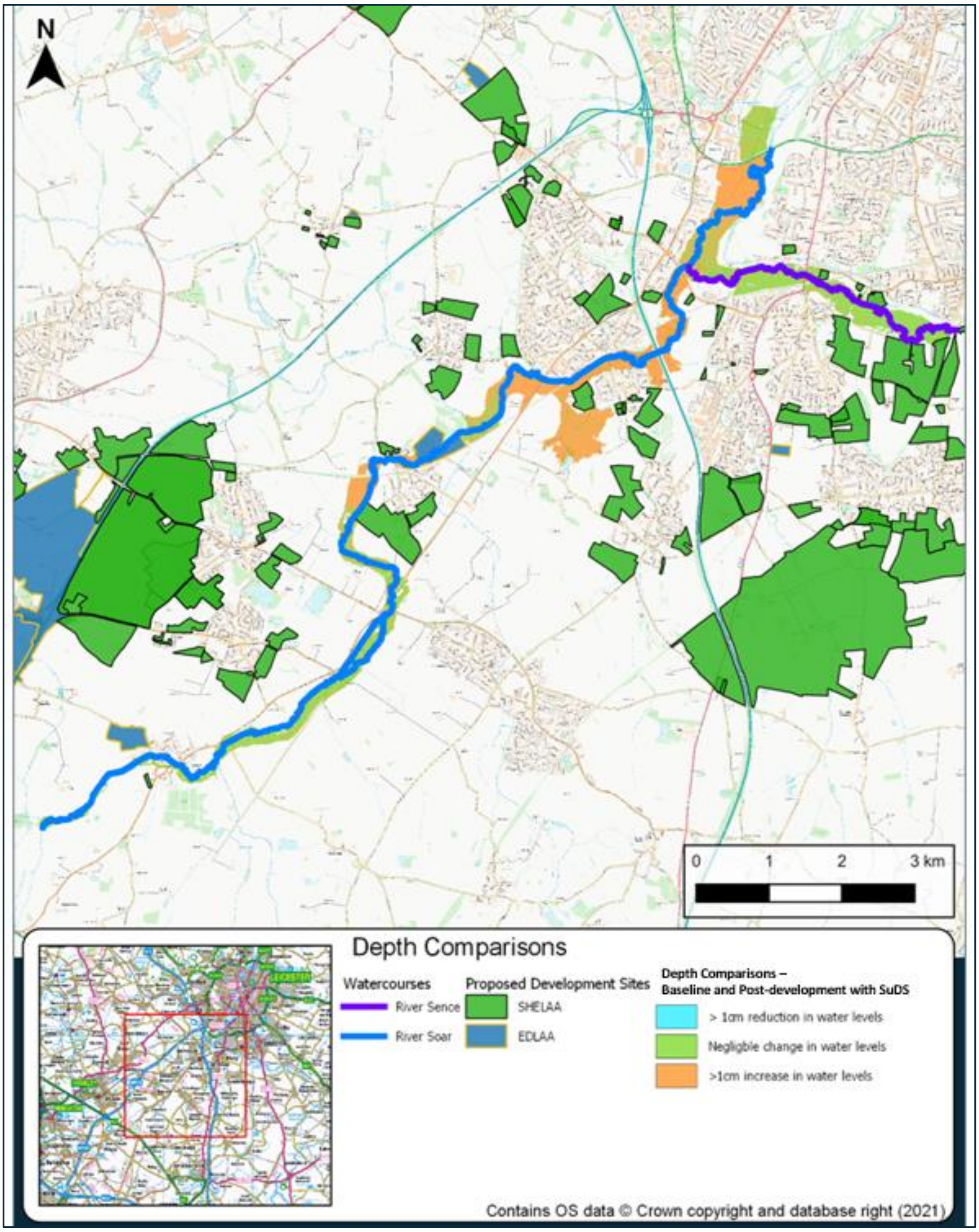


Figure 7-18: Rivers Soar and Sence model results comparison between pre- and post-development with SuDS

7.8 General approach and policy recommendations for managing the excess storage needed to account for an increase in impervious area

The cumulative impact assessment 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.

7.9 Catchment-specific 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. 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 the true storage needs and potential at each site. This should refine the estimates of required storage taken from the UK SuDS Tool for each site.

Consideration should also be taken to the cumulative impact of increased volumes from all major tributaries on the River Soar through Blaby District and the proposed developments within Leicester City. If flooding occurs in these catchments that coincides with flooding in the Soar, the impact could be greater than in individual catchments.

Catchment-specific recommendations are discussed below; however, it is recommended that on a wider catchment scale, engagement with the local Catchment Based Approach (CaBA) partnership through the Trent Rivers Trust, Environment Agency and Leicestershire & Rutland Wildlife Trust is maintained to aid collaboration with existing and upcoming NFM and FRM projects within the River Soar catchment.

7.9.1 Sence (from Countesthorpe Brook to Soar)

There are 19 sites partially within the River Sence (from Countesthorpe Brook to Soar) catchment which cover a large area in the centre of the catchment, and also join development sites that cross the boundary into the Whetstone Brook catchment in the south.

There are only 2 historic events in the Sence, one of which is located within the central collation of proposed developments in site BLA034. Integrated SuDS systems at this site should be designed to hold greater storage volumes than the minimum requirements stated in Table 7-3. These events are shown in Figure 7-4.

The opportunity should be taken to store additional water on development sites in this catchment to alleviate flooding in the wider area, in addition to long term storage requirements. Opportunities to complement and enhance the existing NFM scheme within the wider catchment should also be investigated.

7.9.2 Soar (from Thurlaston Brook to Sence)

There are 30 development sites within/ partially within this section of the Soar catchment. Many of these sites are located in the Cosby brook tributary associated with the catchment, with others flowing into a smaller unnamed tributary.

Due to this, it is recommended that opportunities for NFM and FRM are focussed within the tributaries instead of the Soar itself. These, alongside integrated SuDS systems within development sites, should be designed to hold greater storage volumes than the minimum requirements stated in Table 7-4.

7.9.3 Soar (from Sence to Rothley Brook)

This catchment covers large area (5911ha), with only a small portion within Blaby District. The remainder covers much of the City of Leicester and Charnwood Borough. There are 9 small development sites within/ partially within Blaby District 7 along the southern edge of the catchment (3 cross-boundary into the River Sence), and two other cross boundary sites into the Rothley Brook to the west.

Cumulatively, these pose a lesser increase to flood risk to the Soar itself, more-so the tributaries that cross-boundary sites flow into (Sence and Rothley Brook). More significant risk is associated with the development proposals within the City of Leicester in this catchment, which include >25 individual development sites across the wider city region, and one large central development area, containing >100 developments/ re-developments within the city centre, many of which along the River Soar. For more information on the Rothley Brook, see section 7.9.6.

It is recommended that the potential for enhancement of blue-green infrastructure and large-scale SuDS systems are investigated in urban developments within this catchment. Consultation with Risk Management Authorities may also be beneficial. Drainage requirements should also be established early in the development process and in accordance with industry guidance such as the CIRIA Report C753: The SuDS Manual, as stated in Leicester City Council's Level 1 & 2 SFRA, and urban river restoration techniques explored.

There are a significant number of large historic landfill sites immediately upstream of these development sites in the City of Leicester along the River Soar. It is therefore more important that existing flows are increased a little as possible as a result of development sites upstream in Blaby District and the wider Soar catchment.

There are only 2 historic flooding events recorded in Blaby District in this catchment, one of which is close to development site END026/END027. This site is also located on a historic landfill, and thus consideration should be taken here as to the SuDS techniques used, and ensure storage volumes, that should be held outside of the landfill extent, do not filtrate into the groundwater network.

Integrated SuDS systems in at sites in this catchment should be designed to intercept and hold greater surface water volumes than the minimum requirements stated in Table 7-5.

The opportunity should be taken to store additional water on development sites in the Soar to help alleviate flooding in the wider area, in addition to long term storage requirements. Opportunities to complement and enhance the existing NFM scheme within the wider catchment upstream should also be investigated.

7.9.4 Lubbesthorpe Brook

There are 12 development sites within/ partially within the Lubbesthorpe Brook catchment, all of which are located in the upper catchment reaches. Thus, there is little increased flood risk to the sites themselves, though the increased flow rate and volume could pose a risk to the Soar and the development sites proposed in the City of Leicester.

Integrated SuDS systems at all sites in this catchment should therefore be designed to intercept and hold greater surface water volumes than the minimum requirements stated in Table 7-5. Opportunities for NFM and FRM across the wider catchment should seek to complement the 2013 Lubbesthorpe Brook Flood Alleviation Scheme (FAS), which is located at Lubbesthorpe Road, and ensure no increase in flood risk downstream.

Connection with the current 'New Lubbesthorpe' development near Leicester Forest East should also be sought, and recent alleviation work should be integrated into wider flood remediation techniques designed to attenuate storage from sites KMU025, LFE019, LFE020, and LFE021.

7.9.5 Soar (from Soar Brook to Thurlaston)

Most of this catchment area is located within the neighbouring district of Harborough in the form of the Broughton Astley Brook. However, there are 24 development sites within/ partially within this catchment that are predominantly located around the small section of the Soar and all within close proximity.

A collection of proposed development sites across the catchment boundary into the Thurlaston Brook which combined have the potential to behave as a singular strategic development site. Thus, it is recommended that these sites (STO002, STO026, STO028, STO029, SAP028, EELM001, ELM008, ELM001, ELM009, ELM010 and EAST001) are considered as such, and further investigation and modelling is undertaken prior to any development work beginning.

There are 4 smaller proposed sites within Harborough in the Broughton Astley Brook.

As a result, it is recommended that opportunities for NFM and FRM are investigated in the Broughton Astley Brook catchment, and the upper reaches and tributaries of the Thurlaston Brook catchment, and the upper Soar itself. These, alongside integrated SuDS systems within development sites should be designed to hold greater storage volumes than the minimum requirements stated in Table 7-7.

Site(s) SAP028/STO026/STO029 contain a historic flooding event and where historic flooding events have occurred, SuDS systems should also be designed to hold greater storage volumes than the minimum requirements and care should be taken that development does not alter any surface water flow paths affecting communities up or downstream.

7.9.6 Other Recommendations

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.

Although not ranked High risk in this assessment, the Rothley Brook was assessed at Level 2 stage for both the **Hinckley and Bosworth District SFRA** (https://www.hinckley-bosworth.gov.uk/downloads/file/6957/level_2_strategic_flood_assessment_2020) and **Charnwood Borough SFRA** (https://www.charnwood.gov.uk/pages/charnwood_borough_council_level_2_strategic_flood_risk_assessment_2021) in respect to increases in flood risk in response to development proposals in those regions. As a significant proportion of proposed development in Blaby District crosses catchment boundaries into the Rothley Brook, consideration of the recommendations set forth in their Level 2 SFRA Cumulative Impact Assessments should be taken.

These include utilising reservoirs and existing pools for flood and runoff attenuation, such as Thornton reservoir and Groby Pool SSSI; Implementing SuDS to reduce high volumes of runoff flowing into sewers, gardens and properties; and exploring culverts to ensure they have the required capacity for the additional volumes.

Other storage recommendations here include creating online storage capacity and increasing floodplain connectivity as part of blue corridor initiatives. These should be designed to attenuate high-flow storage requirements to reduce long-term dependence on engineered flood defences.

Similar recommendations apply to the Thurlaston Brook, as the catchment contains significant development proposals as discussed above. Attenuation techniques should be extensive and be designed to store volumes greater than those stated in Table 7-7.

8 Summary of Level 2 assessment and recommendations

8.1 Assessment methods

As part of the Level 2 SFRA, 42 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 Food 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 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 detailed outline hydraulic models available for the River Soar (including the Whetstone, Cosby, Soar and Broughton Brook), but where models are unavailable, 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.

8.2 Summary of key site issues

- 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 sites ECRO002, KMU022, LIT008, LIT009, WHE026, WHE019 and GPA024. These will require more detailed investigations on sequential site layouts, SuDS possibilities, safe access, and egress and so on, as part of a site-specific Flood Risk Assessment at the planning application stage.
- Some sites at fluvial risk are also at risk from surface water flooding; however, there is not always a direct correlation between fluvial and surface water risk. For example, LIT023 has a higher fluvial risk than KIL006, but the latter is at a higher risk from surface water flooding, with more areas of ponding in the higher return period events. As a result, 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, for example site STO025 (surface water should also be considered when assessing safe access and egress to and from the site).
- Surface water tends to follow topographic flow routes, for example along the watercourses or isolated pockets of ponding where there are topographic depressions.
- 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 28%, 37% and 60% climate change fluvial scenarios to be considered in future developments, these are the **latest allowances** (https://www.gov.uk/government/publications/peak-river-flow-climate-change-allowances-by-management-catchment) as of the 20th July 2021. 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.

- Residual risk was considered at the sites. 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.
- A strategic assessment was conducted of SuDS options using regional datasets and JBA's Groundwater map. 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. Also, consideration should be given to whether the risk forms a flow path or bisects the site where access from one side to another may be compromised.
- 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.

8.2.1 Considering the Exception Test for the proposed sites in Blaby District

In principle, it is possible for the majority of 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 where this is appropriate.

In some areas of Blaby, more detailed fluvial modelling has been carried out in recent years, providing a more accurate representation of the Flood Zones within the District. The catchments modelled are the River Soar, River Sence, Whetstone Brook, Broughton Brook, and the Cosby Brook.

Consideration should be given to the surface water risk within Blaby District, particularly within Kirby Muxloe, Elmesthorpe and Whetstone. For example, a site may pass the test based on fluvial flood risk alone, but greater risk may come from surface water at sites assessed in these areas. However, the national surface water mapping does not account for culverts, structures, channel hydraulics or sewer capacity, and therefore this is deemed to overestimate risk and therefore the confidence in this dataset is reduced. It is recommended that developers investigate surface water risk in more detail at the planning application stage and may need to consider undertaking integrated modelling.

If larger sites, Whetstone Pastures for example, 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.

8.3 Planning Policy recommendations

The Planning Policy recommendations in Chapter 7.6 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:

- Developers should consider flood resilience measures for new development, including raised thresholds, self-sealing UPVC doors, non-return valves and air brick covers.
- Combine infiltration (e.g. permeable surfaces) and attenuation (e.g. balancing ponds and flood storage reservoirs) SuDS techniques to overcome constraints to the area of a site set aside for infiltration systems caused by development pressures.
- Where appropriate, opportunities for betterment should be sought where surface water flooding issues are present, which could be implemented through Supplementary Planning documents for individual settlements.
- Encourage the use of permeable surfacing in gardens and use measures to optimise drainage and reduce runoff.
- Consider opportunities for water conservation through rainwater harvesting and water butts where appropriate for new and existing development.
- Promote land management practices where appropriate to attenuate runoff and alleviate potential issues downstream.

Further site-specific recommendations have been made in the Level 2 report regarding Cumulative Impact Assessment. These are made in Chapter 7.

8.4 Guidance for windfall sites and sites not assessed in the L2

- 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.

- If a site's extents either include or borders with a Main River (including a culverted reach of Main River), an easement of 8m is required from either bank for access and maintenance. Any future development will require a flood risk permit from any activity within 8m of a Main River.
- If an ordinary watercourse is within or immediately adjacent to the site area, consultation with the Lead Local Flood Authority should be undertaken. If alterations or discharges are proposed to the watercourse, a land drainage consent will be required.
- 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.
- Sites where there is a canal within or immediately adjacent to the site area, developers should consult the Canals and Rivers Trust. Any proposed alterations to the canal or discharges must be agreed with the Canals and Rivers Trust.
- If a site is located within 250m of a landfill site, there could be amenity, dirt and contamination issues. Sites could be sensitive from the perspective of controlled waters and therefore any redevelopment must ensure there is no pollution risk to the water environment.

8.5 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 the Blaby District Council, Leicestershire County Council, the Highways Authority, Canal and River Trust, Severn Trent Water and the Environment Agency. Such information may be in the form of:

- New hydraulic modelling results
- 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.

8.5.1 Neighbourhood Plans

Flood risk should be fully addressed in the plan preparation and in bringing forward policies for the allocation of land and therefore the SFRA findings should be used in the production of Neighbourhood Plans.

Neighbourhood planners can use the information in the Level 1 and Level 2 SFRA on the sources of flood risk across Blaby District and the flood risk mapping, to assess the risk of flooding to sites within their community. The SFRA will also be helpful for developing community level flood risk policies in high flood risk areas.

The Level 1 SFRA highlights on a broad scale where flood risk from fluvial, surface water, groundwater and the effects of climate change are most likely. The maps are useful to provide a community level view of flood risk but may not identify if an individual property is at risk of flooding or model small scale changes in flood risk. Local knowledge of flood mechanisms will need to be included to complement this broadscale mapping.

Similarly, all known recorded historical flood events for Blaby are listed in the Level 1 SFRA and updated in Section 2.10 of this report and this can be used to supplement local knowledge regarding areas worst hit by flooding. Ongoing and proposed flood alleviation schemes planned by Blaby District Council, Leicestershire County Council and the EA are outlined in Section 6.5. The Level 2 SFRA uses the same updated information as the 2020 Level 1 report to assess sites; this includes latest flood incident data from the LLFA. Please contact the Council to obtain further information.

Appendices

A Level 2 Assessment

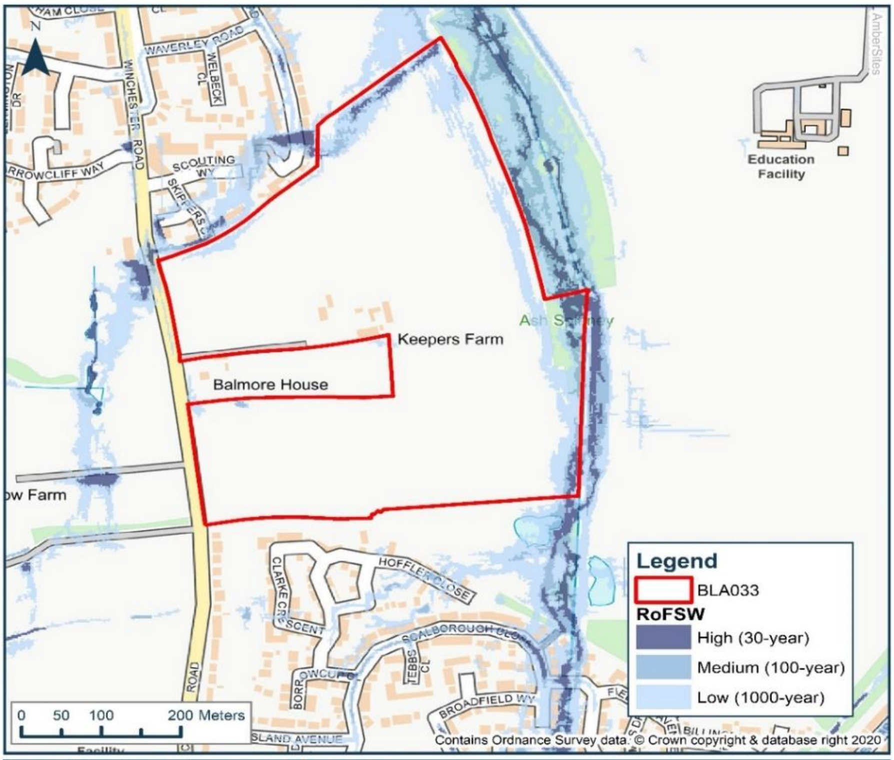
A.1 Site Summary Tables

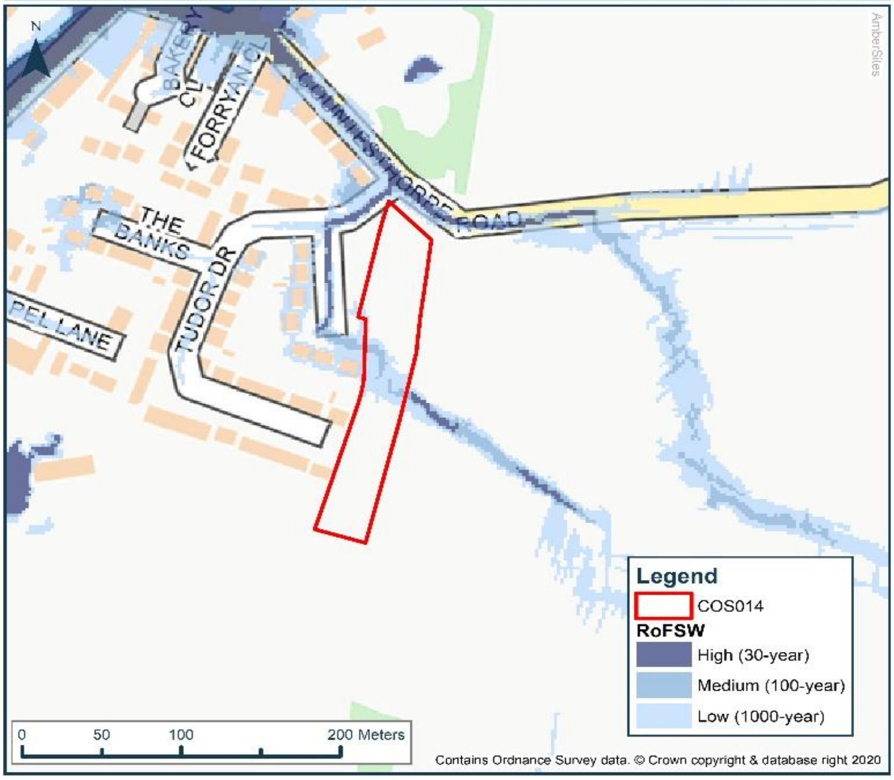
A.2 GeoPDF mapping

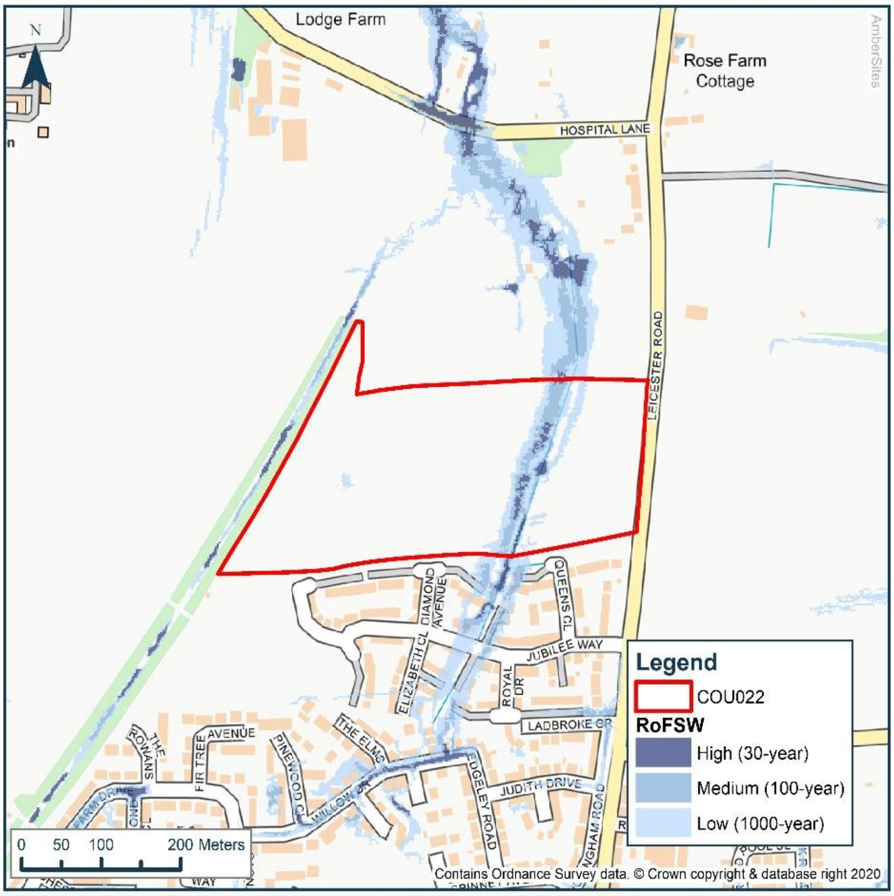
Instructions for using GeoPDFs

1. GeoPDFs should be opened with Adobe. They display the mapping datasets relevant to this report for each site
2. Datasets shown in the legend can be switched on and off using the tick boxes

B Amber Sites






Lodge Farm
Rose Farm Cottage
HOSPITAL LANE
LEICESTER ROAD
QUEENS CL
DIAMOND AVENUE
JUBILEE WAY
ELIZABETH CL
ROYAL DR
LADBROKE GR
THE ELMS
AVENUE
THE ROWANS
FIR TREE
PINEWOOD CL
WILLOW DR
EDGELEY ROAD
JUDITH DRIVE
FARM DRIVE
Legend
COU022
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
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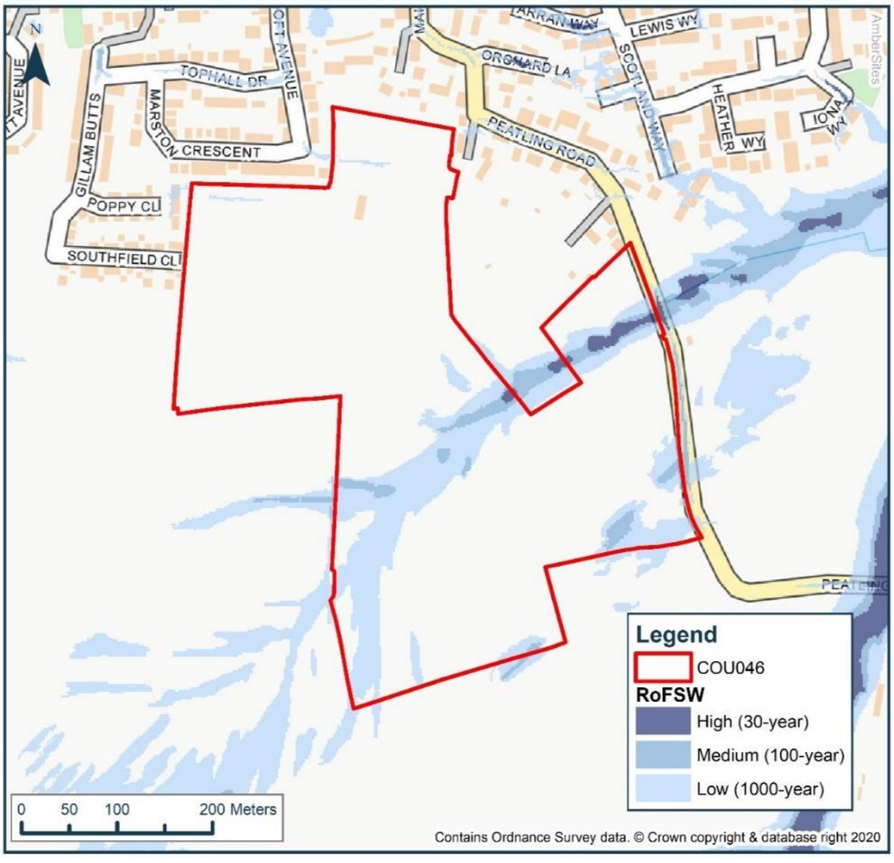
AmberSites


TOPHALL DR
MARSTON CRESCENT
GILLAM BUTTS
POPPY CL
SOUTHFIELD CL
ORCHARD LA
PEATLING ROAD
LEWIS WY
SCOTLAND WAY
HEATHER WY
IONA WY
ARRAN WAY
Legend
COU046
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
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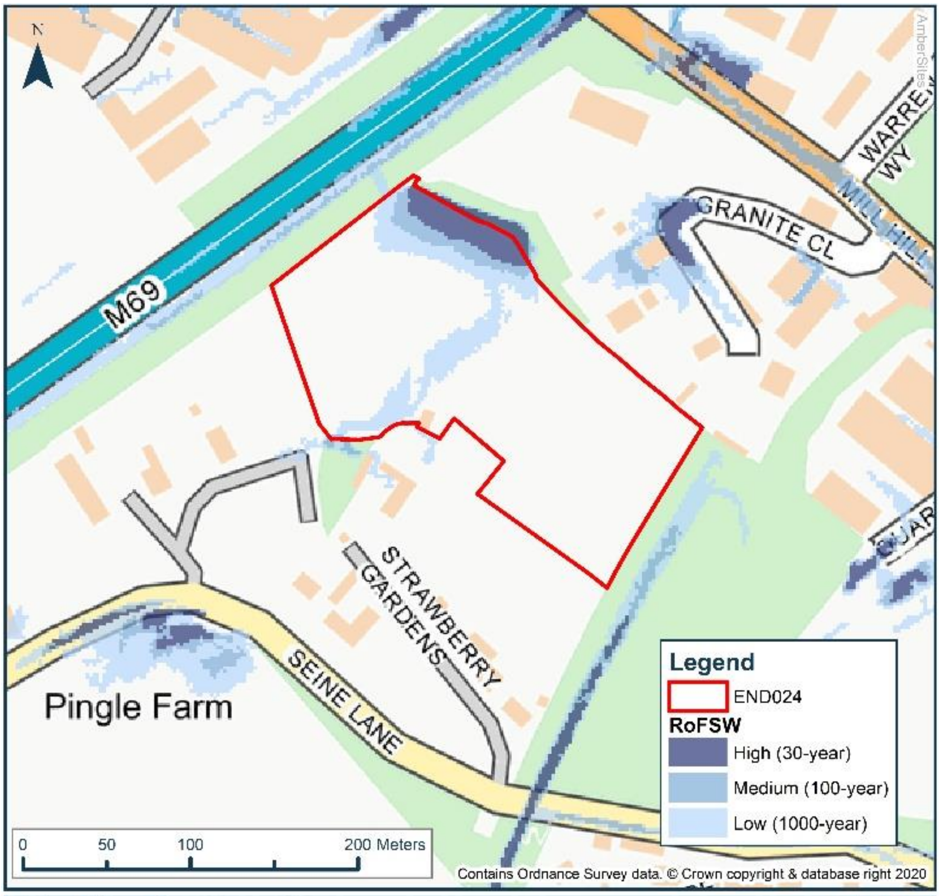
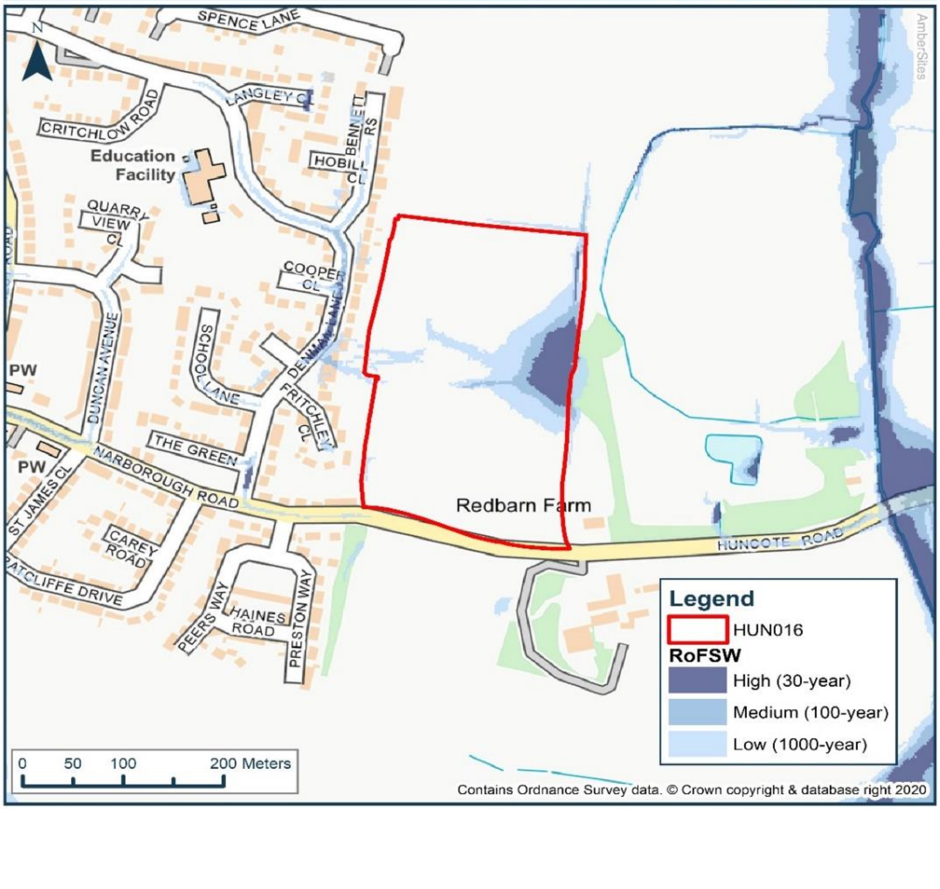
AmberSites


M69
GRANITE CL
MILL HILL
WARREN WY
STRAWBERRY GARDENS
SEINE LANE
Pingle Farm
Legend
END024
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
Contains Ordnance Survey data. © Crown copyright & database right 2020


SPENCE LANE
LANGLEY CL
CRITCHLOW ROAD
Education Facility
HOBILL CL
QUARRY VIEW CL
COOPER CL
DUNCAN AVENUE
SCHOOL LANE
FRITCHLEY CL
THE GREEN
NARBOROUGH ROAD
PW
ST JAMES CL
CAREY ROAD
RATCLIFFE DRIVE
PEERS WAY
HAINES ROAD
PRESTON WAY
Redbarn Farm
HUNCOTE ROAD
Legend
HUN016
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
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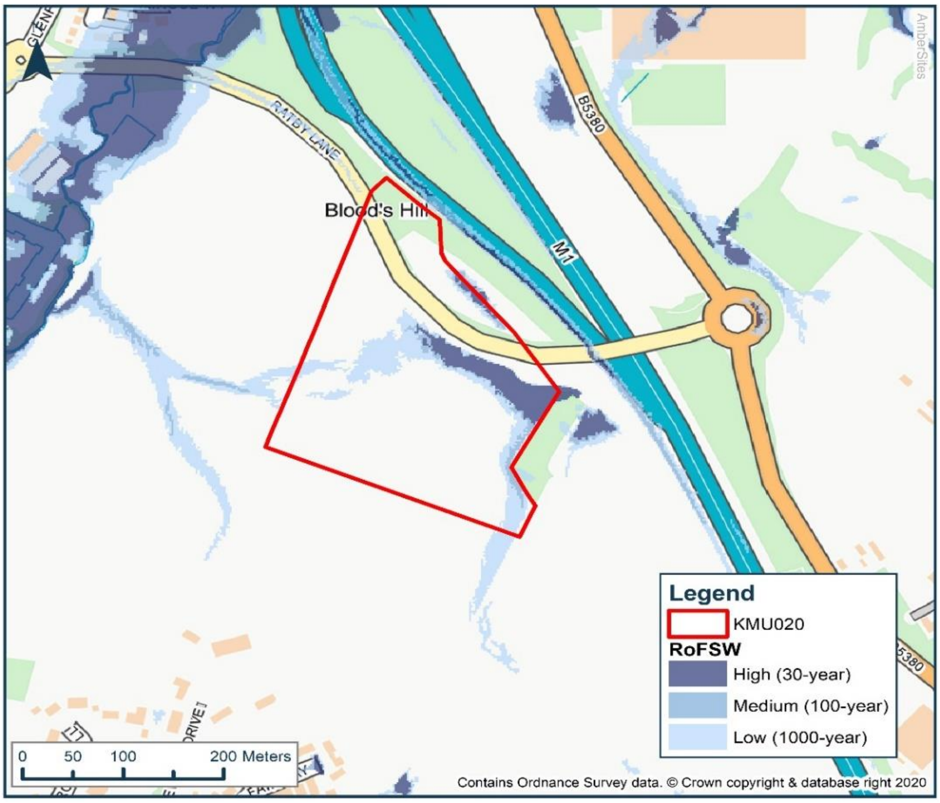
Blood's Hill
RATBY LANE
M1
B5380
Legend
KMU020
RoFSW
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Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
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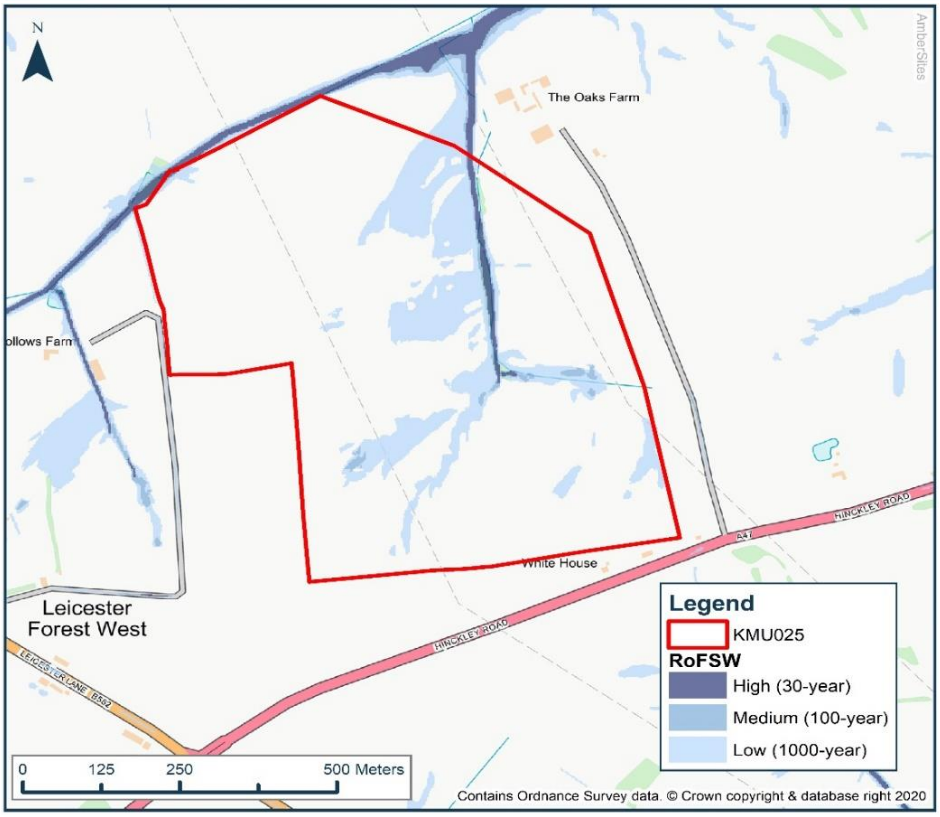
The Oaks Farm
White House
HINCKLEY ROAD
A47
Leicester Forest West
Legend
KMU025
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
0 125 250 500 Meters
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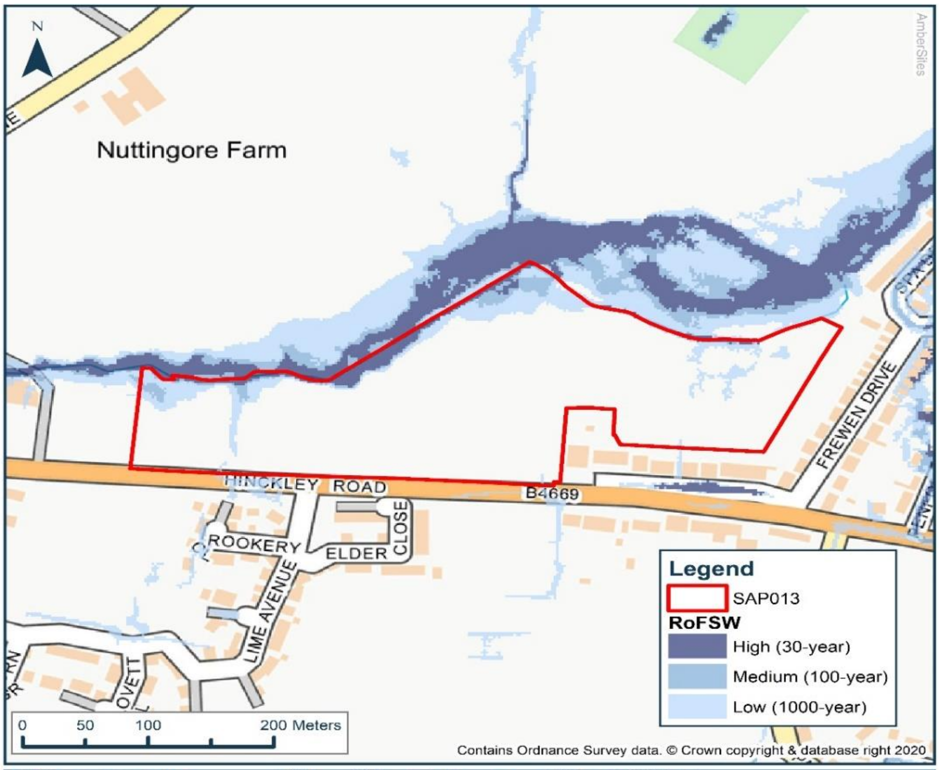
Nuttingore Farm
HINCKLEY ROAD
B4669
ROOKERY
ELDER
CLOSE
LIME AVENUE
FREWEN DRIVE
Legend
SAP013
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
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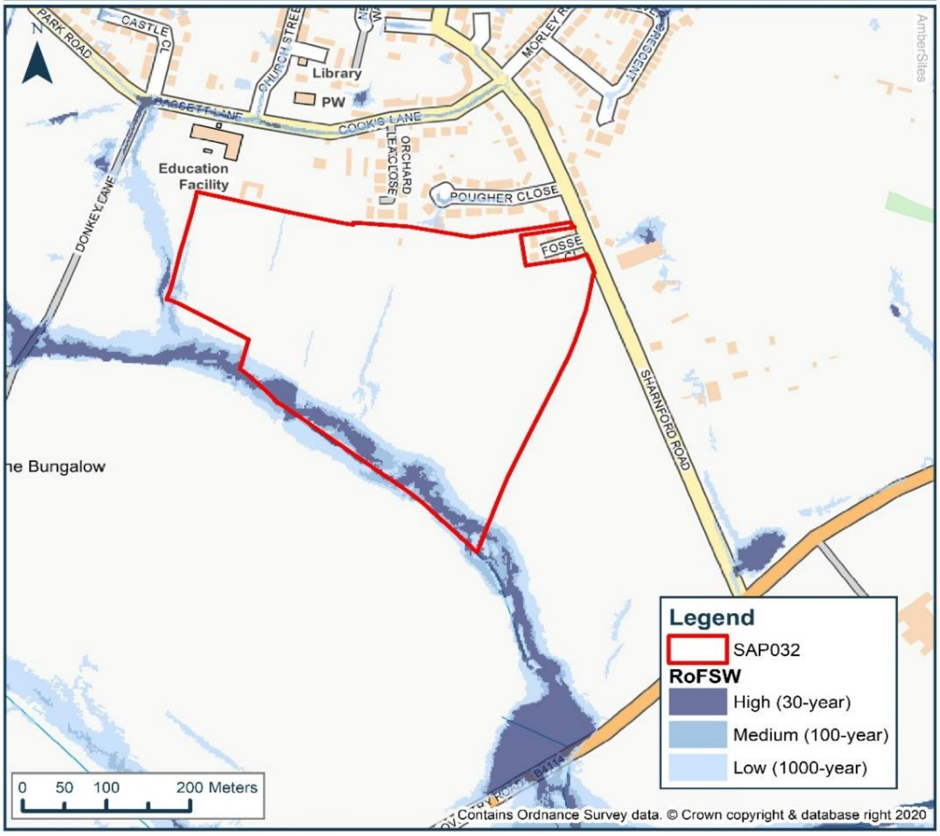
PARK ROAD
CASTLE
Library
PW
COOK'S LANE
Education Facility
DONKEY LANE
ORCHARD
POUGHER CLOSE
FOSSE
SHARNFORD ROAD
he Bungalow
Legend
SAP032
RoFSW
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Medium (100-year)
Low (1000-year)
0 50 100 200 Meters
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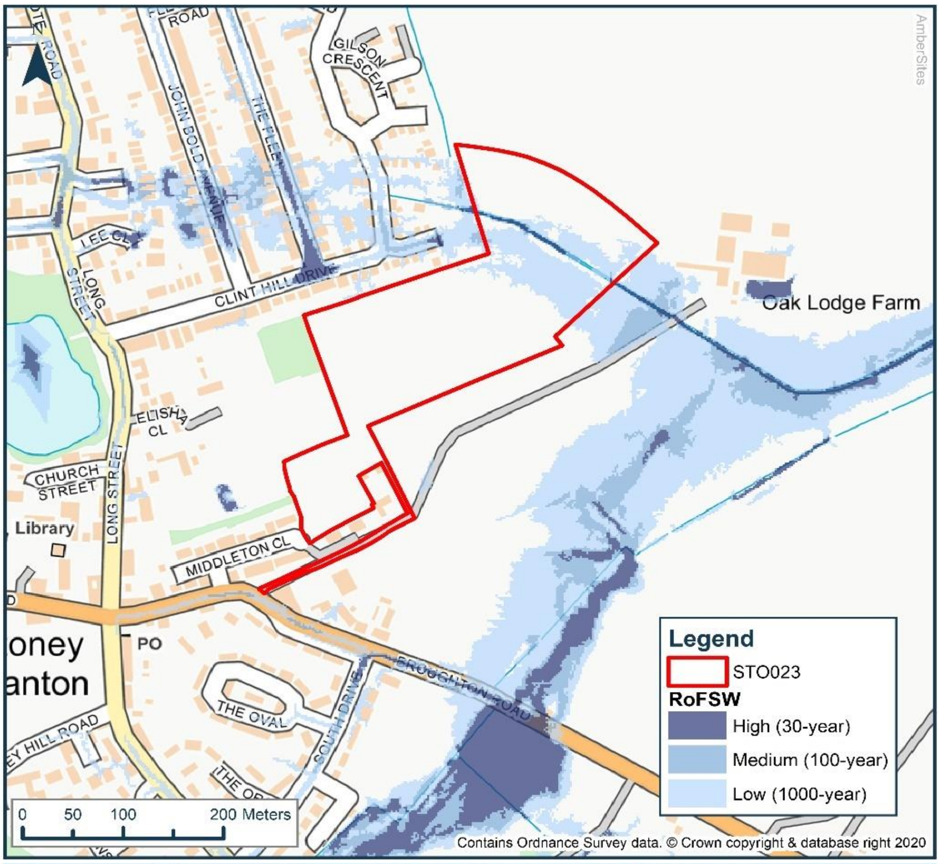
Legend
STO023
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
Oak Lodge Farm
CLINT HILL DRIVE
MIDDLETON CL
BROUGHTON ROAD
THE OVAL
SOUTH DRIVE
LONG STREET
CHURCH STREET
Library
PO
0 50 100 200 Meters
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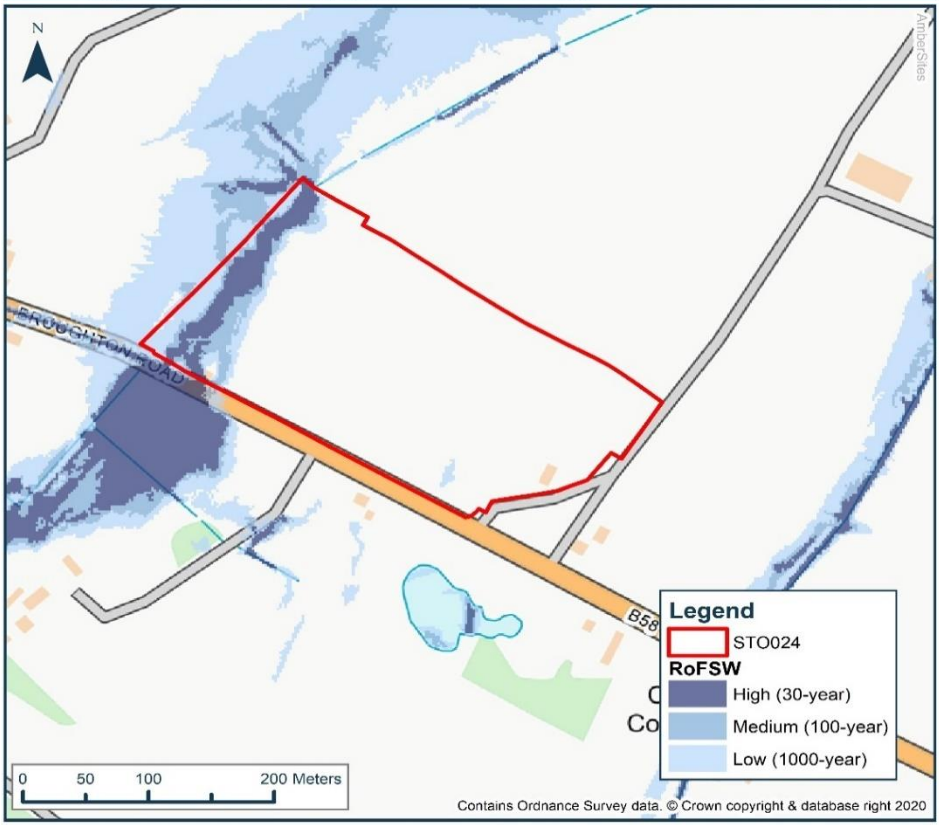
Legend
STO024
RoFSW
High (30-year)
Medium (100-year)
Low (1000-year)
BROUGHTON ROAD
0 50 100 200 Meters
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