City of Wolverhampton Council Level 1 Strategic Flood Risk Assessment

Final

A1-C01

August 2024

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City of Wolverhampton Council

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Contract

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This report describes work commissioned by The City of Wolverhampton Council by an instruction dated May 2024. The Client's representative for the contract was Michele Ross of The City of Wolverhampton Council. Lucy Briscoe and Georgie Troy of JBA Consulting carried out this work.

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Acknowledgements

We would like to acknowledge the assistance of:

- City of Wolverhampton Council
- Environment Agency
- Staffordshire County Council
- Neighbouring Authorities
- Severn Trent Water
- Canal and River Trust

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Abbreviations

AEP	Annual Exceedance Probability
CFMP	Catchment Flood Management Plan
CWC	City of Wolverhampton Council
EA	Environment Agency
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
LFFA	Lead Local Flood Authority
LFRMS	Local Flood Risk Management Strategy
LPA	Local Planning Authority
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
RBMP	River Basin Management Plan
SFRA	Strategic Flood Risk Assessment
SOP	Standard of Protection
STW	Severn Trent Water
SWMP	Surface Water Management Plan
WCS	Water Cycle Study
WFD	Water Framework Directive

Definitions

1D model: One-dimensional hydraulic model.

2D model: Two-dimensional hydraulic model.

Annual Exceedance Probability (AEP): The probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

Brownfield: Previously developed parcel of land.

Design flood: This is a flood event of a given annual flood probability, which is generally taken as:

- river flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year); or
- tidal flooding with a 0.5% annual probability (1 in 200 chance each year); or
- surface water flooding likely to occur with a 1% annual probability (a 1 in 100 chance each year), plus, an appropriate allowance for climate change.

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.

Flood defence: Infrastructure used to protect an area against floods as floodwalls and embankments; they are designed to a specific standard of protection (design standard).

Flood Map for Planning: The Environment Agency Flood Map for Planning (Rivers and Sea) is an online mapping portal which shows the Flood Zones in England. The Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences and do not account for the possible impacts of climate change.

Flood Risk Area: An area determined as having a significant risk of flooding in accordance with guidance published by Defra and WAG (Welsh Assembly Government).

Flood Risk Regulations: Transposition of the EU Floods Directive into UK law. The EU Floods Directive is a piece of European Community (EC) legislation to specifically address flood risk by prescribing a common framework for its measurement and management.

Flood and Water Management Act (2010): 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.

Functional Floodplain: The land where water has to flow or be stored in times of flood.

Greenfield: Undeveloped parcel of land.

Lead Local Flood Authority (LLFA): County councils and unitary authorities which lead in managing local flood risks (risks of flooding from surface water, groundwater and ordinary (smaller) watercourses). The City of Wolverhampton Council is a Lead Local Flood Authority.

Local Planning Authority (LPA): The local government body which is responsible by law to exercise planning functions for a particular area. The City of Wolverhampton Council is a 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.

Natural Flood Management (NFM): A wide range of techniques can be used that aim to reduce flooding by working with natural features and processes to store or slow down flood waters before they can damage flood risk receptors (e.g., people, property, infrastructure, etc.).

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.

Pitt Review: Comprehensive independent review of the 2007 summer floods by Sir Michael Pitt, which provided recommendations to improve flood risk management in England.

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.

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.

Standard of Protection (SoP): Defences are provided to reduce the risk of flooding from a river and within the flood and defence field standards are usually described in terms of a flood event return period. For example, a flood embankment could be described as providing a 1% AEP standard of protection.

Stakeholder: A person or organisation affected by the problem or solution or interested in the problem or solution. They can be individuals or organisations, includes the public and communities.

Sustainable Drainage Systems (SuDS): 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 (pluvial) flooding: Flooding 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.

Executive Summary

Introduction

The City of Wolverhampton Council (CWC) have commissioned JBA Consulting to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in line with the updated Local Plan. It replaces the 2020 Black Country Authorities Level 1 SFRA, and provides an understanding of the risk from all types of flooding across Wolverhampton and presents clear and robust evidence. It also provides useful information to inform future Infrastructure Planning and Neighbourhood Plans.

SFRA Objectives

The key objectives of the Level 1 SFRA are to:

- Inform CWC Local Plan by assessing flood risk from all sources, current and future.
- Identify which locations are most and least vulnerable to flooding from all sources.
- Produce a comprehensive set of maps presenting flood risk from all sources, including historic records, that can be used as evidence base for flood management purposes.
- Identify areas where further assessment of flood risk is needed and provide sufficient detail to enable the Sequential Test to be applied to inform allocations of land for development.
- Provide clear advice for developers undertaking site-specific flood risk assessments.
- Assess or identify existing and proposed flood defences as well as their design Standard of Protection and condition rating.
- Summarise the role that the Lead Local Flood Authority (LLFA) plays in the management of flood risk.
- Consider outputs from the Preliminary Flood Risk Assessment (PFRA) and any local flood risk strategies.
- Assess the role and functionality of culverts and their potential to cause or exacerbate flood risk.
- Take into account climate change.
- Assess the cumulative impact that development may have on flood risk.
- Produce clear and specific recommendations and guidance identifying responsible agencies and actions where appropriate, in order for CWC to implement recommendations effectively.

SFRA Outputs

The following outputs are available:

- Identification of policy and technical updates.
- Recommendations of the criteria that should be used to assess future development proposals and the development of a Sequential Test and Sequential Approach to flood risk.
- Assessment of the potential increase in flood risk due to climate change.
- Appraisal of all potential sources of flooding, including Main River, ordinary watercourse, surface water, sewers, groundwater, reservoirs and canals.
- Mapping showing distribution of flood risk from all sources of flooding including climate change allowances.
- Reporting on the Standard of Protection (SoP) provided by existing flood risk management infrastructure.
- Assessment of strategic flood risk solutions that can be implemented to reduce risks.
- Flood Risk Assessment (FRA) guidance for developers.
- Guidance for developers on the use of Sustainable Drainage Systems (SuDS).
- An assessment of the implications of climate change for flood risk over an appropriate time period;
- Identification of methods of reducing flood risk within the plan area (including identifying potential pieces of land that should be safeguarded from development in order to help manage flooding).

Summary of Flood Risk in Wolverhampton

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

- *Fluvial flooding:* The primary fluvial flood risk is along the Smestow Brook and along a culverted tributary of the River Tame in the north of Bilston. Elsewhere, fluvial flooding occurs in close proximity to the Waterhead Brook (feeding into the River Penk) and across an area to the south and east of the Black Country Route (A463). There are several culverted watercourses within Wolverhampton which pose a residual flood risk to the city in the event of blockage, becoming overwhelmed or failure.
- *Surface water:* Surface water flooding is caused by intense rainfall. There are many areas at high risk of surface water flooding in Wolverhampton, due to the heavily urbanised nature of the area that impedes natural infiltration and drainage. Areas at particularly high risk include Pendeford, Perry Hall, Ettingshall and land between Dunstall Hill and Low Hill. The areas least impacted by surface water flood risk include large open green spaces which are situated along the northern, western and southern boundaries of Wolverhampton.

- *Sewer:* The sewers in Wolverhampton are managed by Severn Trent Water. Severn Trent Water provided their Hydraulic Flood Risk Register which details recorded incidents of sewer flooding in Wolverhampton between 11th June 1997 and 24th October 2023. According to this dataset, there are spatial clusters of sewer flooding in Aldersley, Claregate, Tettenhall, Castlecroft, Ettingshall Park and Fordhouses. The Severn Trent Drainage and Wastewater Management Plan (DWMP) was published in March 2023. The plan states planning objectives for internal sewer flooding risk is a high priority in the catchment served by the Barnhurst Wastewater Treatment Works to the west of Oxley. Storm overflow is considered a high priority for the catchment served by Trescott which is located in Perton to the west of Wolverhampton. The risk of internal flooding in a 1 in 50-year storm as well as storm overflow performance are classed as high priorities in the catchment served by Coven Heath which partly drains suburbs in the north of Wolverhampton including Fordhouses and Moseley Green.
- *Groundwater:* The JBA Groundwater Emergence Map indicates that there are areas in the city with groundwater levels that are either at or very near (within 0.025m of) the ground surface. These are situated predominantly in the north of the city in Pendeford, Oxley and Fordhouses as well as some areas across the western half of Wolverhampton in Tettenhall and Compton. The 2020 SFRA recognises that as pumping and abstraction regimes have ceased or been changed, that local groundwater flooding incidences have occurred in the north-east and south-east of Wolverhampton. It is therefore anticipated that groundwater flooding issues are likely to be localised in their nature, affecting limited areas and a small number of properties.
- *Canals:* There are six canals in Wolverhampton which are the Birmingham Canal Navigations, Bradley Arm of the Birmingham Canal Navigations, Shropshire Union Canal, Staffordshire and Worcestershire Canal, Walsall Canal, and the Wryrley and Essington Canal. These have the potential to interact with other watercourses and pose a risk of flooding during breach or overtopping incidents. Records provided by the Canal and River Trust show that there have been three recorded breaches and four recorded instances of overtopping, all of which have occurred along the Staffordshire and Worcestershire Canal. There are several locations along the Birmingham Canal Navigations between Cannock Road and Wolverhampton Racecourse where the canal is perched. This means the canal is raised above the ground level of the surrounding land, which increases the risk of flooding from the canal in this area.
- *Reservoirs:* There are no reservoirs situated within Wolverhampton. However, there is a potential risk of reservoir flooding within Wolverhampton, and this risk is posed by the Sedgely Beacon Reservoir which is located to the south of the city. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach/uncontrolled release and this should be considered in any site-specific FRAs (where relevant).

How to use this Report

Planners

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

It provides the latest flood risk data and guidance to inform the Sequential Test and provides guidance on how to apply the Exception Test. CWC will use this information to apply the Sequential Test to strategic allocations and identify where the Exception Test will also be needed.

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

Developers

When assessing sites not identified in the Local Plan (windfall sites), developers should use evidence provided in this SFRA to apply the Sequential Test and provide evidence to show that they have adequately considered reasonably available sites at lower flood risk. For sites which are within Flood Zones 2 or 3, whether strategic allocations or windfall sites, developers will need to apply the Exception Test and use information in a site-specific FRA to inform this test at planning application stage.

This is a strategic assessment and does not replace the need for site specific FRAs where a development is either within Flood Zones 2 or 3, greater than one hectare in Flood Zone 1 and at risk from other sources of flooding now or in the future. In addition, a surface water drainage strategy will be needed for all major developments to satisfy CWC.

Developers can use the information in this SFRA, alongside site specific research to help to scope out what additional work will be needed in a detailed FRA. To do this they should refer to Section 5: Understanding Flood Risk in Wolverhampton and the flood maps in the appendices.

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

Developers need to ensure that new development does not increase surface water runoff from a site. Section 10 provides information on the surface water drainage requirements of Wolverhampton. SuDS should be considered at the earliest stages that a site is developed which will help to minimise costs and overcome any site-specific constraints.

FRAs will need to identify how flood risk will be mitigated to ensure the development is safe from flooding. In high-risk areas the FRA will also need to consider emergency

arrangements, including how there will be safe access and egress from the site, and arrangement ss for flood warning and evacuation if necessary.

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

Recommendations for Future Works

A Level 2 SFRA may be necessary where there are sites that are to be taken forward for development in Flood Zones 2 or 3 or where there is a significant risk of flooding from other sources. This would inform the Exception Test required in the National Planning Policy Framework (NPPF). Further detailed work could also support local strategic drainage planning for larger strategic development areas and/ or high flood risk catchments likely to see a relatively large degree of development.

1 Introduction

This section outlines the purpose of a Strategic Flood Risk Assessment and the outputs. It introduces the study area and explains key flood risk management concepts.

1.1 Purpose of the Strategic Flood Risk Assessment

"Strategic policies should be informed by a strategic flood risk assessment and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards" (National Planning Policy Framework, paragraph 166).

JBA Consulting were commissioned by the City of Wolverhampton Council (CWC) to produce a Level 1 Strategic Flood Risk Assessment (SFRA) in line with the updated Local Plan. This SFRA will replace the 2020 Black Country Authorities Level 1 SFRA. The 2024 SFRA will be used to inform decisions on the location of future development and the preparation of sustainable policies for the long-term management of flood risk.

This Level 1 SFRA (2024) document supersedes the previous Level 1 SFRA (2020). The report has updated the content that was included in the previous SFRA to provide a comprehensive and robust evidence base to support the production of CWC's Draft Local Plan 2024.

The SFRA update is also required to:

- be compliant with the latest guidance described in the 2021 revision to the National Planning Policy Framework (NPPF) and subsequent minor amendments (latest July 2024),
- be compliant with the implications of the August 2022 changes to the Planning Practice Guidance (PPG) and subsequent minor amendments made in February 2024,
- support the selection of site allocations in the Local Plan Review, and;
- provide information and guidance to be used in the preparation of Flood Risk Assessments (FRAs) in support of site specific planning applications.

The evidence in this SFRA shall also be used to support the formulation of Neighbourhood Plans.

1.2 Local Plan

The current Local Plan for Wolverhampton is the Black Country Core Strategy. This will be replaced with the Wolverhampton Local Plan which CWC is currently developing. The Local

Plan aims to establish a planning framework that identifies available land for housing, employment and infrastructure for future development.

1.3 Levels of SFRA

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

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

This report fulfils the Level 1 SFRA requirements.

1.4 SFRA Objectives

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

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

- Produce clear and specific recommendations and guidance identifying responsible agencies and actions where appropriate, in order for CWC to implement recommendations effectively.

1.5 SFRA Study Area

The City of Wolverhampton is located in the West Midlands, north-west of Birmingham. The City is approximately 69.4 km^2, with a population of approximately 263,700 (2021 Census, Office for National Statistics). The City shares boundaries with Dudley Metropolitan Borough Council, Sandwell Metropolitan Borough Council, South Staffordshire District Council, and Walsall Council. The location of CWC and its neighbouring authorities is shown within Figure 1-1.

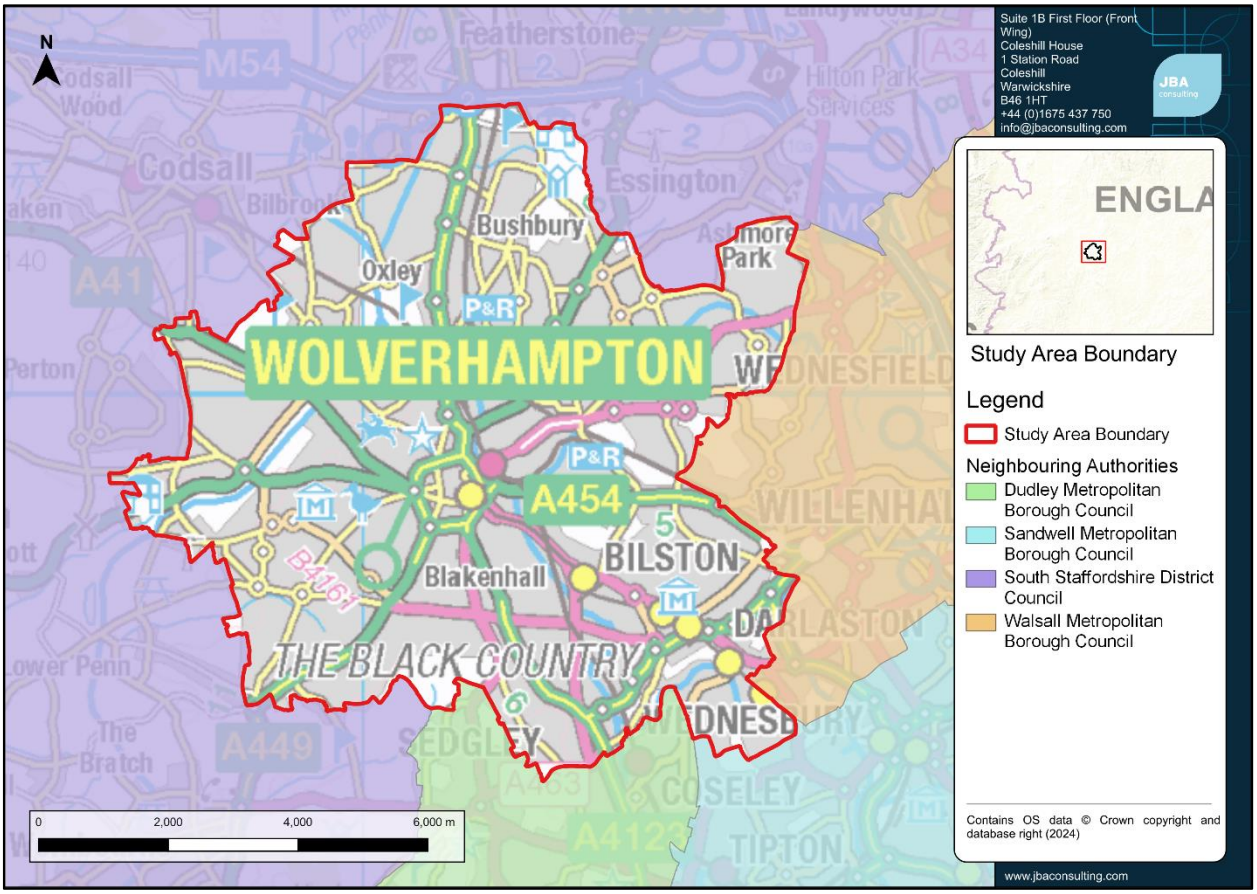


Figure 1-1: Study area boundary and neighbouring authorities

The Main Rivers that flow through Wolverhampton are the Smestow Brook and Darlaston Brook, which are partially culverted, as well as an unnamed culverted tributary of the River Tame. These can be seen in Figure 1-2. There are several other watercourses, which are either partially or completely culverted, that flow through Wolverhampton which are listed below and can be seen in Figure 1-3:

- River Penk (becomes a Main River further downstream outside of Wolverhampton)

- Waterhead Brook (becomes a Main River further downstream outside of Wolverhampton)
- Pendeford Brook
- Graiseley Brook
- Waddens Brook
- Merryhill Brook
- Bilston Brook
- Oxley Brook
- Ettingshall Brook
- Finchfield Brook (also known as Castlecroft Brook)
- Penn Brook

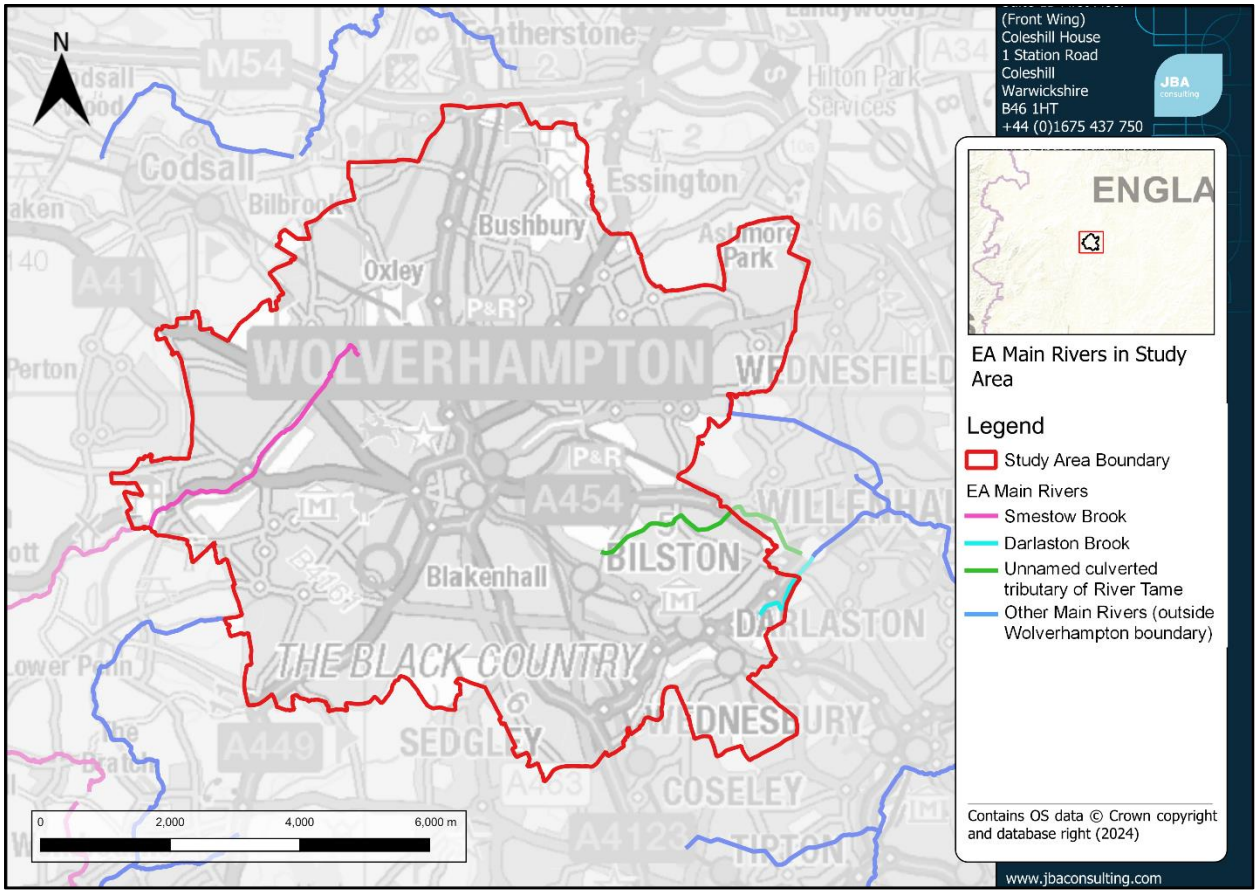


Figure 1-2: Main Rivers within Wolverhampton

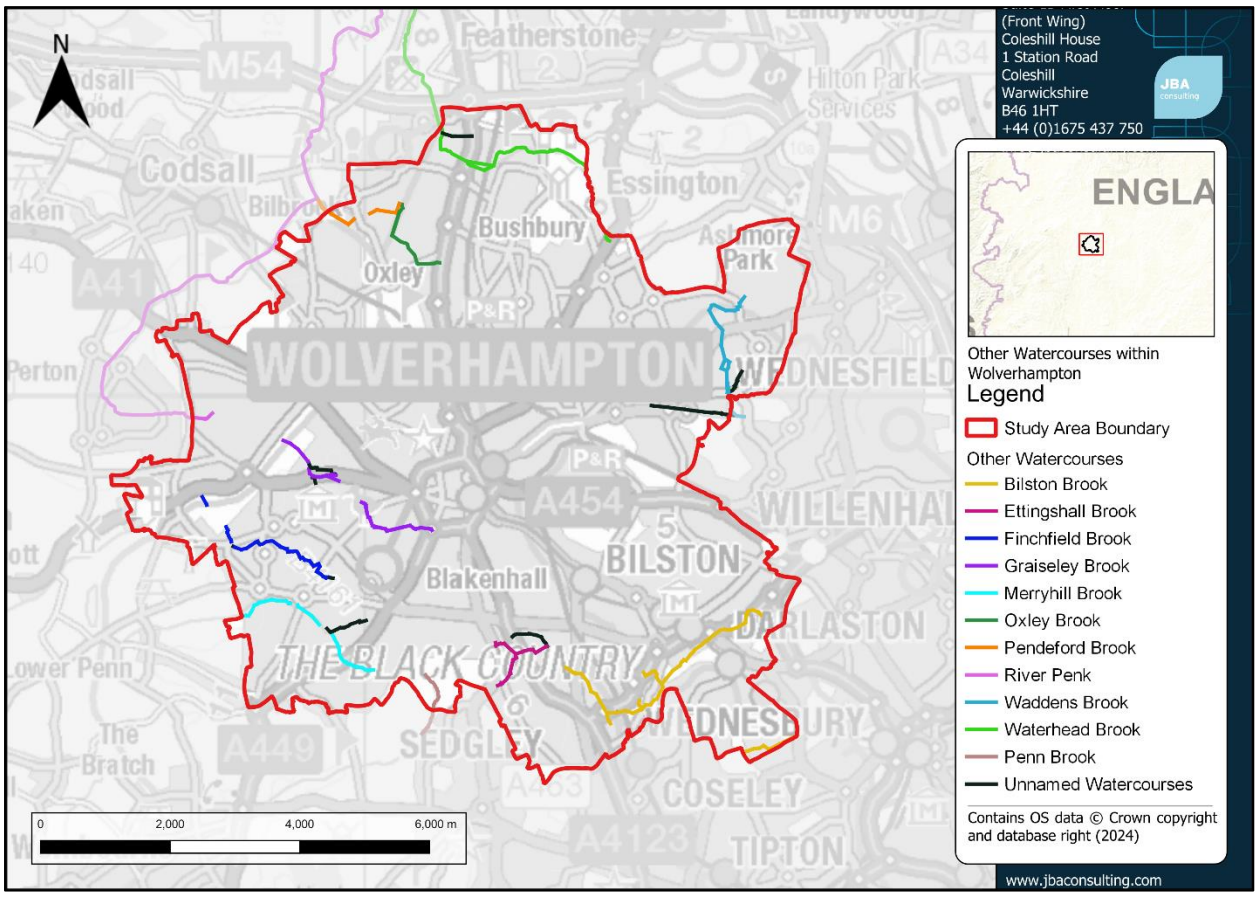


Figure 1-3: Other watercourses within Wolverhampton

Additionally, there are six canals within Wolverhampton, as seen in Figure 1-4. These are listed as follows:

- The Birmingham Canal Navigations;
- Bradley Arm of the Birmingham Canal Navigations;
- Shropshire Union Canal;
- Staffordshire and Worcestershire Canal,
- Walsall Canal;
- Wryley and Essington Canal.

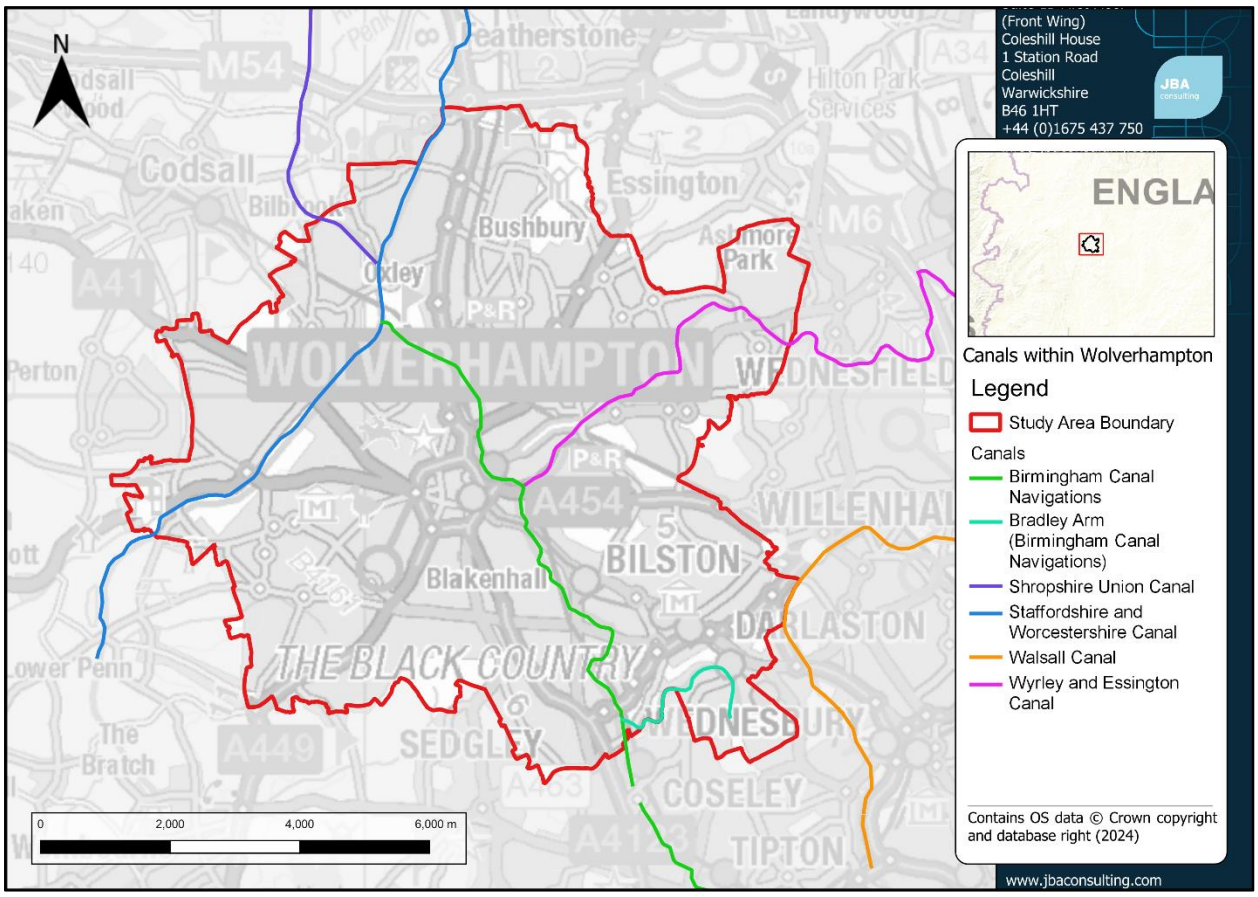


Figure 1-4: Canals within Wolverhampton

The sewerage undertaker and potable water provider is Severn Trent Water (STW). The study area falls under three management catchments, the Tame Anker and Mease Management Catchment, the Severn Middle Worcestershire Management Catchment, and the Trent Valley Staffordshire Management Catchment. CWC is the Lead Local Flood Authority (LLFA) and the Local Plan Authority (LPA).

1.6 Consultation

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

- Staffordshire County Council
- Environment Agency
- Severn Trent Water
- Canal and River Trust
- Neighbouring Authorities:
  - Dudley Metropolitan Borough Council
  - Sandwell Metropolitan Borough Council
  - South Staffordshire District Council
  - Walsall Council

1.7 Use of SFRA Data

It is important to recognise that Level 1 SFRAs are high level strategic documents and, as such, do not go into detail on an individual site-specific basis. 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 all sources, and the potential impacts of future climate change.

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

SFRAs should be a 'living document', and as a result should be updated when new information on flood risk, new planning guidance, or legislation becomes available. New information on flood risk may be provided by CWC, the Environment Agency (EA), and Severn Trent Water. Such information may be in the form of:

- New hydraulic modelling results
- Flood event information following a flood event
- Policy/ legislation updates
- Environment Agency flood map updates
- New flood defence schemes etc.

The Environment Agency regularly reviews their flood risk mapping, and it is important that they are approached to determine whether updated information is available prior to commencing a detailed Flood Risk Assessment. It is recommended that the SFRA is reviewed internally, 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.

1.8 Structure of this report

Section	Contents
Executive Summary	Focuses on how the SFRA can be used by planners, developers and neighbourhood planners
1. Introduction	Provides a background to the study, the Local Plan stage the SFRA informs, the study area, the roles and responsibilities for the organisations involved in flood management and how they were involved in the SFRA Provides a short introduction to how flood risk is assessed and the importance of considering all sources
2. Flood risk policy and strategy	Sets out the relevant legislation, policy and strategy for flood risk management at a national, regional and local level.

Section	Contents
3. Planning policy for flood risk management	Provides an overview of both national and existing Local Plan policy on flood risk management This includes the Flood Zones, application of the Sequential Approach and Sequential/Exception Test process. Provides guidance for the Councils and Developers on the application of the Sequential and Exception Test for both allocations and windfall sites, at allocation and planning application stages.
4. The impact of climate change	Outlines the latest climate change guidance published by the Environment Agency and how this was applied to the SFRA Sets out how developers should apply the guidance to inform site specific Flood Risk Assessments
5. Understanding flood risk in Wolverhampton	Provides an overview of the characteristics of flooding affecting the study area and key risks including historical flooding incidents, flood risk from all sources and flood warning arrangements.
6. Flood alleviation schemes and assets	Provides a summary of current flood defences and asset management and future planned schemes. Introduces actual and residual flood risk.
7. Cumulative impact of development and strategic solutions	This section provides a summary of the catchments with the highest susceptibility to increased risk in future and development pressures, considers opportunities for strategic flood risk solutions and makes recommendations for local planning policy based on these.
8. Guidance for developers	Guidance for developers on Flood Risk Assessments, considering flood risk from all sources
9. Surface water management and Sustainable Drainage Systems	An overview of Sustainable Drainage Systems, Guidance for developers on Surface Water Drainage Strategies, considering any specific local standards and guidance for Sustainable Drainage Systems (SuDS) from the Lead Local Flood Authority
10. Summary and recommendations	Summarises sources of flood risk in the study area and outlines planning policy recommendations

Section	Contents
Appendices: • Appendix A: Static mapping • Appendix B: Data sources • Appendix C: SFRA user guide • Appendix D: Flood Alert and Flood Warnings • Appendix E: Summary of flood risk in Wolverhampton	

1.9 Understanding Flood Risk

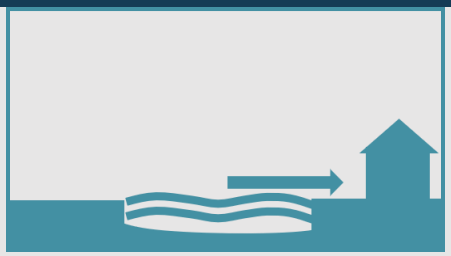
This section provides useful background information on how flooding arises and how flood risk is determined.

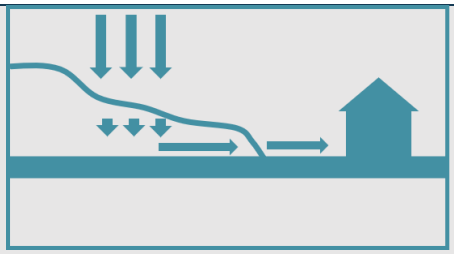
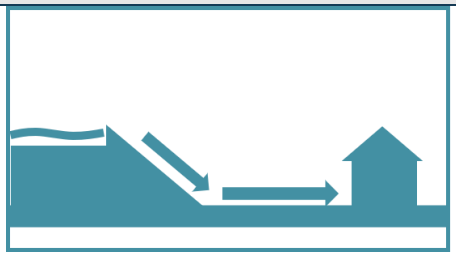
1.9.1 Sources of Flooding

Flooding can occur from many different and combined sources and in many different ways, as illustrated in Table 1-1. The major sources of flooding in Wolverhampton are:

- **Fluvial (rivers)** - inundation of floodplains from rivers and smaller watercourses; inundation of areas outside the floodplain due to influence of bridges, embankments and other features that artificially raise water levels; overtopping or breaching of defences; blockages of culverts; blockages of flood channels/corridors.
- **Surface water** - direct run-off from land due to exceeding the infiltration rate of the soil or the capacity of the drainage network. It is generally caused by intense short periods of rainfall and usually affects lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems are inextricably linked to issues of poor drainage, or drainage blocked by debris and sewer flooding.
- **Groundwater** – rising water table; most likely to occur in low-lying areas underlain by permeable rock (aquifers) or groundwater recovery after pumping for mining or industry has ceased.
- **Infrastructure failure** - reservoirs; canals; industrial processes; burst water mains; blocked sewers or failed pumping stations.

Table 1-1: Description and illustration of the types of flooding

Flooding Type	Description	Illustration
Fluvial (River)	River flows exceed the capacity of the river channel, with water spilling out on to the floodplain. Can include breach or overtopping of flood defences.	

Flooding Type	Description	Illustration
Surface water	Water falls onto the ground and is unable to soak into the ground due to impermeable surfaces or rainfall intensities exceeding the infiltration rate into the soil or the capacity of the drainage network.	
Groundwater	Water is stored in rock layers underground. The water table rises as infiltration exceeds the drainage from the aquifer or permeable layer, leading to the water table rising to the surface through springs or wetted areas.	
Residual Risk	Breach or overtopping of a raised structure storing water, such as a reservoir.	

1.10 Likelihood, Consequences, and Risk

Flood risk is a combination of the likelihood of flooding and the potential consequences arising. It is assessed using the source – pathway – receptor model as shown in Figure 1-5. This is a standard environmental risk model common to many hazards and should be the starting point of any assessment of flood risk. However, it should be remembered that flooding could occur from many different sources and pathways, and not simply those shown in the illustration below.

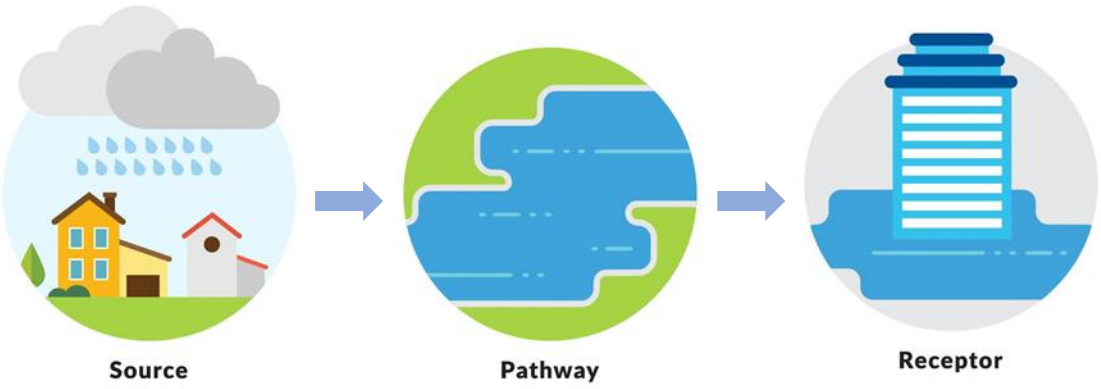


Figure 1-5: The source - pathway - receptor model

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

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

1.10.1 Likelihood

The likelihood of flooding is often measured by a percentage probability or by stating how regularly it may occur on average. Many everyday practitioners refer to a 1% Annual Exceedance Probability (AEP) flood as a 1 in 100-year flood. However, this does not mean that the flood will only happen once every 100 years. Instead, the chance of a flood of this magnitude occurring in any given year is 1% and it is therefore possible that two 100-year floods could happen within a single year. Higher probability flood events may occur between the larger events.

Drainage systems and flood defences are designed to provide Standards of Protection (SoP) from events with specific magnitudes. Some examples of SoP are as follows:

- Surface water drains and sewers are designed to have a surcharged capacity (the water in the sewer system is at or below ground level) for a 3.3% AEP event.
- Fluvial defences are often built to protect against a 1% AEP event.
- Drainage for new highways is designed to a 3.3% AEP event. However, the majority of the existing highway network is not built to modern standards. The AEP of a flooding event which exceeds the highway drainage network in some areas could be 10% or higher.

1.10.2 Consequence

The consequences of flooding include fatalities, property damage and disruption to lives and businesses, with severe social and economic implications for people. Consequences of flooding depend on the hazards caused by flooding such as the depth of water, speed of flow, rate of onset and duration, and the vulnerability of receptors such as the type of development and population demographics.

1.10.3 Risk

Risk varies depending on the severity of the event, the source of the water, the pathways of flooding (such as the condition of flood defences) and the vulnerability of receptors as mentioned above. Flood risk as an equation is then expressed in terms of the following relationship, as displayed in Figure 1-6.

Figure 1-6: Risk calculation and definition

2 Flood Risk Policy and Strategy

The overarching aim of development and flood risk planning policy in the UK is to ensure that the potential risk of flooding is taken into account at every stage of the planning process. This section of the SFRA provides an overview of the planning framework and flood risk policy.

2.1 Roles and Responsibilities for Flood Risk Management in the City of Wolverhampton Council

Organisations that cover the City of Wolverhampton Council CWCwhich have responsibilities for flood risk management, are known as Risk Management Authorities (RMAs). These are shown on Table 2-1, with a summary of their responsibilities.

Table 2-1: Roles and responsibilities for flood risk management within Wolverhampton

Risk Management Authority	Strategic Level	Operational Level	Planning Role
Environment Agency	Strategic overview for all sources of flooding National Strategy Reporting and general supervision	Main rivers (Smestow Brook and culverted branch of River Tame) Reservoirs	Statutory consultee for development in Flood Zones 2 and 3 or within 20m of a Main River
City of Wolverhampton Council as LLFA	Preliminary Flood Risk Assessment Local Flood Risk Management Strategy	Surface Water Groundwater Ordinary Watercourses (consenting and enforcement) Ordinary watercourses (works)	Statutory consultee for major developments
City of Wolverhampton Council as Local Planning Authority (LPA)	Local Plans as Local Planning Authorities	Determination of Planning Applications as Local Planning Authorities Managing open spaces under	Determination of Planning Applications as Local Planning Authorities Managing open spaces under

Risk Management Authority	Strategic Level	Operational Level	Planning Role
		Council ownership	Council ownership
Water Companies: Severn Trent Water	Asset Management Plans, supported by Periodic Reviews (business cases) Develop Drainage and Wastewater management plans	Public sewers and water supply	Non-statutory consultee
Highways Authorities: *Highways Agency (motorways and trunk roads)* City of Wolverhampton Council; *(All other adopted roads in respective Council areas)*	Highway drainage policy and planning	Highway drainage	Internal planning consultee regarding highways design standards and adoptions

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

2.2 Relevant Legislation

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

- Flood Risk Regulations (2009) transpose the EU Floods Directive (2000) into UK law and require the Environment Agency and LLFAs to produce Preliminary Flood Risk Assessments (PFRAs) and identify where there are nationally significant Flood Risk Areas. For the Flood Risk Areas, detailed flood maps and a Flood Risk Management Plan is produced. This is a six-year cycle of work and the second cycle started in 2017.
- Town and Country Planning Act (1990), Water Industry Act (1991), Land Drainage Act (1991), Environment Act (2021) and Flood and Water Management Act (2010) – as amended and implanted via secondary legislation. These set out the roles and responsibilities for organisations that have a role in FRM.

- Land Drainage Act (1991) and Environmental Permitting Regulations (2016) also set out where developers will need to apply for additional permission (as well as Planning Permission) to undertake works to an ordinary watercourse or Main River. An Environmental Permit is required for works within 8m of any flood defence structure on or within the flood plain of a main river.
- Water Environment Regulations (2017) transpose the European Water Framework Directive (2000) into law and require the Environment Agency to produces River Basin Management Plans (RBMPs). These aim to ensure that the water quality of aquatic ecosystems, riparian ecosystems and wetlands reach 'good status'.
- Other environmental legislation such as the Habitats Directive (1992), Environmental Impact Assessment Directive (2014) and Strategic Environmental Assessment Directive (2001) can be appropriately applied to strategic and site-specific developments to guard against environmental damage.

2.3 Relevant flood risk policy and strategy documents

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

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

Table 2-2: National, Regional and Local flood risk policy and strategy documents

	Document, lead author and date	Information	Policy and measures	Development design requirements	Next update due (if known)
National	National Flood and Coastal Erosion Risk Management Strategy for England **(Environment Agency) 2022**	No	Yes	No	-
	National Planning Policy Framework **(DLUHC) 2023**	No	No	Yes	-
	Planning Practice Guidance **(DLUHC & MHCLG)**	No	No	Yes	-
	Building Regulations Part H **(MCHLG) 2010**	No	No	Yes	-
Regional	River Trent Catchment Flood Management Plan **(Environment Agency) 2009**	Yes	Yes	No	-
	Humber Flood Risk Management Strategy **(Environment Agency) 2008**	Yes	Yes	No	-
	Severn River Basin District Flood Risk Management Plan **(Environment Agency) 2016, updated 2023**	Yes	Yes	No	2027
	Humber River Basin Management Plan **(Environment Agency) 2022**	No	Yes	No	-
	Severn River Basin Management Plan **(Environment Agency) 2023**	No	Yes	No	-
	Climate Change Guidance for Development and Flood Risk **(Environment Agency) 2022**	No	No	Yes	-

	Document, lead author and date	Information	Policy and measures	Development design requirements	Next update due (if known)
Local	Local Flood Risk Management Strategy **(The Black Country) 2015**	Yes	Yes	No	-
	Drainage and Wastewater Management Plan **(Severn Trent Water) 2023**	Yes	Yes	No	-
	Wolverhampton Preliminary Flood Risk Assessment **(2011) and** Addendum **(2017)**	Yes	No	No	-

2.4 Key National, Regional, and Local Documents and Strategies

2.4.1 The National Flood and Coastal Erosion Risk Management Strategy for England (2020)

The National Flood and Coastal Erosion Risk Management Strategy for England (2020) (FCERM) provides the overarching framework for future action by all risk management authorities to tackle flooding and coastal erosion in England. The Environment Agency brought together a wide range of stakeholders to develop the strategy collaboratively. The Strategy is much more ambitious than the previous one from 2011 and looks ahead to 2100 and the action needed to address the challenge of climate change. A progress update to the Strategy was published in 2022 outlining what had been achieved by 2022 and the roadmap to achieving the goals set out in the Strategy until the year 2026.

The Strategy has been split into three high level ambitions: climate resilient places; today's growth and infrastructure resilient in tomorrow's climate; and a nation ready to respond and adapt to flooding and coastal change. The strategy outlines strategic objectives relating to these ambitions, with specific measures to achieve these.

The Strategy was laid before parliament in July 2020 for formal adoption and published alongside a New National Policy Statement for Flood and Coastal Erosion Risk Management. The statement sets out five key commitments which will accelerate progress to better protect and better prepare the country for the coming years:

1. Upgrading and expanding flood defences and infrastructure across the country,
2. Managing the flow of water to both reduce flood risk and manage drought,
3. Harnessing the power of nature to not only reduce flood risk, but deliver benefits for the environment, nature, and communities,
4. Better preparing communities for when flooding and erosion does occur, and
5. Ensuring every area of England has a comprehensive local plan for dealing with flooding and coastal erosion.

The Flood and Coastal Erosion Risk Management Strategy Roadmap to 2026 describes how the National Flood and Coastal Erosion Risk Management Strategy for England will be translated into practical actions until the year 2026, and what aspirations it hopes to achieve. By defining actions, the Strategy Roadmap supports the government's £5.2 billion Flood and Coastal Erosion Risk Management Investment Programme in decision making for allocating funds.

The Strategy Roadmap also incorporates innovating programmes to improve evidence on the costs and benefits of new resilience actions. Improving the knowledge base will help inform future approaches and investments in flood and coastal risk management. The three programmes which address this are:

- The Flood and Coastal Resilience Innovation Programme which enables local authorities, businesses and communities to test and demonstrate innovative actions.

- The Adaptive Pathways Programme which develops long term investment plans for managing flood and coastal change to 2100 and beyond.
- The Coastal Transition Accelerators Programme which supports communities in areas at significant risk of coastal erosion to transition and adapt to changing climate.

The Strategy Roadmap describes a cross-disciplinary, multi-organisational approach to assessing and addressing flood and coastal erosion risk in England, including the funding structures, and with sensitivity to sustainability and the environment.

2.4.2 River Basin Management Plans

River Basin Management Plans (RBMPs) are prepared under the Water Framework Directive (WFD) and assess the pressure facing the water environment in River Basin Districts. Wolverhampton falls within the Humber and Severn RBMPs.

The Humber and Severn RBMPs, managed by the EA, have been updated since the first cycle in 2009. The latest version was published in December 2022. Water quality and flood risk can go hand in hand in that flood risk management activities can help to deliver habitat restoration techniques. The plans include an assessment of river basin characteristics, a review of the impact on human activity, statuses of water bodies, and an economic analysis of water use and progress since the first plan in 2009. The Plans are currently being reviewed. Within the Humber RBMP, the future aims of the Staffordshire Trent Valley catchment include:

- Setting up a stakeholder group identifying priority water bodies to achieve projects that reduce rural diffuse pollution issues. This would be partially undertaken by intervention measures such as rural SuDS.
- Continued river restoration work in Trent headwaters to reduce flood risk and improve water quality.

Some of the Tame, Anker and Mease catchment's future aims within the Humber RBMP are also detailed below:

- Restoration work on the River Tame
- Achieve improvement work on the significant number of heavily modified, urban watercourses, in line with Black Country Nature Improvement Area priorities.

Within the Severn RBMP, the Severn Valley Water Management Scheme is looking to adopt a catchment based approach to flood risk in the Severn Catchment with the promotion of nature based solutions and environmental enhancements to complement other more formal flood risk management interventions.

2.4.3 Flood Risk Regulations

The 2009 Flood Risk Regulations implement the 2007 European Floods Directive in England and Wales. They require a six-year cycle of assessment, mapping and planning.

The Preliminary Flood Risk Assessments (PFRAs) are part of the six-year cycle of assessment, mapping and planning. These were last undertaken by the Councils in 2017: City of Wolverhampton Council PFRA (2011) and Addendum (2017).

The PFRA identified that approximately 8,700 dwellings at risk from localised flooding that is considered to be nationally significant. The Environment Agency undertook a PFRA for river, sea and reservoir flooding in 2018. No nationally significant areas were identified for river, sea or reservoir flooding in the Wolverhampton area.

Flood Risk Management Plans (FRMPs) are also part of the six-year cycle of assessment, mapping and planning required under the Flood Risk Regulations. The Environment Agency led the development of the Humber and Severn FRMPs, which were published in 2016 and updated in April 2023. The FRMPs summarise the flooding affecting the area and describes the measures to be taken to address the risk in accordance with the Flood Risk Regulations, focussing on areas of nationally significant flood risk. The FRMPs draw on policies and actions identified in Catchment Flood Management Plans and Local Flood Risk Management Strategies.

2.4.4 Catchment Flood Management Plans

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

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

The six national policies are:

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

CWC is covered by the River Severn CFMP (2009) Policy Option 5 – Areas of moderate to high flood risk where further action can generally be taken to reduce flood risk. In these Policy Options, there are specific 'actions' to manage flood risk in the area. These are:

- Ensure floodplains are not inappropriately developed. Follow the 'sequential approach' and consider land swapping opportunities which involves the exchange of land between two stakeholders to satisfy their needs while optimising the use of the property;
- Encourage compatibility between urban open spaces and their ability to make space for rivers to expand as flood flows occur. One example of a flood-compatible use is playing fields. Develop strategies to create 'blue corridors' by developing/redeveloping to link these flood-compatible spaces;
- Raise awareness of flooding among the public and key partners, especially major operators of infrastructure, allowing them to be better prepared. Encourage them all to increase the resilience and resistance of vulnerable buildings, infrastructure and businesses;
- Develop better understanding of flooding from surface water, from drainage systems, and from 'non-main' watercourses. Produce a strategy for operation and investment, integrating all these with main rivers;
- Review how effective and sustainable each flood defence is. Review maintenance operations to ensure they are proportionate to flood risk. Manage fly-tipping [on floodplains and in channels]. Avoid excessive silt accumulation in artificial channels (Either by channel modifications or by de-silting).

2.4.5 Local Strategy for Flood Risk Management (2016)

CWC is responsible for developing, maintaining, applying and monitoring a Local Flood Risk Management Strategy (LFRMS). The Black Country Local Flood Risk Management Strategy is used as a means by which the LLFA co-ordinates Flood Risk Management on a daily basis.

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

- Develop plans to reduce existing flood risk taking account of people, communities and the environment;
- Ensure that the area remains an attractive place for business and that flood risk is clearly communicated to the public to increase public awareness;
- Ensure that planning decisions take full account of flood risk and that emergency plans are effective so that individuals and communities understand the risks along with their role in an emergency;
- Develop a clear understanding of flood risk across Wolverhampton and identify national, regional and local funding mechanisms to deliver flood risk management solutions;
- Provide a clear explanation of the roles and responsibilities of the flood management authorities and how CWC will coordinate and drive partnership approaches to manage and reduce this risk; and

- Ensure that the natural and historic environment is considered in all flood risk management activities, and where possible enhanced through flood risk management schemes.

2.4.6 LLFA, Surface Water, and SuDS

The 2023 NPPF states that: 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (Para 175). When considering planning applications, local planning authorities should consult the relevant LLFA on the management of surface water in order to satisfy that:

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

CWC's requirements for new developers on SuDS are set out on their draft Local Plan, which can be found on their website, alongside supporting documents.

The 2023 NPPF states that flood risk should be managed "using opportunities provided by new development and improvements in green and other infrastructure to reduce the causes and impacts of flooding." As such, although incorporating SuDS is only a requirement for major development, it is best practice for all development.

2.4.7 Water Cycle Studies

Water Cycle Studies (WCS) – whether scoping, outline or detailed – assist Councils to select and develop sustainable development allocations in locations where there is minimal impact on the environment, water quality, water resources, infrastructure, and flood risk. WCS's provide the required evidence, and an agreed strategy, to ensure that planned growth occurs within environmental constraints (and where possible contributes to environmental improvements), with the appropriate infrastructure in place in a timely manner so that planned allocations are deliverable. This is undertaken by identifying areas where there may be conflict between any proposed development, the requirements of the environment and by recommending potential solutions to these conflicts. At the time of writing this SFRA, a WCS for Wolverhampton had not been prepared. However, the Black Country WCS was published in 2020 which covers the Wolverhampton area.

2.4.8 Surface Water Management Plans

Surface Water Management Plans (SWMPs) outline the preferred surface water management strategy in a given location. SWMPs are undertaken, when required, by LLFAs in consultation with key local partners who are responsible for surface water management and drainage in their area. They are produced to understand the flood risks that arise from local flooding, which is defined by the Flood and Water Management Act (2010) as flooding from surface runoff, groundwater, and Ordinary Watercourses. SWMPs establish a long-term action plan to manage surface water in a particular area and are

intended to influence future capital investment, drainage maintenance, public engagement and understanding, land-use planning, emergency planning and future developments.

The Wolverhampton SWMP was published in 2012.

3 Planning Policy for Flood Risk Management

This section summarises national planning policy for development and flood risk

3.1 National Planning Policy Framework and Guidance

The revised National Planning Policy Framework (NPPF) was published in February 2019 and last amended in December 2023. The NPPF details the UK Government's planning policies for England. The NPPF must be taken into account in the preparation of local plans and is a material consideration in planning decisions. The NPPF defines Flood Zones, how these should be used to allocate land and flood risk assessment requirements. The NPPF (paragraph 166) states that:

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

The Planning Practice Guidance (PPG) for Flood Risk and Coastal Change was first published in March 2014 and last updated in February 2024 and sets out how the NPPF should be implemented. Diagram 1 of the PPG sets out how flood risk should be considered in the preparation of Local Plans.

3.2 The Risk Based Approach

The NPPF takes a risk-based approach to development in flood risk areas. Since July 2021 the approach has adjusted the requirement for the Sequential Test (as defined in Para 168 of the NPPF) so that all sources of flood risk are included in the consideration. At the time of preparation of the 2024 SFRA no updated guidance (PPG) has been published to describe how the approach to the Sequential Test should be modified. The requirement has been addressed by adopting the approach set out in the sections below.

3.2.1 The Flood Zones

The definition of the Flood Zones is provided below. Flood Zones 2 and 3a do not take into account defences. This is important for planning long term developments as long-term policy and funding for maintaining flood defences over the lifetime of a development may change over time.

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

The Flood Zones are:

- **Flood Zone 1 (low probability):** Land having a less than 0.1% annual probability of river or sea flooding. All land uses are appropriate in this zone. For development proposals on sites comprising one hectare or above, a Flood Risk Assessment is required. However, it should be noted that development proposals on sites that are less than one hectare and located within Flood Zone 1 may still require an FRA following the assessment of other sources of flooding.
- **Flood Zone 2 (medium probability):** Land having between a 1% and 0.1% annual probability of river flooding; or having land between a 0.5% and 0.1% annual probability of sea flooding. Essential infrastructure, water compatible infrastructure, less vulnerable and more vulnerable land uses (as set out by NPPF) are appropriate in this zone. Highly vulnerable land uses are permitted provided they pass the Exception Test. All developments in this zone require an FRA.
- **Flood Zone 3a (high probability):** Land having a 1% or greater annual probability of river flooding; or land having a 0.5% or greater annual probability of sea flooding. Developers and the local authorities should seek to reduce the overall level of flood risk, relocating development sequentially to areas of lower flood risk and attempting to restore the floodplain and make open space available for flood storage. Water compatible and less vulnerable land uses are permitted in this zone. Highly vulnerable land uses are not permitted. More vulnerable land uses and essential infrastructure are only permitted if they pass the Exception Test. All developments in this zone require an FRA.
- **Flood Zone 3b (functional floodplain):** this zone comprises land where water from rivers or the sea has to flow or be stored in times of flood. The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. Only water compatible and essential infrastructure are permitted in this zone and should be designed to remain operational in times of flood, resulting in no loss of floodplain or blocking of water flow routes. They must also be safe for users and not increase flood risk elsewhere. Essential Infrastructure will only be permitted if it passes the Exception Test. Where development is appropriate in this flood zone all applications require an FRA. Functional floodplain will normally comprise:
    - land having a 3.3% or greater annual probability of flooding, with any existing flood risk management infrastructure operating effectively; or
    - land that is designed to flood (such as a flood attenuation scheme), even if it would only flood in more extreme events (such as 0.1% annual probability of flooding). It is to be noted that the hydraulic models obtained for this SFRA do not contain the 3.3% AEP event. However, the 2% AEP event for both models have been provided and are deemed appropriate to use as conservative proxies for Flood Zone 3b. As a result, no additional re-runs were required for this Level 1 assessment. For further details of this hydraulic modelling, please refer to Appendix B.

- Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency.

Flood Zone 3b, unlike other Zones, shows flood risk that accounts for the presence of existing flood risk management features and flood defences, as land afforded this standard of protection is not appropriately included as functional floodplain.

3.2.2 The Sequential Test

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

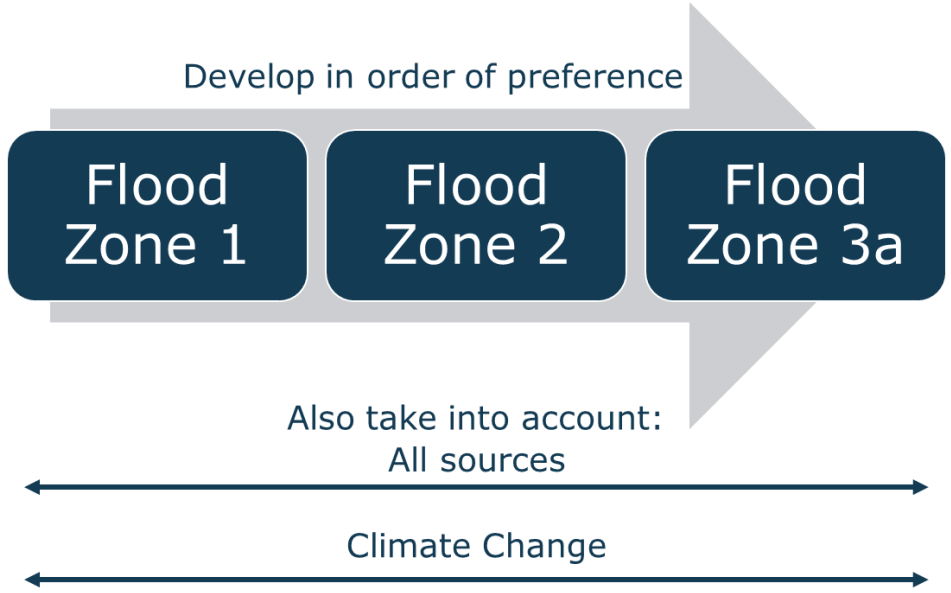


Figure 3-1: Sequential Test concept diagram

The LPA should work with the Environment Agency as well as use local knowledge to define a suitable area of search for the consideration of alternative sites in the Sequential Test. The Sequential Test can be undertaken as part of a Local Plan Sustainability Appraisal. Alternatively, it can be demonstrated through a free-standing document, or as part of Strategic Housing Land or Employment Land Availability Assessments.

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

Figure 3-2 illustrates the Sequential Test as a process flow diagram using the information contained in this SFRA to assess potential development sites against areas of flood risk

and development vulnerability compatibilities. This is a stepwise process, but a challenging one, as a number of the criteria used are qualitative and based on experienced judgement. The process must be documented, and evidence used to support decisions recorded. In addition, the risk of flooding from other sources and the impact of climate change must be considered when considering which sites are suitable to allocate.

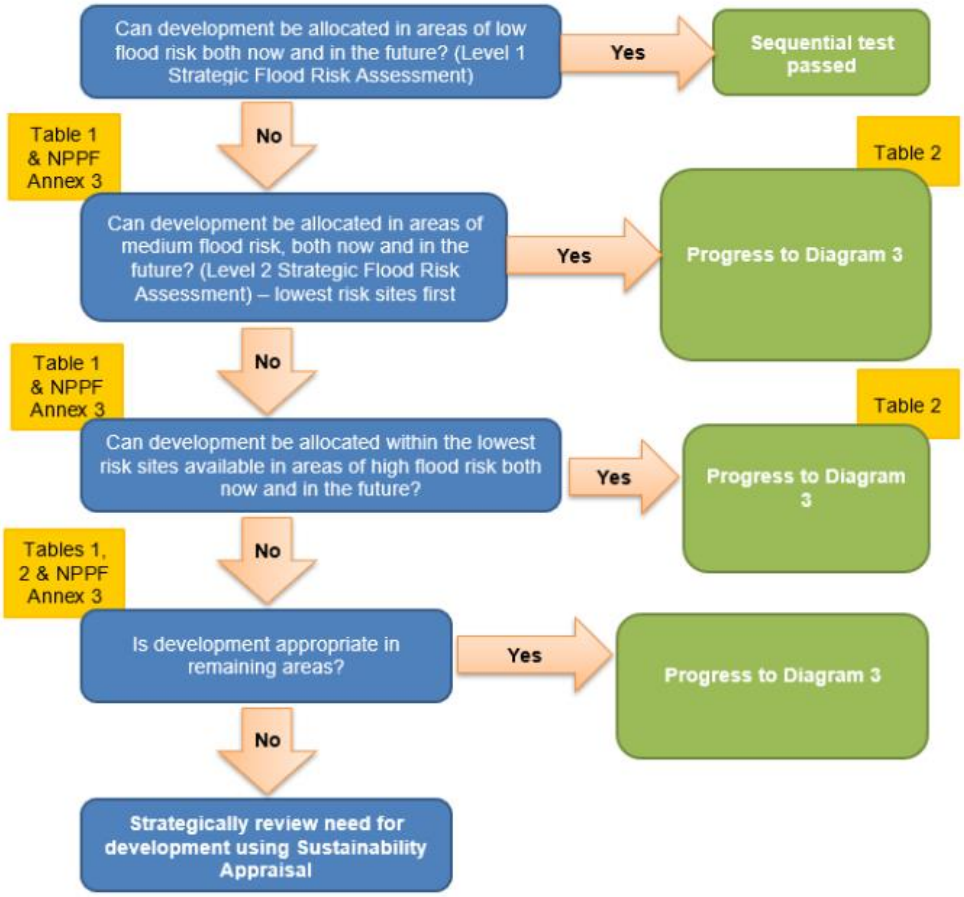


Figure 3-2: Diagram 2 of the PPG: Application of the Sequential Test for plan preparation

3.2.3 The Exception Test

It will not always be possible for all new development to be allocated on land that is not at risk from flooding. To further inform whether land should be allocated, or Planning Permission granted, a greater understanding of the scale and nature of the flood risks is required. In these instances, the Exception Test will be required. Diagram 3 of the PPG (Figure 3-3) summarises the Exception Test.

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

- Essential infrastructure in Flood Zone 3a or 3b
- More vulnerable in Flood Zone 3a (this is NOT permitted in Flood Zone 3b)
- Highly vulnerable in Flood Zone 2 (this is NOT permitted in Flood Zone 3a or 3b)
- Any development with significant* risk in the surface water 1% AEP plus 40% climate change allowance flood extent.

*Flood risk issues are not always black and white - the significance of issues requires professional judgement, based on the location, topography and nature (including depth, velocity and hazard) of flooding, rather than simply whether part of a site is within a given flood extent. This would be determined as part of a Level 2 assessment.

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

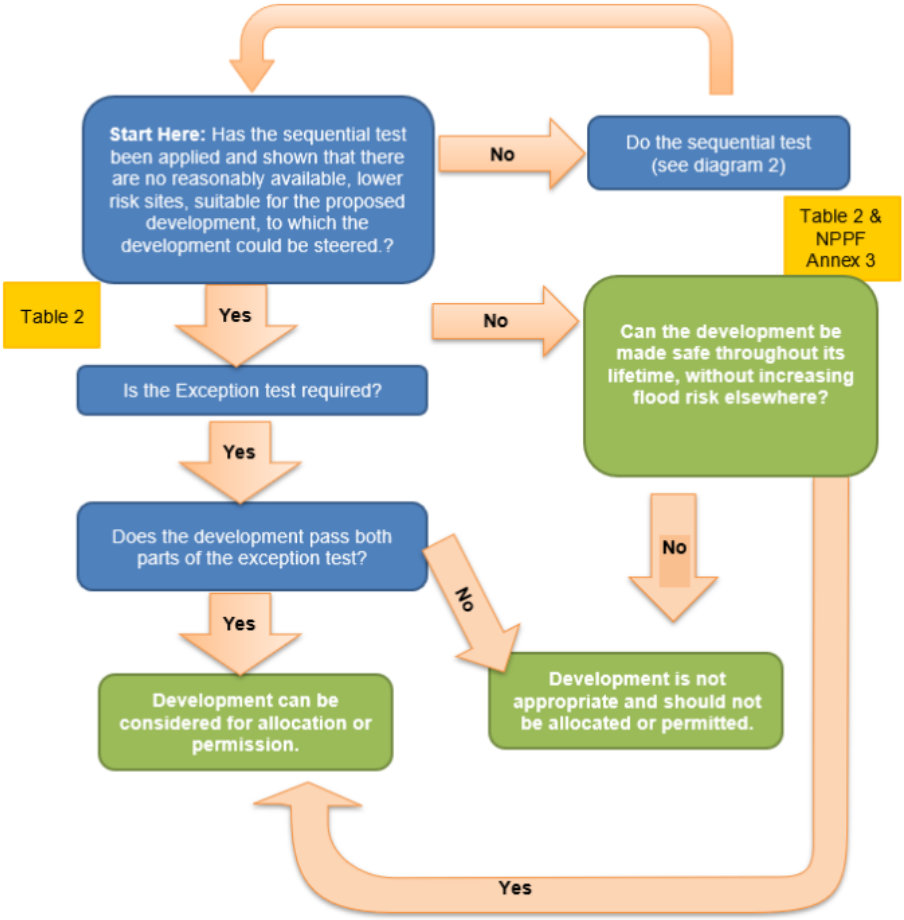


Figure 3-3: Diagram 3 of the PPG: Application of the Exception Test to plan preparation

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

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

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

- Using the information on the Flood Zones, can development be allocated into the lowest flood risk areas?
- Using the information on other sources of flooding, can development be allocated into the lowest flood risk areas?
- Using the information on climate change, is there likely to be a significant increase in flood risk due to climate change? They should form a judgement based on the likely lifetime of a development (e.g. 60 years for commercial and 100 years for residential) as to whether the site is likely to become at unacceptable risk of flooding over time.

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

Having applied this analysis, the following should take place:

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

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

3.4 Applying the Sequential and Exception Tests to Individual Planning Applications

3.4.1 The Sequential Test

CWC, taking account of views from other relevant parties, is responsible for considering whether the Sequential Test has been satisfied.

When appropriate Developers are required to apply the Sequential Test to development sites, unless the site is either:

- a strategic allocation and the test have already been carried out by the LPA

- a change of use (except to a caravan, camping or chalet site, or to a mobile home or park home site)
- a minor development (householder development, small non-residential extensions with a footprint of less than 250m^2); or
- a development in Flood Zone 1 unless there are other flooding issues in the area of the development (e.g., surface water, groundwater, sewer flooding).

The SFRA contains information on all sources of flooding and taking into account the impact of climate change. This should be considered when a developer is preparing the Sequential Test, including the consideration of reasonably available sites at lower flood risk now and in the future, but more detailed site-specific information should also be prepared where appropriate.

CWC as the LPA should work with the Environment Agency as well as use local knowledge to define the area of application of the Sequential Test (within which it is appropriate to identify reasonably available alternatives). The criteria used to determine the appropriate search area relate to the catchment area for the type of development being proposed. For some sites this may be clear e.g., school catchments, in other cases it may be identified by other Local Plan policies. For some sites e.g., regional distribution sites, it may be suitable to widen the search area beyond LPA administrative boundaries.

The sources of information on reasonably available sites may include:

- Site allocations in Local Plans
- Sites with Planning Permission but not yet built out
- Housing and Economic Land Availability Assessments (HELAAs)/ five-year land supply/ annual monitoring reports
- Locally listed sites for sale

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

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

3.4.2 The Exception Test

If, following application of the Sequential Test, it is not possible for the development to be located in areas with a lower probability of flooding the Exception Test must then be applied if required (as set out in Diagram 3 of the PPG). Developers are required to apply the Exception Test to all applicable sites (including strategic allocations).

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

- *Demonstrating that the development would provide wider sustainability benefits to the community that outweigh the flood risk using a method agreed with City of Wolverhampton Council.*

- *Demonstrating that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*

The site-specific Flood Risk Assessment should demonstrate that the site and its users will be safe from flooding from all sources throughout its lifetime. A site-specific FRA should consider actual and residual risk and how this will be managed over the lifetime of the development, including:

- the design, operation and maintenance of any flood defence infrastructure;
- access and egress, including plans for warning and evacuation if necessary;
- design of the development to manage and reduce flood risk wherever possible;
- resident awareness;
- flood warning and evacuation procedures, including whether the developer would increase the pressure on emergency services to rescue people during a flood event; and
- any funding arrangements required for implementing measures.

3.5 Existing Local Plan Policy on Development and Flood Risk

Once adopted, the Wolverhampton Draft Local Plan will replace the Black Country Core Strategy (2011), until the Local Plan is adopted, the Black Country Core Strategy may still apply. Currently, the policy relevant to development and flood risk in the Black Country Core Strategy is outlined below:

> *"The Black Country Authorities will seek to minimize the probability and consequences of flood risk by adopting a strong risk-based approach in line with PPS25. Development will be steered to areas with a low probability of flooding first through the application of the Sequential Test. The Exception Test will then be required for certain vulnerable uses in medium and high probability flood areas."*

3.6 Existing Area Action Plans

Area Action Plans (AAPs) are a type of Development Plan Document focused on specific locations that are subject to conservation or significant change. They consist of objectives, policies and proposals for each area. Within Wolverhampton there are three AAPs:

3.6.1 City Centre Area Action Plan

The City Centre Area Action Plan primarily addresses regeneration of the city centre with a focus on protection and enhancement, and to be used as an aid into decision making for planning applications. The AAP builds upon and working in conjunction with the Black Country Core Strategy and covers the areas of:

- The city centre within the ring road
- Canalside Quarter
- Graiseley
- Blakenhall

- All Saints
- Chapel Ash

Policy CC10 in this AAP states:

"All development proposals and public realm improvements should consider the use of Urban Wetlands and Street Rain Gardens as part of Sustainable Urban Drainage Schemes (SuDS) and the incorporation of street trees and areas of woodland in new development, particularly where there are known surface water flooding issues or where wildlife habitat connectivity could be enhanced".

3.6.2 Stafford Road Corridor Area Action Plan

The Stafford Road Corridor Area Action Plan aims to provide a detailed, local level framework within the Black Country Core Strategy and for sustainable development to be achieved.

3.6.3 Bilston Corridor Area Action Plan (including Bilston Neighbourhood Plan)

The Bilston Corridor Area Action Plan considers and identifies the locations of new development, transport, facilities, employment, and regeneration schemes. The AAP builds upon and works in conjunction with the Black Country Core Strategy and covers the areas of:

- Bilston and Bilston Town Centre
- East Park
- Ettingshall
- Monmore Green
- Ladymoor
- Loxdale

Policy BC8 in this AAP states:

"All development proposals and public realm improvements should consider the use of Urban Wetlands and Street Rain Gardens as part of Sustainable Urban Drainage Schemes (SuDS) and the incorporation of street trees and areas of woodland in new development, particularly where there are known surface water flooding issues or where wildlife habitat connectivity could be enhanced."

This AAP also states that development within Loxdale Industrial area and Bilston Urban Village will incorporate sustainable drainage features to minimise flood risk.

4 Impact of Climate Change

4.1 Revised Climate Change Guidance

The revised NPPF (July 2024) sets out how the planning system should help minimise vulnerability and provide resilience to the impacts of climate change. The NPPF and PPG describe how FRAs should demonstrate how flood risk will be managed over the lifetime of the development, taking climate change into account.

The NPPF also states that the:

"sequential approach should be used in areas known to be at risk now or in the future from any form of flooding" (para 168).

4.2 Applying the Climate Change Guidance

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. Planning policy and decisions on planning applications have roles in mitigating climate change and adapting to its impacts.

In 2018, the Met Office published new UK Climate Projections (UKCP18). The Environment Agency has since updated their guidance on climate change allowances for river flow (in 2021) and rainfall intensity (in 2022) for new developments. This includes information on how these allowances should be included in both SFRAs and Flood Risk Assessments (FRA). The guidance adopts a risk-based approach considering the vulnerability of the development and (in the case of fluvial and rainfall intensity) considers risk allowances on a management catchment level.

Developers should check on the government website for the most recent guidance before undertaking a detailed FRA. To further support this, the Environment Agency can provide a preliminary opinion to applicants on their proposals at pre-application stage. There may be a charge associated with this.

4.3 Relevant allowances for Wolverhampton

Climate change is expected to increase the frequency, extent and impact of flooding, reflected in peak river flows. Wetter winters and more intense rainfall may increase fluvial flooding and surface water runoff and there may be increased storm intensity in summer. Rising river levels may also increase flood risk.

The peak river flow allowances provided in the guidance show the anticipated changes to peak flow for the management catchment (sub-catchment of river basin districts) within which the subject watercourse is located. Once the management catchment has been identified, guidance on uplift in peak flows are provided for three allowance categories, Central, Higher Central and Upper End which are based on the 50th, 70th and 95th percentiles respectively. The allowance category to be used is based on the vulnerability classification of the development and the flood zones within which it is located.

These allowances (increases) are provided in the form of figures for the total potential change anticipated, for three climate change periods:

- The '2020s' (2015 to 2039)
- The '2050s' (2040 to 2069)
- The '2080s' (2070 to 2125)

The time period used in the assessment depends upon the expected lifetime of the proposed development. Residential development should be considered for a minimum of 100 years, whilst the lifetime of a non-residential development depends upon the characteristics of that development but a period of at least 75 years is likely to form a starting point for assessment. Further information on what is considered to be the lifetime of development is provided in the PPG.

Wolverhampton is located across three management catchments, the Tame Anker and Mease, Severn Middle Worcestershire, and Trent Valley Staffordshire Management Catchments. Maps showing the extent of the management catchments are for peak river flow allowances and peak rainfall intensity allowances are provided by the EA.

Table 4-1 and Table 4-2 show the peak river flows and peak rainfall intensity for the catchments. Climate change scenarios have been run for relevant fluvial models for the 3.3%, 1% and 0.1% AEP events in line with the PPG requirements to assess high, medium and low risk both now and in the future.

Table 4-1: Peak river flow allowances for the Wolverhampton Management Catchments

Management Catchment	Allowance Category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Tame Anker and Mease	Upper end	24%	30%	51%
	Higher central	15%	17%	30%
	Central	10%	11%	22%
Trent Valley Staffordshire	Upper end	30%	38%	61%
	Higher central	19%	23%	39%
	Central	15%	17%	29%
Severn Middle Worcestershire	Upper end	25%	38%	67%
	Higher central	16%	21%	40%
	Central	12%	15%	30%

Table 4-2: Peak rainfall intensities for the Wolverhampton Management Catchments

Management Catchment	% AEP event	Epoch	Central Allowance	Upper End Allowance
Tame Anker and Mease	3.3	2050	20	35
	3.3	2070	25	35
	1	2050	20	40
	1	2070	25	40
Trent Valley Staffordshire	3.3	2050	20	35
	3.3	2070	25	35
	1	2050	25	40
	1	2070	25	40
Severn Middle Worcestershire	3.3	2050	20	35
	3.3	2070	25	35
	1	2050	20	40
	1	2070	25	40

The Flood Zone and flood risk vulnerability classification should be considered when deciding which allowances apply to the development or the plan. Vulnerability classifications are found in the PPG. The Environment Agency guidance states that both the central and higher central allowances should be assessed in strategic flood risk assessments. Specific guidance for which climate change allowance estimates should be applied can be found in the Environment Agency guidance on climate change allowances. For site specific Flood Risk Assessments, the central allowances should be used in most instances with the exception of 'essential infrastructure' where the guidance is to use the 'higher central' allowance.

Currently there in no guidance on considering the impact of climate change on flood risk to development located within Flood Zone 1.

Climate change is predicted to result in wetter, winters and increased summer storm intensity in the future. This increased rainfall intensity will affect land and urban drainage systems, resulting in surface water flooding, due to the increased volume of water entering the systems. The anticipated changes in peak rainfall intensity which can be used for site-scale applications (like drainage design), surface water flood mapping in small catchments (less than 5km2) and urbanised drainage catchments.

The guidance suggests that direct rainfall modelling may not be suited to larger (>5km^2) catchment with rural land use. In these instances, the guidance states that the fluvial flood risk affected by climate change should be assessed using uplifts from peak river flow allowances.

4.4 Representing climate change in the Level 1 SFRA

The Waddens Brook and Smestow Brook fluvial models, which were provided by the EA, contained climate change uplifts which were within +/-10% of the latest allowances made in May 2022. The following fluvial model outputs were used to represent climate change:

- Waddens Brook (JBA, 2017) - Tame, Anker and Mease Management Catchment:
  - 1% AEP (+20%, +30%, +50%)
- Smestow Brook (Capita, 2012) - Severn Middle Worcestershire Management Catchment:
  - 1% AEP (+20%)

Appendix B provides further details of the models used in this assessment.

It is noted that the 1% AEP plus 20% climate change flood event was the only climate change uplift that was simulated in the original 2012 Smestow Brook hydraulic model. Although this is sufficient for a high level strategic study of flood risk, developers will need to use the latest climate change allowances in updated hydraulic modelling to obtain the Higher Central and Upper End allowances as well as the most recent Central allowance. This will support detailed site-specific FRAs. Should a Level 2 assessment be required, it may be deemed necessary to simulate flood events with these climate change uplifts if any site allocations are classified as 'Essential Infrastructure'.

For any sites not covered by the EA's detailed modelling, or where models were not run for climate change allowances, Flood Zone 2 was used as an indicative climate change extent for the 1% AEP event. This is appropriate for a strategic assessment given the Upper End climate change estimates are often similar to the Flood Zone 2 extents. Detailed modelling should be undertaken as part of a site-specific flood risk assessment for any sites which may be at fluvial flood risk in the future and detailed modelling does not already exist.

For this SFRA, the following climate change uplifts have been applied to the Environment Agency's Risk of Flooding from Surface Water dataset:

- 3.3% AEP 2070s Upper End climate change allowance – 35% uplift
- 1% AEP 2070s Upper End climate change allowance – 40% uplift

The recommended epoch and use of either the central or upper end allowances should be based on the design lifetime of the proposed development. Further details are provided within the Environment Agency guidance on climate change allowances. For developments with a lifetime beyond 2100, the Upper end allowance should be used. For developments with a shorter lifetime, the Central allowance can be used.

4.5 Impact of climate change in Wolverhampton

This section explores which areas of Wolverhampton are most sensitive to increases in flood risk due to climate change. It should be noted that areas that are already at high risk will also be at increasing risk in the future and the frequency of flooding is likely to increase in such areas.

It is recommended that the City of Wolverhampton Council work with other Risk Management Authorities to review the long-term sustainability of existing and new

development in these areas when developing climate change plans and strategies for the district.

4.5.1 Impact of climate change on fluvial flood risk

Climate change modelled flood extents (or Flood Zone 2 where no modelling exists) are comparable to the 0.1% AEP flood extents for an indication of areas most sensitive to climate change.

It is noted that the City of Wolverhampton Council boundary lies within three different management catchments, as such there are different climate change allowances within the boundary which will impact potential fluvial extents. The area in Wolverhampton most sensitive to the fluvial impacts of climate change, based on flood extents and number of properties at risk of flooding, is the Bilston area (south-east Wolverhampton). According to the Waddens Brook hydraulic model, the modelled 1% AEP plus 20% climate change extent is similar to the larger 0.1% AEP event which extends across Moseley Road, Proud's Lane, Stowheath Lane, and several associated residential offshoots.

Flood Zones suggest that the culverted Bilston Brook and partially culverted Darlaston Brook in the south-east of Wolverhampton are particularly sensitive to climate change. Here, Flood Zone 2 extends across industrial warehouse units to the east of Murdoch Road in Bilston as well as across large sections of Coseley Road and adjoining residential streets to the south. It should be noted that there are no detailed models available for the Bilston or Darlaston Brooks, and modelling may be required to confirm the risk to sites within the vicinity of these watercourses.

The FMfP's Flood Zones do not cover Ordinary Watercourses. However, the EA's Risk of Flooding from Surface Water mapping can be used as an indication of fluvial flood risk from these smaller watercourses. As such, the Smestow Brook at Compton and Tettenhall is sensitive to climate change as flood extents increase significantly from the 1% AEP event to the 1% AEP plus 40% climate change event. Equally, the Waterhead Brook at Moseley Green is also sensitive to climate change.

4.5.2 Impact of climate change on surface water flood risk

The latest climate change allowances have been applied to the Environment Agency's Risk of Flooding from Surface Water dataset to understand the impact of climate change on surface water flooding (as well as for smaller watercourses which are not included in the Flood Zones). The uplifts applied for the 2070s epoch are detailed in Table 4-2.

The areas of Wolverhampton most sensitive to climate change, assessed using the change between the 1% AEP event and the 1% AEP plus 40% climate change event, are the residential areas of Bilston, Dunstall Hill, Ettingshall, Pendeford, Penn, and Wednesfield.i

It should be noted that the Environment Agency's Risk of Flooding from Surface Water dataset may not account for local drainage features such as drains and culverts, which may change the risk profile of a given area. These climate change outputs should be used to give an indication of the likely sensitivity of a site to climate change, but more detailed work,

possibly including surface water modelling, will be required as part of a site-specific FRA to confirm the risk to sites where these outputs suggest there is a risk.

4.5.3 Impact of climate change on groundwater flood risk

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. Flood risk could increase when groundwater is already high or emerged, causing additional overland flow paths or areas of still ponding.

4.6 Requirements for Site-Specific Flood Risk Assessments

When undertaking a site-specific FRA, developers should:

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

4.6.1 Adapting to Climate Change

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

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm for example by building in flexibility to allow future adaptation if needed, such as setting new development back from watercourses.

5 Understanding Flood Risk in Wolverhampton

This section details the different sources of flooding within Wolverhampton. A summary of the key flood risks to the City can be found in Appendix E.

5.1 Historical Flooding

As part of this SFRA, CWC provided one Section 19 report. It should be noted that, at the time of writing this SFRA, other such reports are currently being written for flood events which occurred in 2023. However, these will not be available until the end of 2024. The Section 19 details flooding which occurred in February and June 2020 which were both the result of highly intense storm events. 11 localised incidents of flooding were reported which ranged from water outflowing from highway gullies, rivers breaching banks, sewers surcharging and internal property flooding. During both events, rainfall gauges across the Midlands varied significantly, with the total gauged rainfall for a 24-hour period reaching over 37.2mm and over 43mm for the February and June 2020 storm events, respectively. The areas impacted during these flood events include Wood End, Bushbury, Oxley, Compton and Ashmore. In February 2020, there were 19 reports of internal property flooding whilst in June 2020, there were 11 internal property flooding incidents.

Historic flooding incident data provided by Staffordshire County Council shows there are spatial clusters of flooding which occurred along Primrose Avenue in Moseley Green as well as along Compton Road and Clark Road in Compton. Where data was recorded for the flooding in Compton, these incidents occurred in June 2020 and were caused by a range of issues including sewers surcharging, overflow of highway drainage and overtopping from the local brooks. Although the data for Primrose Avenue does not include the date of the flooding, it is likely this data corresponds to the information provided in the aforementioned Section 19 report which specifically mentions six properties were internally flooded along Primrose Avenue during the June 2020 flood event.

The EA's historic flood map and recorded flood outlines datasets have been assessed which show no records of historic flooding within CWC boundaries.

5.2 Topography, Geology, and Soils

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

5.2.1 Topography

Figure 5-1 shows 1m resolution LiDAR data which illustrates the topography of Wolverhampton. Elevations in the west of the City along the Smestow Brook are as low as

approximately 92m AOD at Castlecroft. Maximum elevations of approximately 220m AOD are located at the Cinder Hill Black Country Geosite at Woodcross in the south of Wolverhampton. The areas of Goldthorn Park and Goldthorn Hill in the south of the City have peak elevations of around 180m AOD, and slope to elevations of around 125m AOD to the west at Merryhill, and 130m AOD - 140m AOD in the east at Bilston.

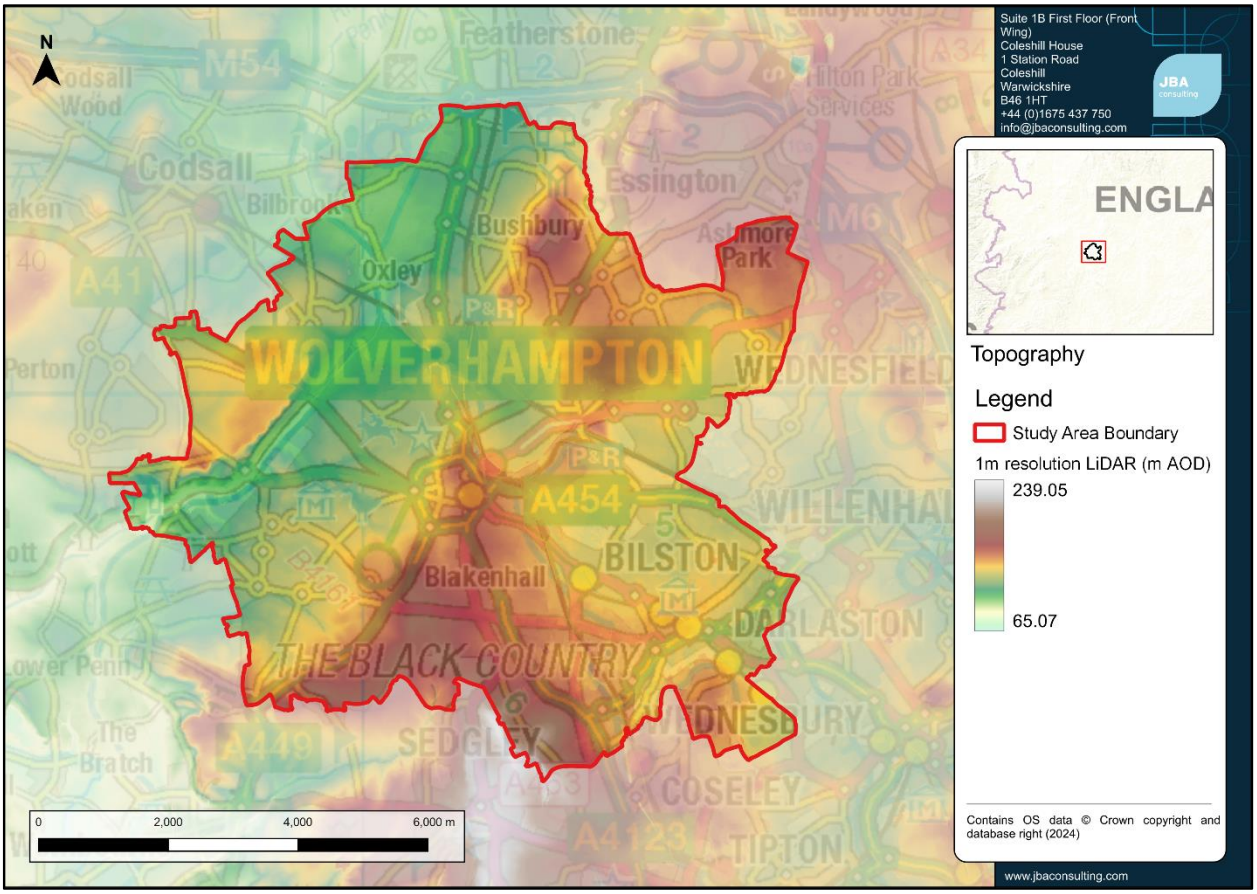


Figure 5-1: Study area topography

5.2.2 Geology and soils

Bedrock geology at the site is predominantly sedimentary rock, as seen in Figure 5-2, where there is some variation between rock type and age. Within the study area bedrock consists of:

- Ludlow rock consisting of mudstone, siltstone, and sandstone;
- Pennine and South Wales lower coal measures formations consisting of mudstone, siltstone, sandstone, coal, ironstone, and ferricrete;
- Pennine and South Wales middle coal measures formations consisting of mudstone, siltstone, sandstone, coal, ironstone, and ferricrete;
- Silurian Rock consisting of limestone, mudstone, and calcareous mudstone
- Triassic Rock consisting of interbedded sandstone and conglomerate;

- Unnamed igneous intrusion (Carboniferous to Permian) consisting of mafic igneous rock;
- Warwickshire group consisting of siltstone and sandstone, with subordinate mudstone.

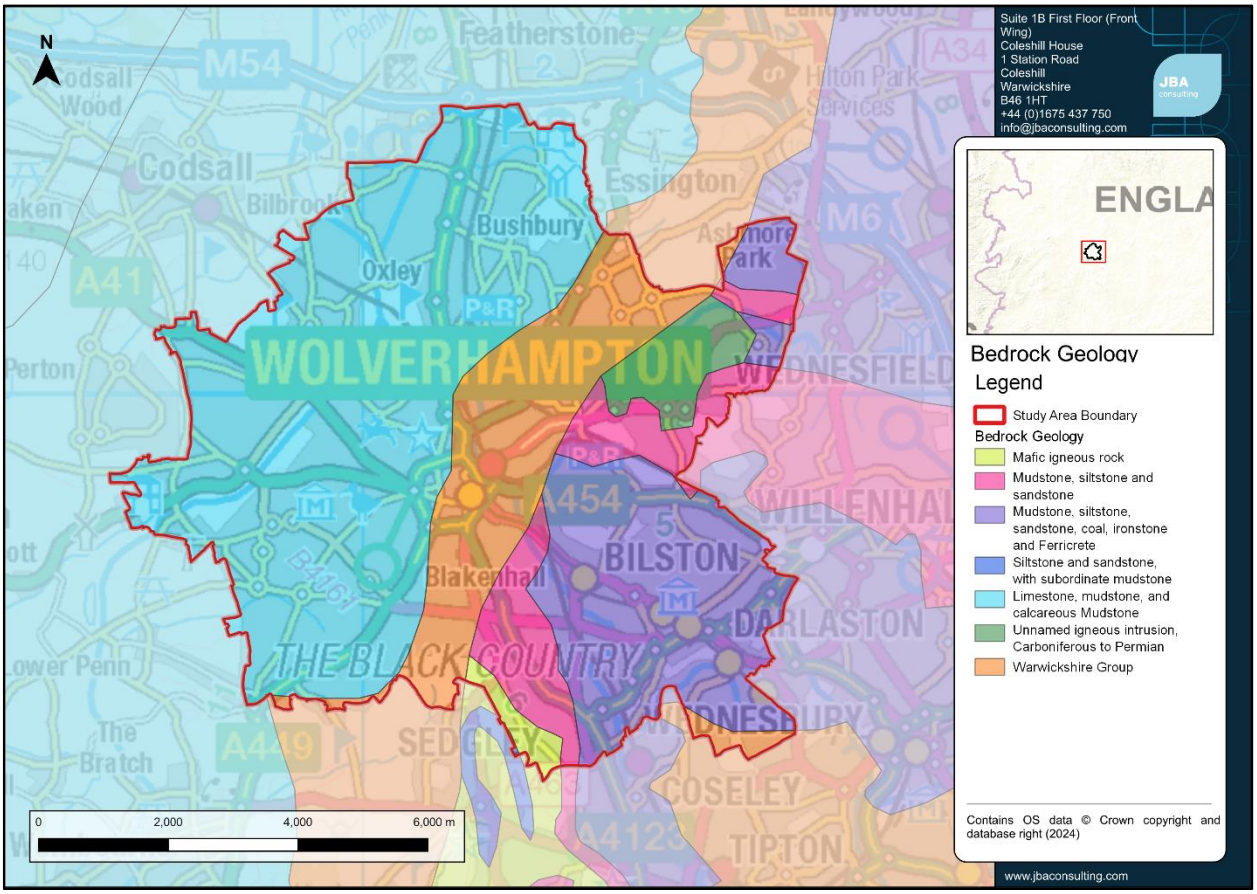


Figure 5-2: Bedrock geology at the study area

Superficial geology at the site is predominantly till, that is focused in the central area from the south-west to the north-east, as seen in Figure 5-3. Within the study area, superficial geological deposits consist of:

- Alluvium;
- Glacial sand and gravel;
- Undifferentiated river terrace deposits;
- Till.

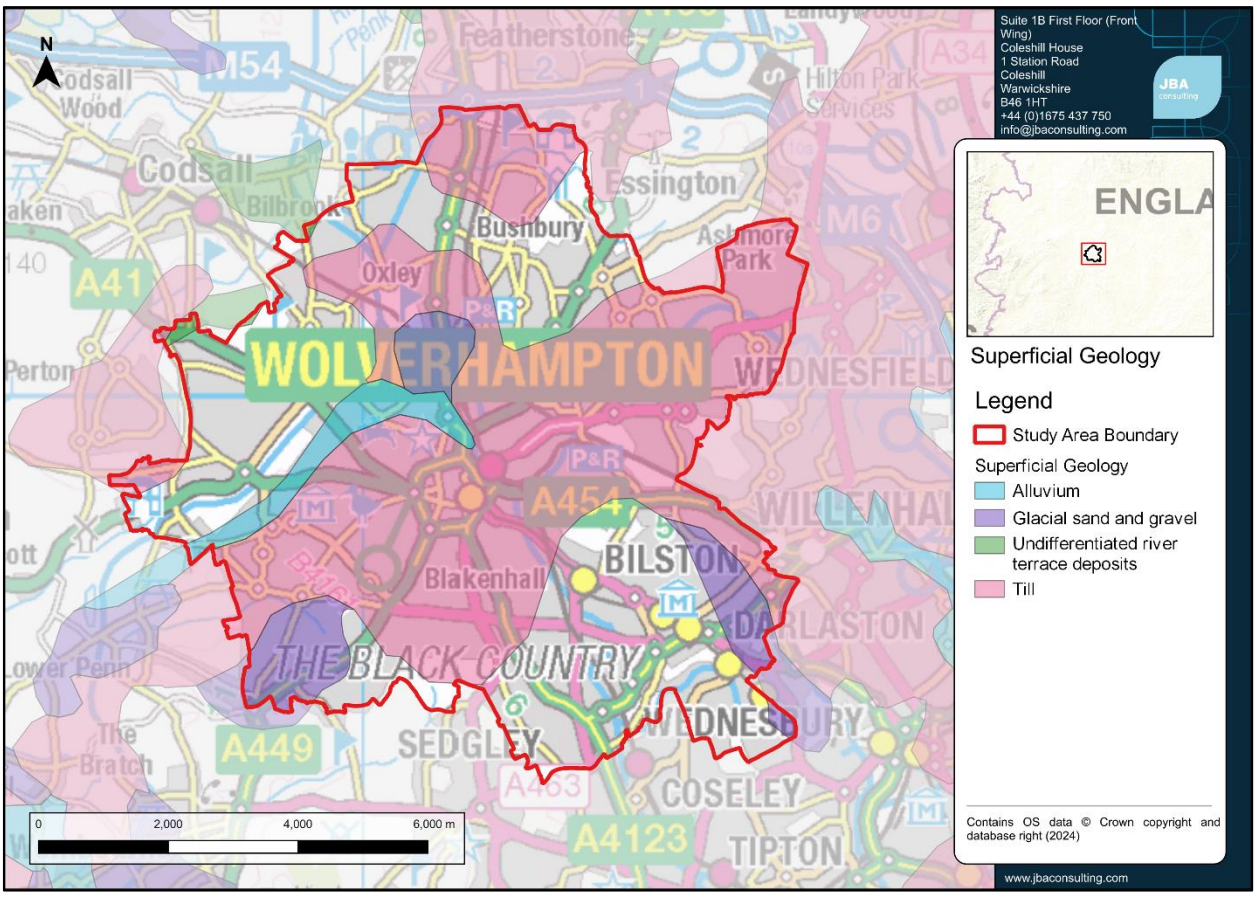


Figure 5-3: Superficial geology at the study area

Using the LandIS Soilscapes, the study area predominantly consists of slowly permeable, seasonally wet, slightly acidic but base rich loamy and clayey soils (Soilscape18). Soils within the study area are:

- Freely Draining, slightly acidic loamy soils (Soilscape6);
- Slightly acidic, loamy and clayey soils with impeded drainage (Soilscape8);
- Freely draining, slightly acidic sandy soil (Soilscape10);
- Naturally wet, very acidic, sand and loamy soils (Soilscape15);
- Slowly permeable, seasonally wet, acidic loamy and clayey soils (Soilscape17);
- Slowly permeable, seasonally wet, slightly acidic but base rich loamy and clayey soils (Soilscape18);
- Loamy soils with naturally high groundwater (Soilscape22).

5.3 Hydrology

The Main Rivers that flow through Wolverhampton are the Smestow Brook and Darlaston Brook, which are partially culverted, as well as an unnamed culverted tributary of the River Tame. These can be seen in Figure 1-2. There are several other watercourses, which are either partially or completely culverted, that flow through Wolverhampton which are listed below and can be seen in Figure 1-3:

- River Penk (becomes a Main River further downstream outside of Wolverhampton)
- Waterhead Brook (becomes a Main River further downstream outside of Wolverhampton)
- Pendeford Brook
- Graiseley Brook
- Waddens Brook
- Merryhill Brook
- Bilston Brook
- Oxley Brook
- Ettingshall Brook
- Finchfield Brook (also known as Castlecroft Brook)
- Penn Brook

Additionally, there are six canals within Wolverhampton, as seen in Figure 1-4. These are listed as follows:

- The Birmingham Canal Navigations;
- Bradley Arm of the Birmingham Canal Navigations;
- Shropshire Union Canal;
- Staffordshire and Worcestershire Canal,
- Walsall Canal;
- Wryley and Essington Canal;

5.4 Fluvial Flood Risk

Hydraulic modelling of the Smestow Brook (2012) suggests the areas with high fluvial flood risk in CWC are along the Smestow Brook in the west of the City between Castlecroft and Aldersley. Waddens Brook (2017) hydraulic modelling suggests land in in the north of Bilston between Stowheath Lane and The Keyway (A454) are at high fluvial flood risk. These extents are similar to those of the EA's FMfP Flood Zones. The only formal flood defences within Wolverhampton, according to the AIMS Spatial Flood Defences dataset, are located along the Smestow Brook at, and in close proximity to, the Dunstall Water Bridge in Aldersley. The Flood Zones also suggest the areas in close proximity to the Waterhead Brook (feeding into the River Penk), where topography tends to be the lowest, are at high fluvial flood risk. These Flood Zones also show fluvial flood risk to extend across an area to the south and east of the Black Country Route (A463).

The Flood Zone maps for CWC are shown in Appendix A mapping. These maps show Flood Zones 2 and 3 where the Flood Zones reflect the Environment Agency's Flood Map for Planning Flood Zones at the time of preparing the SFRA.

Flood Zone mapping (where more detailed modelling investigations are not available) has only been prepared for watercourses with a catchment greater than 3km^2. Therefore, whilst smaller watercourses may not be shown as having fluvial flood risk on the flood risk

mapping, it does not necessarily mean there is no fluvial flood risk. As part of a site-specific Flood Risk Assessment, the potential flood risk and extent of Flood Zones should be refined for these smaller watercourses and this information used as appropriate to perform the Sequential and Exception Tests. The Risk of Flooding from Surface Water (RoFSW) mapping can be used to indicate where this is likely to be an issue.

5.5 Culverted Watercourses

Many of the watercourses in Wolverhampton have been heavily modified over time. Watercourses may have been piped (culverted), straightened, narrowed, disconnected from their floodplains by land raising and the shape of the channel may have been artificially altered. There is a residual, but real flood risk from such watercourses should they become blocked, surcharge or collapse. This might cause localised flooding where a culvert screen becomes partially blocked or major flooding if a culvert becomes completely blocked, overwhelmed by the amount of water or if it fails.

Where a watercourse passes through a development site an opportunity exists to restore the watercourse to a more natural condition, for example by opening culverts, reinstating a natural, sinuous channel and restoring functional floodplain (places where water is designed to flow or be stored at times of flood). Doing so can help to reduce flood risk, improve water quality, benefit biodiversity and add amenity value.

Throughout Wolverhampton, there is an estimated 30.4km of culverted watercourses. There is an extensive network of culverted Ordinary Watercourses across Wolverhampton on minor watercourses and under highways. The LLFAs hold some data on culverted watercourses, but given how extensive the network is, detailed records do not exist for every culvert. The approximate spatial locations of culverts that are known about can be found in Appendix A within the Interactive mapping.

Where a watercourse passes through a site (open or culverted) the developer should demonstrate they have considered the above matters in developing their proposals for development. CWC have provided a dataset of mapped culverts present within the study area at the time of writing which are shown within Figure 5-4.

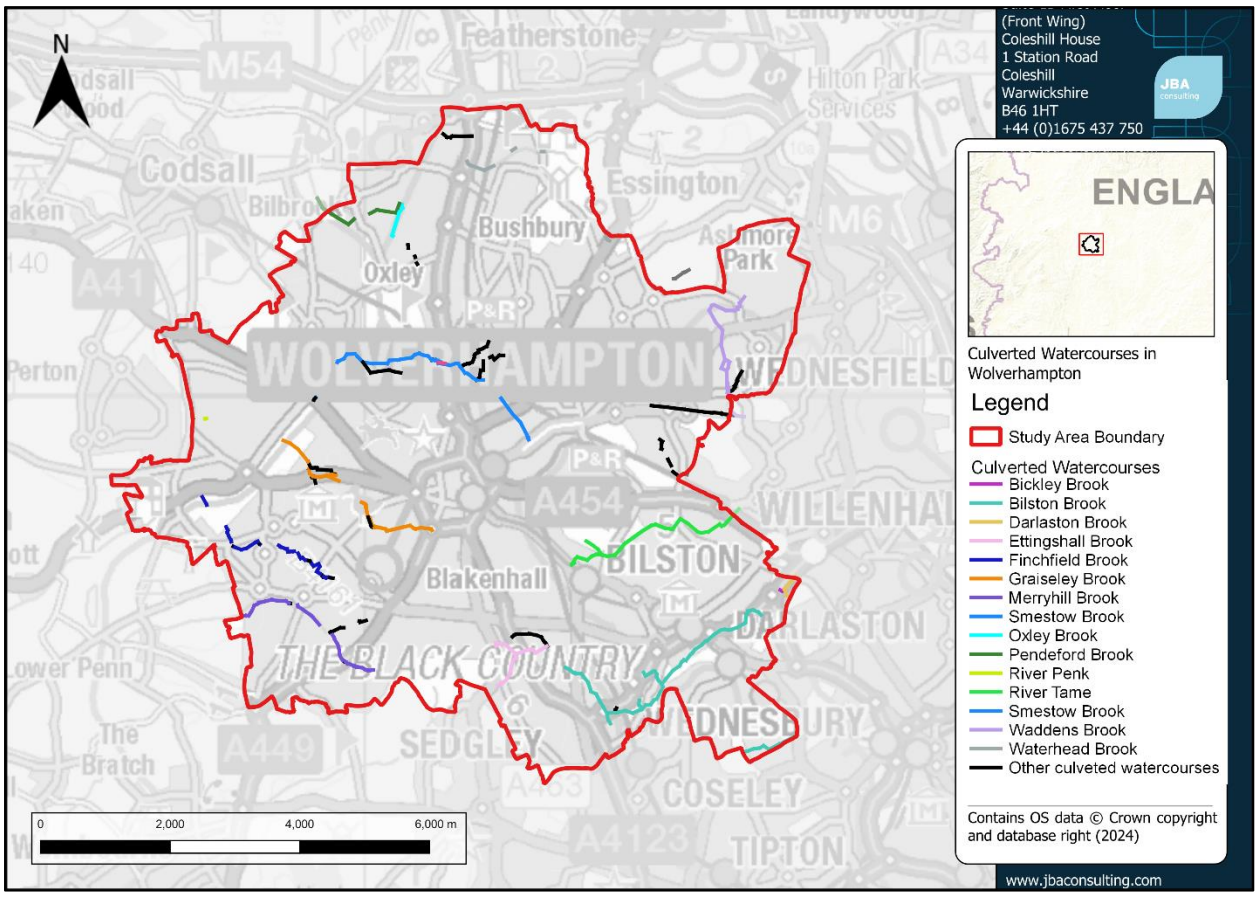


Figure 5-4: Culverted watercourses in the study area

In 2021, CWC, in conjunction with Sandwell and Dudley Borough Councils, carried out culvert blockage modelling covering sections of the Waterhead Brook and Graiseley Brook. Flood extents during the 10%, 1% and 0.1% AEP flood events with 100% blockage impact the following locations:

- Greenfield Lane, Northycote Lane, and residential offshoots from these roads to the north of the Waterhead Brook in Moseley Green.
- Greenacres Avenue, Grassy Lane and Cannock Road in Bushbury where the Waterhead Brook flows along part of the Wolverhampton boundary.
- Compton Road, Clark Road, Ross Close, Glen Court, Avenue Road and Wyvis Close in Compton where the Graiseley Brook is culverted beneath Compton Road (A545).

The Councils should be contacted for further information pertaining to this modelling.

5.6 Surface water flooding

Flooding from surface water runoff (or 'pluvial' flooding) is usually caused by intense rainfall that may only last a few hours and usually occurs in lower lying areas, often where the natural (or artificial) drainage system is unable to cope with the volume of water. Surface water flooding problems can be inextricably linked to issues of poor drainage, or drainage

blockage by debris, and sewer flooding. This can be made worse by local insufficient drainage capacity. Where surface water sewers discharge is directly to a watercourse, locally high-water levels can cause back-up and prevent water from draining through the drainage system.

The Environment Agency's Risk of Flooding from Surface Water mapping (RoFSW) shows that a number of communities are at risk of surface water flooding. Areas at particularly high risk include Pendeford, Perry Hall, Ettingshall and land between Dunstall Hill and Low Hill. The mapping shows that surface water predominantly follows topographical flow paths of existing watercourses and can pond in low-lying areas.

Surface water flood extents follow the topography, draining into the open channels of main rivers, canals and ordinary watercourses. Additionally, there are areas of pooling within topographically low areas. Some particularly prominent flow paths are situated along Cannock Road at Fallings Park, Parkfield Road at Ettingshall, First Avenue at Low Hill and Ward Grove and Dovedale Road at Ettingshall Park. There are also significant areas of ponding along Spring Road in Ettingshall, off Warstones Crescent in Penn, at Guy Avenue in Low Hill, and north of Chillington Street to the south-east of Wolverhampton city centre. For CWC, surface water predominantly flows into the canals, and open channel watercourses such as the Smestow Brook, with flow paths similar to Wolverhampton's culverted watercourses. The RoFSW mapping for CWC can be found in Appendix A.

According to the Wolverhampton SWMP, produced by CWC in 2012, there are up to 7,900 properties at risk of surface water flooding in the City. However, CWC consider there to be no significant areas of surface water flood risk within Wolverhampton as the implementation of new drainage infrastructure in response to past flood events have resulted in no repeat incidences of flooding.

5.7 Groundwater Flooding

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

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

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

Mapping of groundwater flood risk has been based on the JBA Groundwater Emergence mapping dataset. The dataset is a strategic scale map showing groundwater flood areas on a 5m square grid and illustrates where groundwater may emerge (although not where groundwater may flow to and cause flooding after emergence). The data is indicative and

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

The data indicates that groundwater levels differ greatly with the eastern half of the study area predominantly having a negligible risk from groundwater due to the local geological deposits, though there are pockets of areas at risk. The western half of the study area is at greater risk from groundwater emergence. Land in close proximity to the Smestow Brook, Waterhead Brook, and the culverted Graiseley and Merryhill Brooks, are at the highest risk, where groundwater levels are within 0.025m of the ground surface. These are also areas which are at high risk of surface water flooding, according to the RoFSW dataset. Areas in Low Hill, Tettenhall and Goldthorn Hill are where groundwater levels are between 0.025m and 0.5m below the ground surface. These areas are underlain with Triassic Rocks (undifferentiated).

Mapping of the district has been provided showing the risk from groundwater flooding dataset and is shown in Appendix A. Notable areas at higher risk are:

- Areas along the Smestow Brook;
- Bushby;
- Oxley;
- Pendeford;
- Penn;
- Areas along the Waterhead Brook.

Whilst the likelihood of groundwater flooding in Wolverhampton is relatively low, onsite ground investigations should be utilised to confirm the risk of ground water emergence. The British Geological Survey provides further information on groundwater flooding on their website.

5.8 Flooding from Canals

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

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

Flooding from a breach of a canal embankment is largely dictated by canal and ground levels, canal embankment construction, breach characteristics and the volume of water within the canal that can discharge into the lower lying areas behind the embankment. The volume of water released during a breach is dependent on the pound length (i.e. the

distance between locks) and how quickly the operating authorities can react to prevent further water loss, for example by the fitting of stop boards to restrict the length of the canal that can empty through the breach, or repair of the breach. The Canal and River Trust monitor embankments at the highest risk of failure and have equipment in place to steam breaches in the highest risk locations.

There are six canals within the study area, shown in Figure 5-5: Canal breach and overtopping locations, which are the Birmingham Canal Navigations, Bradley Arm of the Birmingham Canal Navigations, Shropshire Union Canal, Staffordshire and Worcestershire Canal, Walsall Canal, and the Wryrley and Essington Canal.

Records provided by the Canal and River Trust show that there have been three recorded breaches and four recorded instances of overtopping, show in Figure 5-5. All breaches and instances of overtopping occurred along the Staffordshire and Worcestershire Canal. The recorded breaches occurred in 1895 (cause unknown), 1981 (Smestow Brook culvert failure), and 1987 (Graiseley Brook culvert failure). For overtopping, two instances from the 20th July 2007 to 22nd July 2007 occurred, with a further two instances lasting a day on the 1st August 2012.

There are several locations along the Birmingham Canal Navigations between Cannock Road and Wolverhampton Racecourse where the canal is perched. This means the canal is raised above the ground level of the surrounding land, which increases the risk of flooding from the canal in this area.

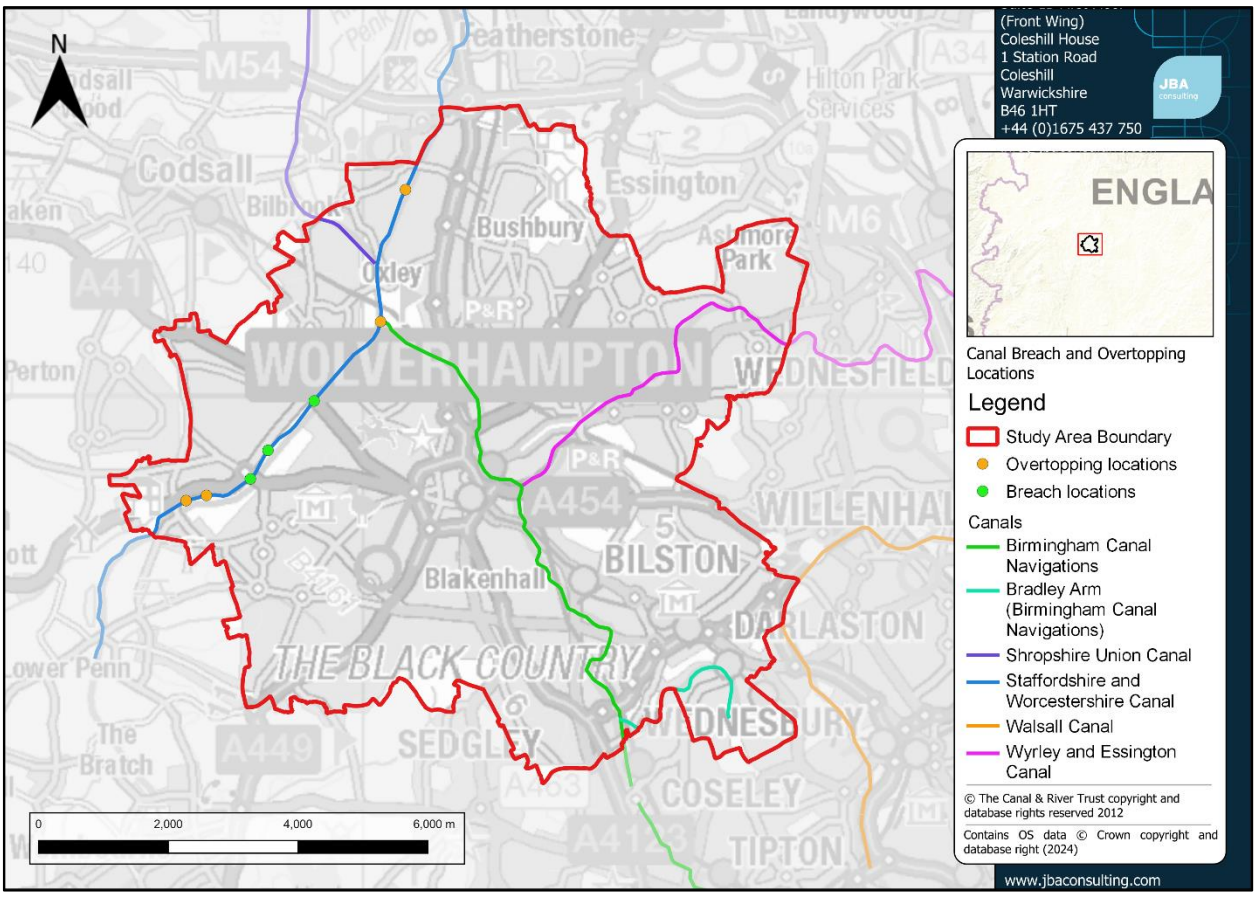


Figure 5-5: Canal breach and overtopping locations

5.9 Flooding from Sewers

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

Since 1980, the Sewers for Adoption guidelines mean that new surface water sewers have been designed to have capacity for a rainfall event with a 3.3% AEP chance of occurring in any given year, although until recently this did not apply to smaller private systems. This means that sewers will be overwhelmed in larger rainfall and flood events. Existing sewers can also become overloaded as new development adds to the surface water discharge to their catchment, or due to incremental increases in roofed and paved surfaces at the individual property scale (urban creep). Sewer flooding is therefore a problem that could occur in many locations across the study area.

The Severn Trent Drainage and Wastewater Management Plan (DWMP) was published in March 2023. The plan states planning objectives for internal sewer flooding risk is a high priority in the catchment served by the Barnhurst Wastewater Treatment Works to the west of Oxley. Storm overflow is considered a high priority for the catchment served by Trescott which is located in Perton to the west of Wolverhampton. The risk of internal flooding in a 1 in 50-year storm as well as storm overflow performance are classed as high priorities in the

catchment served by Coven Heath which partly drains suburbs in the north of Wolverhampton including Fordhouses and Moseley Green.

Severn Trent Water records sewer flooding on their Historic Flooding Incidents Registers. This database records incidents of flooding relating to public foul, combined or surface water sewers and displays which properties suffered flooding. For confidentiality reasons this data has been supplied on a postcode basis. The datasets were supplied on the 31/07/2024. STW are the water company responsible for the management of public sewers in the study area.

Records show sewer flooding is widespread across Wolverhampton, with recorded incidents across 14 different 3/4 digit postcode areas between 11th June 1997 and 24th October 2023. The most incidents occurred on 6th July 2006, with 34 separate incidents reported. There are spatial clusters of sewer flooding in Aldersley, Claregate, Tettenhall, Castlecroft, Ettingshall Park and Fordhouses.

Table 5-1 details the number of sewer flooding incidents by postcode which have been recorded by Severn Trent Water between June 1997 and October 2023.

Table 5-1: Severn Trent Water recorded sewer flooding incidents in Wolverhampton (1997 - 2023)

Postcode	Recorded flood incidents
DY3	0
WV1	20
WV12	1
WV6	92
WV11	52
WV14	10
WV9	0
WV13	3
WV8	3
WV3	29
WV10	42
WV2	7
WV98	0
WV4	47
Total: 306	

It is important to recognise the Hydraulic Sewer Flooding Risk Register represents a snapshot in time and will get outdated with properties being added to the register following rainfall events, whilst risk will be reduced in some locations by capital investment in increasing the capacity of the network. As such the summary of the Hydraulic Sewer Flooding Risk Register in this report is not a comprehensive ‘at risk register’.

5.10 Flooding from Reservoirs

Reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975 and are on a register held by the Environment Agency. The level and standard of inspection and maintenance required under the Act means that the risk of flooding from reservoirs is very low.

Flooding from reservoirs occurs following partial or complete failure of the control structure designed to retain water in the artificial storage area. Reservoir flooding is very different from other forms of flooding; it may happen with little to no warning and evacuation will need to happen immediately. The likelihood of such flooding is difficult to estimate but is extremely low compared to flooding from other sources. It may not be possible to seek refuge upstairs from floodwater as buildings could be unsafe or unstable due to the force of water from the reservoir breach or failure.

The Environment Agency hold mapping showing what might happen if reservoirs fail. Developers and planners should check the Long-Term Risk of Flooding website before using the reservoir data shown in this SFRA to make sure they are using the most up to date mapping. The Environment Agency provide two flooding scenarios for the reservoir flood maps: a “dry day” and a “wet day”. The “dry day” scenario shows the predicted flooding which would occur if the dam or reservoir fails when rivers are at normal levels. The “wet day” scenario shows the predicted worsening of the flooding which would be expected if a river is already experiencing an extreme natural flood.

At the time of writing, only Dry Day scenario flood extents were available within the study area. It is likely this is due to the influence of the Birmingham Canal Navigations where flows do not increase as a result of rainfall events, which is why the Wet Day flood extent is not larger than the Dry Day flood extent. There is only one Dry Day extent that affect the study area, the Sedgely Beacon Reservoir, as detailed in Figure 5-6, it is likely to also affect the study area in the Wet Day scenario.

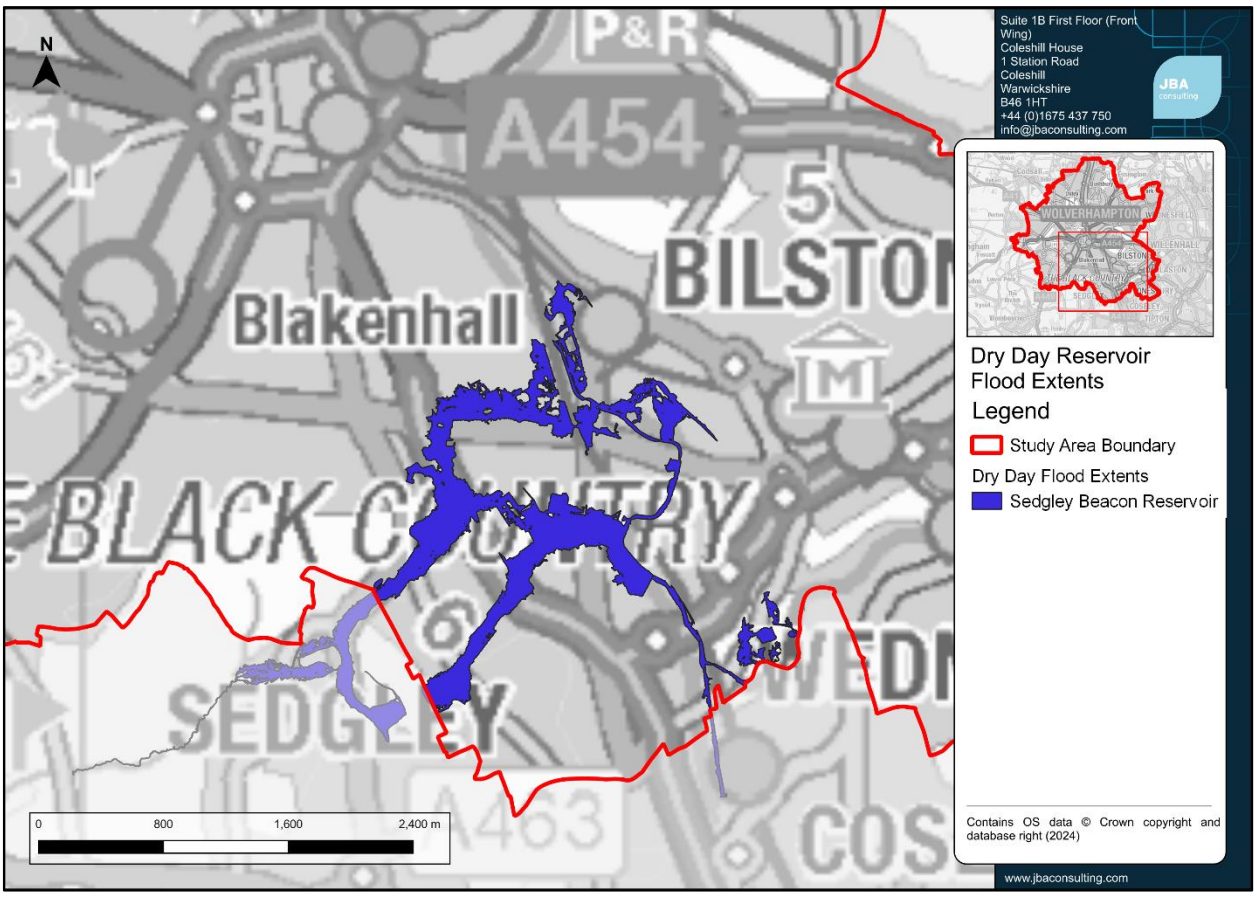


Figure 5-6: Dry Day reservoir extents

5.11 Flood Alerts and Flood Warnings

The Environment Agency is the lead organisation for providing warnings of river flooding. Flood Warnings are supplied via the Flood Warning System (FWS) service to homes and businesses. These areas are generally larger than the FMfP Flood Zones as flooding can indirectly impact additional locations due to disruption resulting in access and egress issues. . Flood Alert Areas and Flood Warning Areas within the study area are shown within Figure 5-7.

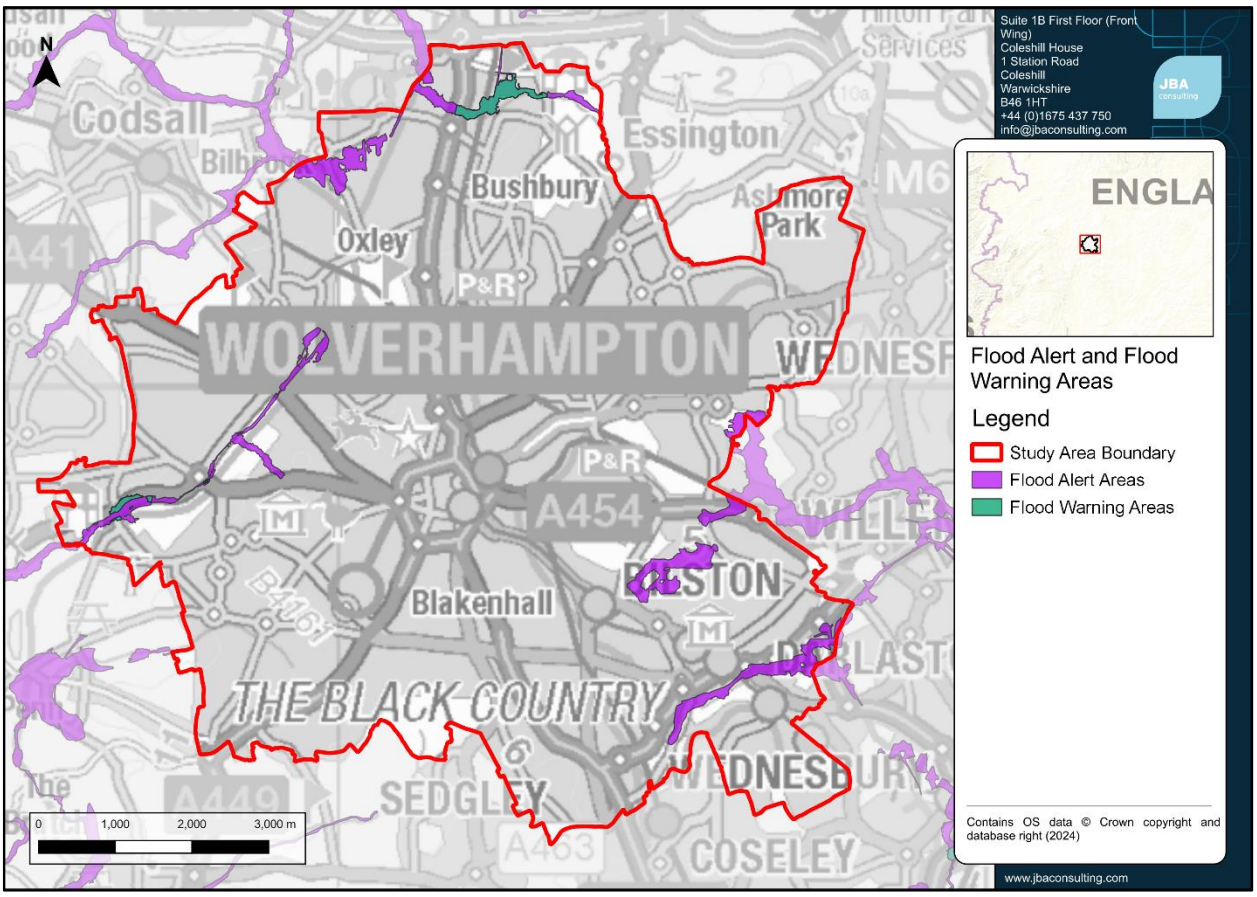


Figure 5-7: Flood Alert Areas and Flood Warning Areas in the study area

Within the study area, there are three Flood Alert Areas, which are:

- Upper Tame (033WAF303)
- River Sow and River Penk (033WAF312)
- River Stour and Smestow Brook in the Black Country and South Staffordshire (033WAF330)

There are two Flood Warning Areas within Wolverhampton. These are detailed as follows:

- Smestow Brook at Wightwick (033FWF3SMES01)
- Waterhead Brook at Bushbury, Wolverhampton (033FWF3WATERHEAD)

6 Flood Alleviation Schemes and Assets

6.1 Asset Management

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

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

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

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

6.2 Standards of Protection

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

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

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

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

6.3 Maintenance

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

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

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

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

Formal structural defences are given a rating based on a grading system for their condition. A summary of the grading system used by the EA for condition is provided in Table 6-1.

Table 6-1: Grading system used by the EA to assess flood defence condition

Grade	Rating	Description
1	Very good	Cosmetic defects that will have no effect on performance.
2	Good	Minor defects that will not reduce the overall performance of the asset.
3	Fair	Defects that could reduce the performance of the asset.
4	Poor	Defects that would significantly reduce the performance of the asset. Further investigation required.
5	Very poor	Severe defects resulting in complete performance failure.

6.4 Major Flood Risk Management Assets in Wolverhampton

The EA provide a dataset called the 'Reduction in risk of flooding from rivers and sea' which provides areas that are offered some level of reduced flood risk from defences, but with no defined SoP.

A developer can enter their address on the EA website here to get information about their specific site and request flood risk assessment data for planning (also known as product 4).

In Wolverhampton, a small number of areas are shown to have reduced flood risk due to defences. These areas include a small section of land adjacent to Darlaston Brook along the eastern boundary of Wolverhampton, as well as small sections along the Smestow Brook and Staffordshire and Worcestershire Canal in Castlecroft and Tettenhall, respectively. The most notable area benefitting from defences is land to the south-east of the A463 which covers sections of Coseley Road, Horning Drive, Broadmoor Road, Broad Lane and Cairnhill Drive. The Aldersley spillway is located approximately 20m downstream of the Dunstall Water Bridge along the Smestow Brook. There are also several walls along some sections of the Smestow Brook at Dunstall Water Bridge and 130m downstream of this structure. Natural and engineered high ground is present along the banks of the Smestow Brook and Darlaston Brook.

The EA 'AIMS' (Asset Information Management System) flood defence dataset gives further information on all flood defence assets within Wolverhampton and is displayed in Appendix A mapping. Table 6-2 details the locations which benefit from flood defences and their associated design SoP.

Table 6-2: Locations shown in the EA 'AIMS' dataset

Watercourse	Location	Type	Design SoP	Condition Rating (1-5)
Darlaston Brook	Both banks from Murdoch Road to A4444. Left bank only between the A4444 to the point at which it is culverted adjacent to the A463.	Natural High Ground	25 years	Unknown
Darlaston Brook	Right bank only between the A4444 to the point at which it is culverted adjacent to the A463.	Engineered High Ground	25 years	Unknown
Smestow Brook	Both banks from Dunstall Water Bridge to the south of Bridgnorth Road in Castlecroft.	Natural High Ground	5-25 years	Unknown / 3
Smestow Brook	Small section of right bank at College View, Tettenhall.	Engineered High Ground	25 years	Unknown
Smestow Brook	Various sections	Wall	0-5 years	Unknown / 3

Watercourse	Location	Type	Design SoP	Condition Rating (1-5)
	along both banks to the east of Aldersley Road, including across Dunstall Water Bridge.			
Smestow Brook	Small section of watercourse to the north of Dunstall Water Bridge.	Spillway	Unknown	Unknown
Smestow Brook	Left bank to the south of Dunstall Water Bridge. Both banks from Main Road to the north-west of Stapleford to the west of Frisby on the Wreake, and left bank to west of Brooksby	Engineered High Ground	5 years	Unknown

6.5 Actual and Residual Flood Risk

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

6.5.1 Actual Risk

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

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

- The level of protection afforded by existing defences might be less than the appropriate standards and hence may need to be improved if further growth is contemplated.
- The flood risk management policy for the defences will provide information on the level of future commitment to maintain existing standards of protection. If there is a conflict between the proposed level of commitment and the future needs to support growth, then it will be a priority for this to be reviewed.
- The standard of safety must be maintained for the intended lifetime of the development. Over time the effects of climate change will erode the present-day

standard of protection afforded by defences and so commitment is needed to invest in the maintenance and upgrade of defences if the present-day levels of protection are to be maintained and where necessary, land secured and safeguarded that is required for affordable future flood risk management measures.

- By understanding the depth, velocity, speed of onset and rate of rise of floodwater it is possible to assess the level of hazard posed by flood events from the respective sources.

6.5.2 Residual Risk

Residual risk is the risk that remains after the effects of flood risk infrastructure have been taken into account. It is important that these risks are quantified to confirm that the consequences can be safely managed. The residual risk can be:

- The effects of a larger flood than defences were designed to alleviate (the 'design flood'). This can cause overtopping of flood banks, failure of flood gates to cope with the level of flow or failure of pumping systems to cope with the incoming amount of water. This can cause culverted watercourses to become overwhelmed.
- Failure of the defences or flood risk management measures, such as breaches in embankments or walls, failure of flood gates to open or close, failure or blockage of culverted watercourses or failure of pumping stations.

Parts of the Smestow Brook at, or in close proximity to, the Dunstall Water Bridge at Aldersley in west Wolverhampton rely on formal flood defences for protection against fluvial flooding. Consequently, there are areas vulnerable to rapid inundation in the event of a breach / failure. The assessment of the residual risk should take into account:

- The flood hazard, depth and velocity that would result from overtopping or breach of defences. Flood gate or pumping station failure and/ or culvert blockage (as appropriate). The Environment Agency can provide advice at site-specific development level for advice on breach/ overtopping parameters for flood models.
- The design of the development to take account of the highest risk parts of the site e.g. allowing for flood storage on parts of the site and considering the design of the development to keep people safe and / or ensuring all sleeping accommodation is above the flood level.
- Flood Warning and Evacuation Plans for users of the site and emergency services in the event of a flood. These plans must also consider the risk of culvert blockages. If a culverted section of an EA Main River is present within, or in close proximity to, the site, an 8-10m easement area will be required from the channel. Although ordinary watercourses do not fall under the management of the EA and are therefore not subject to this requirement, it is recommended that CWC, as the LLFA for Wolverhampton, should adopt the same approach for ordinary watercourses.

7 Cumulative Impact of Development, Schemes, and Strategic Solutions

7.1 Introduction

Cumulative impacts are the combined effects of multiple impacts from individual sites and/or a number of smaller sites within a locality. Under the NPPF, strategic policies and their supporting SFRAs, are required to 'consider cumulative impacts in, or affecting, local areas susceptible to flooding' (para 166).

When allocating land for development, consideration should be given to the potential cumulative impact on flood risk within a catchment. Development has the potential to increase the impermeable area within a catchment, which if not properly managed, can cause loss of floodplain storage, increased volumes and velocities of surface water runoff, and result in heightened downstream flood risk. Whilst individual development with appropriate site mitigation measures should not result in measurable local effects with respect to hydrology and flood risk, the cumulative effect of multiple developments may be more severe at sensitive downstream locations in the catchment. Locations where there are existing flood risk issues with people, property or infrastructure will be particularly sensitive to cumulative effects.

The cumulative impact should be considered throughout the planning process, from the allocation of sites within the Local Plan, to the planning application and development design stages.

Site-specific FRAs must consider the cumulative impact of the proposed development on flood risk within the wider catchment area if there are potentially material effects.

As part of the Level 1 SFRA, an assessment of the cumulative effects within catchments in the Wolverhampton boundary has been undertaken.

7.2 Cross-Boundary Issues

The topography of the district means that a number of major watercourses such as the River Tame and River Penk flow through the study area and into neighbouring authorities. As such, future development, both within and outside Wolverhampton can have the potential to affect flood risk to existing development and surrounding areas, depending on the effectiveness of SuDS and drainage implementation. Wolverhampton has boundaries with the following Local Authorities, which can be seen in Figure 1-1:

- Walsall Metropolitan Borough Council
- Sandwell Metropolitan Borough Council
- Dudley Metropolitan Borough Council
- South Staffordshire District Council

Development control should ensure that the impact on receiving watercourses from development in Wolverhampton has been sufficiently considered during the planning stage

and appropriate development management decisions put in place to ensure there is no adverse impact on flood risk or water quality.

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

The neighbouring authorities were contacted for information on their site allocations, to determine where development in neighbouring authorities may have an impact on flood risk within the City of Wolverhampton Council boundary.

7.3 Cumulative Impact Assessment (CIA)

As agreed in the meeting on 10th June 2024, the CIA is being undertaken in conjunction with Sandwell and Dudley Councils and is due to be issued after this version of the report has been released. This section will be updated in a later version once the CIA has been completed.

Historic flood risk, surface water flood risk, potential development, predicted flood risk from increased runoff upstream and sewer flooding were all considered during the assessment, and each catchment was ranked within each of these categories. The individual rankings were combined to give and overall risk ranking for each catchment, and these were then allocated a Red, Amber, Yellow or Green rating corresponding to high-risk, medium-risk, lower-risk and low-risk overall. More detailed information on the methodology, assumptions, considerations and results of the Cumulative Impact Assessment will be provided upon completion of the CIA.

8 Guidance for Developers

8.1 Principles for New Developments

Apply the Sequential and Exception Tests

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

Developers should also apply the sequential approach to locating development within the site. The following questions should be considered:

- can risk be avoided through substituting less vulnerable uses or by amending the site layout?
- can it be demonstrated that less vulnerable uses for the site have been considered and reasonably discounted?
- can layout be varied to reduce the number of people or flood risk vulnerability or building units located in higher risk parts of the site?

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

Developers should consult with the Environment Agency, City of Wolverhampton Council as LLFA, and Severn Trent Water, at an early stage to discuss flood risk including requirements for site-specific FRAs, detailed hydraulic modelling and drainage assessment and design. Developers should also consult the Canal and River Trust who have produced a checklist for developments close to canals. Further details of the planning buffer zones around the Canal and River Trust network can be found here. This dataset is also included within Appendix A mapping.

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

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

Ensure that the development does not increase flood risk elsewhere

Section 9 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 (Section 6.5).

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

Manage the surface water runoff rates of new development

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

Enhance the natural river corridor and floodplain environment through new development

Developments should demonstrate opportunities to create, enhance and link green assets. This can provide multiple benefits across several disciplines including flood risk and biodiversity/ ecology and may provide opportunities to use the land for 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.

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

Wherever possible, developments should seek to help 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 they are contributing towards this vision.

8.2 Requirements for Site Specific Flood Risk Assessments

8.2.1 When is an FRA Required?

Site-specific FRAs are required in the following circumstances:

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

An FRA may also be required for some specific situations:

- If the site may be at risk from the breach of a local defence (even if the site is actually in Flood Zone 1).
- Where evidence of historical or recent flood events have been passed to the LPA.
- In an area of significant surface water flood risk (consult the LLFA for their latest requirements).

8.2.2 Objectives of a Site-Specific FRA

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

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

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

- Standing Advice on Flood Risk (Environment Agency);
- Flood Risk Assessment for Planning Applications (Environment Agency);
- Site-specific Flood Risk Assessment: CHECKLIST (NPPF PPG, Defra);

Guidance for local planning authorities for reviewing flood risk assessments submitted as part of planning applications has been published by Defra in 2015 and is available on the Government website here.

8.3 Local Requirements for Mitigation Measures

8.3.1 Site layout and design

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. Early engagement with CWC, the EA, Severn Trent Water and the Canal and River Trust is advised. The Canal and River Trust have produced a checklist for developments close to canals. Further details of the planning buffer zones around the Canal and River Trust network can be found here. The Canal and River Trust should be notified of any development taking place within these areas. This dataset is also included within Appendix A mapping. The buffer zones include land within 150m of all six canals within Wolverhampton.

The NPPF states that a sequential, risk-based approach should be applied to try to locate more vulnerable land use away from flood zones to higher ground, while more flood-

compatible development (e.g. vehicular parking, recreational space) can be located in higher risk areas. Whether parking in floodplains is appropriate will be based on the likely flood depths and hazard, evacuation procedures and availability of flood warning.

Waterside areas, or areas along known flow routes, can act as Green Infrastructure, being used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives. Landscaping should ensure safe access to higher ground from these areas and avoid the creation of isolated islands as water levels rise. When designing sites, developers should consider the Hierarchy of Drainage, as stated in the PPG, aiming to discharge surface water runoff as high up the drainage hierarchy as reasonably practicable:

1. into the ground (infiltration)
2. to a surface water body
3. to a surface water sewer, highway drain, or another drainage system
4. to a combined sewer

8.3.2 Modification of ground levels

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

Modifying ground levels to raise the land above the required flood level is an effective way of reducing flood risk to a particular site in circumstances where the land does not act as conveyance for flood waters. However, care must be taken as raising land above the floodplain could reduce conveyance or flood storage in the floodplain and could adversely impact flood risk downstream or on neighbouring land. Raising ground levels can also deflect flood flows, so analyses should be performed to demonstrate that there are no adverse effects on third party land or property.

Compensatory flood storage should be provided, and would normally be on a level for level, volume for volume basis on land that does not currently flood but is adjacent to the floodplain (in order for it to fill and drain). It should be in the vicinity of the site and within the red line of the planning application boundary (unless the site is strategically allocated). Guidance on how to address floodplain compensation is provided in Appendix A3 of the CIRIA Publication C624, available to download from the CIRIA website here.

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

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

8.3.3 Raised Floor Levels

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

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

Allocating the ground floor of a building for less vulnerable, non-residential, use is an effective way of raising living space above flood levels. Single storey buildings such as ground floor flats or bungalows are especially vulnerable to rapid rise of water (such as that experienced during a breach). This risk can be reduced by use of multiple storey construction and raised areas that provide an escape route.

Similarly, the use of basements should be avoided. Habitable uses of basements within Flood Zone 3 should not be permitted, whilst basement dwellings in Flood Zone 2 will be required to pass the Exception Test. Access should be situated 300mm above the design flood level and waterproof construction techniques used.

8.3.4 Development and Raised Defences

Construction of localised raised floodwalls or embankments to protect new development is not a preferred option, as a residual risk of flooding will remain. Compensatory storage must be provided where raised defences remove storage from the floodplain.

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

8.3.5 Developer Contributions

In some cases, and following the application of the Sequential Test, it may be appropriate for the developer to contribute to the improvement of flood defence provision that would benefit both proposed new development and the existing local community. Developer contributions can also be made to maintenance and provision of flood risk management assets, flood warning and the reduction of surface water flooding (i.e. SuDS). Where possible, opportunities should be sought to work with other bodies and landowners to encourage and promote implementation of natural flood management measures which will contribute towards delivering a reduction in local and catchment-wide flood risk and the impacts of climate change as well as achieve other wider environmental benefits.

8.4 Resistance and Resilience Measures

The consideration of resistance and resilience measures should not be used to justify development in inappropriate locations. However, having applied planning policy, there will be instances where developments, such as those that are water compatible and essential infrastructure are permitted in high flood risk areas.

In these instances, the above measures should be considered before resistance and resilience measures are relied on. The effectiveness of these forms of measures are often dependant on the availability of a reliable forecasting and warning system and the use of back up pumping to evacuate water from a property as quickly as possible. The proposals must include details of how the temporary measures will be erected and decommissioned, responsibility for maintenance and the cost of replacement when they deteriorate. Available resistance and resilience measures include:

- Permanent barriers which can include built up doorsteps, rendered brick walls and toughened glass barriers.
- Temporary barriers which consist of moveable flood defences which can be fitted into doorways and/or windows. The permanent fixings required to install these temporary defences should be discrete and keep architectural impact to a minimum. On a smaller scale, temporary snap on covers for airbricks and air vents can also be fitted to prevent the entrance of flood water.
- Community resistance measures which include demountable defences that can be deployed by local communities to reduce the risk of water ingress to several properties. The methods require the deployment of inflatable (usually with water) or temporary quick assembly barriers in conjunction with pumps to collect water that seeps through the systems during a flood.
- Flood resilience measures which aim to limit any permanent damage, prevent the structural integrity of the building being compromised and make the clean up after the flood is easier. Interior design measures to reduce damage caused by flooding can include electrical circuitry installed at a higher level and water-resistant materials for floors, walls, and fixtures.

Guidance on flood resilient and flood resistant construction techniques is available on the government website, here.

There are also opportunities for 'change of use' developments to be used to improve the flood resistance and resilience of existing development, which may not have been informed by a site-specific flood risk assessment when it was first constructed.

8.5 Reducing Flood Risk from Other Sources

8.5.1 Groundwater

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

Infiltration SuDS can cause increased groundwater levels and subsequently may increase flood risk on or off a site. Subsurface developments such as basements and buildings with deep foundations also have the potential to displace groundwater and increase risk

elsewhere. Developers should provide evidence and ensure that this will not be a significant risk.

8.5.2 Surface Water and Sewer Flooding

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

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

When redeveloping existing buildings, the installation of some permanent or temporary floodproofing and resilience measures could protect against both surface water and sewer flooding. Non-return valves prevent water entering the property from drains and sewers. Non-return valves can be installed within gravity sewers or drains within a property's private sewer upstream of the public sewerage system. These need to be carefully installed and must be regularly maintained.

Consideration must also be given to attenuation and flow ensuring that flows during the 100-year plus climate change storm event are retained within the site if any flap valves shut. This should be demonstrated with suitable modelling techniques.

8.5.3 Culverted Watercourses

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

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

The areas in Wolverhampton that are most heavily culverted include Pendeford, Perry Hall, Bilston, Compton and north of Dunstall Hill. Developments should naturalise urban watercourses and open up underground culverts, to provide biodiversity net gain as well as amenity improvements. Culverts are only acceptable for essential infrastructure crossings e.g. a short length for site access crossings, where a culvert passes under a gas main, and the length of culvert should be limited to that which is essential.

In exceptional circumstances where it is not possible to open up a culvert (e.g. due to the significant depth of the feature) the structural loading of surrounding properties should be taken into account, with an appropriate easement of at least 8m on either side of the

culvert. Access should be provided for future maintenance of the culvert and the condition of the culvert should be improved so that it is sufficiently safe against failure for the lifetime of the development. Trash screens should be provided on culvert headwalls that are designed in line with best practice and appropriate maintenance secured to ensure the structure is kept clear for the lifetime of the development.

Where a site is shown on the SFRA mapping (or the outputs available from subsequent Council studies) to be potentially affected by flooding from a culvert blockage either on or off site, the developer should:

- Undertake more detailed modelling of the culverted watercourse network based on detailed survey of the culverts, watercourse structures and site topographical survey to ascertain in more detail the extent and flood hazards from potential blockage.
- If the condition of the culvert is considered to be at least 'Fair': Design the development such that properties will not be flooded to account for a culvert blockage scenario during a 1% AEP flood event, where the culvert would be at least 50% blocked. Ensure that safe access and egress from the site is available in such a scenario.
- If the condition of the culvert is considered to be 'Poor' or 'Very Poor' or is unknown: Design the development such that properties will not be flooded to account for a culvert blockage scenario during a 1% AEP flood event, where the culvert would be at least 90% blocked. Ensure that safe access and egress from the site is available in such a scenario.
- In all instances: Prepare a Flood Warning and Evacuation Plan to account for a culvert blockage scenario during a 1% AEP flood event, where the culvert would be at least 90% blocked.
- In all instances: Safe internal refuge should be available above the flood depths that might be expected should the culvert block by at least 90% in an extreme 0.1% AEP flood event.
- Liaise with the Council about any potential to contribute towards on / off site works to help to alleviate known flooding issues related to the culverts. If such works can be taken forward, the effect of such works should be modelled as above and planned for in the site design.

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

8.5.4 Canals

Developers should consult with the Canal and River Trust who have produced a checklist for developments close to canals. Further details of the planning buffer zones around the Canal and River Trust network can be found here. The Canal and River Trust should be notified of any development taking place within these areas. This dataset is also included

within Appendix A mapping. The buffer zones include land within 150m of all six canals within Wolverhampton.

8.5.5 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 online Reservoir Flood Maps contain information on the extents, depths and velocities following a reservoir breach (note: only for those reservoirs with an impounded volume greater than 25,000 cubic metres are governed by the Reservoir Act 1975). Consideration should be given to the extent, depths and velocities shown in these online maps.

Developers should consult the West Midlands Resilience Forum about emergency plans for reservoir breach.

Developers should use the above information to:

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

The potential implications of proposed development on the risk designation of the reservoir should also be considered, as it is a requirement that in particular circumstances where there could be a danger to life, that a commitment is made to the hydraulic capacity and safety of the reservoir embankment and spillway. The implications of such an obligation should be identified and understood before new development is permitted, to ensure it can be achieved.

8.6 Flood Warning and Emergency Planning

Emergency planning covers three phases: before, during and after a flood. Measures involve developing and maintaining arrangements to reduce, control or mitigate the impact and consequences of flooding and to improve the ability of people and property to absorb,

respond to and recover from flooding. National Planning Policy takes this into account by seeking to avoid inappropriate development in areas of flood risk and considering the vulnerability of new developments to flooding.

The 2021 NPPF requires site level Flood Risk Assessments to demonstrate that:

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

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

Certain sites will need emergency plans:

- Sites with vulnerable users, such as hospitals and care homes
- Camping and caravan sites
- Sites with transient occupants e.g. hostels and hotels
- Developments at a high residual risk of flooding from any source e.g. immediately downstream of a reservoir or behind raised flood defences
- Situations where occupants cannot be evacuated (e.g. prisons) or where it is safer to remain "in-situ" and / or move to a higher floor or safe refuge area (e.g. at risk of a breach).

Emergency Plans will need to consider:

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

Under the Civil Contingencies Act 2004, Category 1 responders such as local authorities, emergency services and Category 2 responders (i.e. gas and water companies) are required to work in partnership and provide a consistent level of civil protection. The West Midlands Resilience Forum provides Emergency Planning information that is both general and flood specific. This includes practical advice before, during and after flooding has occurred including preparation, understanding warnings, actions to limit exposure to risk and recovery. Further information is available from:

- The National Planning Policy Guidance
- 2004 Civil Contingencies Act
- Defra (2014) National Flood Emergency Framework for England

- FloodRe
- The EA and Defra's Standing Advice for FRAs
- EA's 'How to plan ahead for flooding'
- Sign up for Flood Warnings with the EA
- The National Flood Forum
- GOV.UK 'Prepare for flooding' page
- ADEPT Flood Risk Plans for new development

9 Surface Water Management and SuDS

9.1 Role of the LLFA and Local Planning Authority in Surface Water Management

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

When considering planning applications, the LLFA will provide advice to the Planning Department on the management of surface water. As LPA, CWC should satisfy themselves that the development's proposed minimum standards of operation are appropriate and ensure through the use of planning conditions or planning obligations, that there are clear arrangements for on-going maintenance over the lifetime of the development.

Schedule 3 of the Flood and Water Management Act (2010) resulted in LLFAs becoming Sustainable Drainage Systems (SuDS) Approval Bodies (SABs). SABs are responsible for approving and adopting drainage systems on new developments, subject to the application of national standards. The process is separate to the planning process, and SAB approval would be required prior to development commencing on site.

It is essential that developers consider sustainable drainage at an early stage of the development process – ideally at the master-planning stage. This will assist with the delivery of well designed, appropriate and effective SuDS.

9.2 Sustainable Drainage Systems (SuDS)

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

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

It is a requirement for all new major development proposals to ensure that sustainable drainage systems for management of runoff are put in place. Likewise, minor developments should also ensure sustainable systems for runoff management are provided. The developer is responsible for ensuring the design, construction and future/ongoing maintenance of such a scheme is carefully and clearly defined, and a clear and comprehensive understanding of the existing catchment hydrological processes and current drainage arrangements is essential.

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

- To ground;

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

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

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

- Flood risk outside the development;
- Peak flow control;
- Volume control;
- Flood risk within the development;
- Structural integrity;
- Designing for maintenance considerations;
- Construction.

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

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

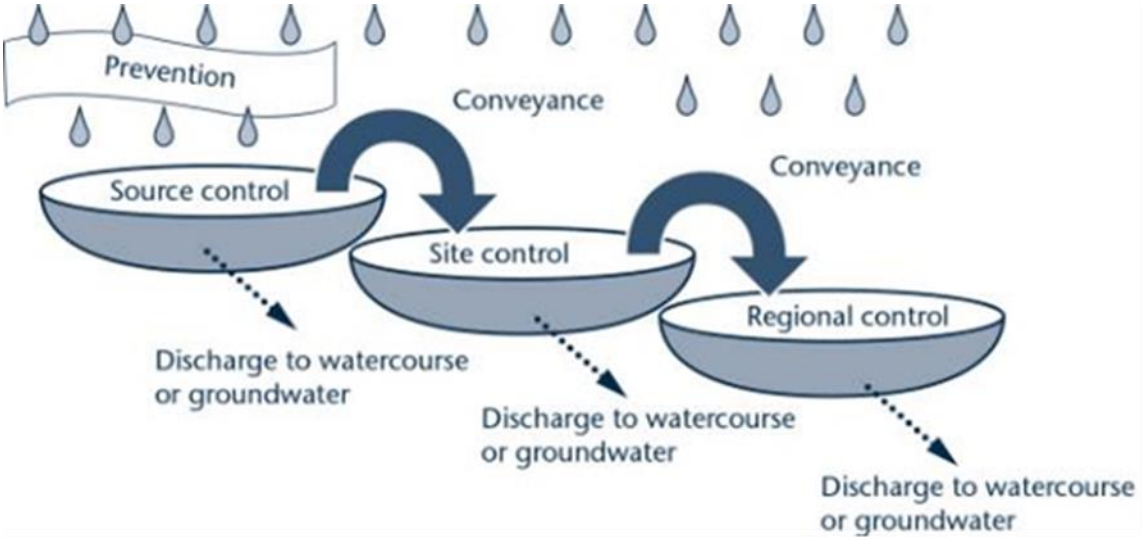


Figure 9-1: SuDS Management Train principles

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

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

9.3 Sources of SuDS Guidance

9.3.1 C753 CIRIA SuDS Manual (2015)

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

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

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

9.3.3 Staffordshire County Council SuDS Handbook

The Black Country Authorities have worked in partnership with five other West Midlands LLFAs to produce the SuDS Handbook, which was published in 2017. The front end of the document is identical across all LLFAs and each LLFA has a specific appendix in their version setting out local design considerations, constraints, case studies and arrangements for SuDS maintenance.

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

The Local Standards are detailed below:

Design Principles

Local Standard A – Phased Development and Drainage Strategies

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

Local Standard B – Pollution Prevention and Control

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

Local Standard C – Conformity with the SuDS Management Train Principles

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

Local Standard D – Multiple Benefits

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

Volume Control

Local Standard E – Climate Change

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

Local Standard F – Urban Creep

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

Local Standard G – Emergency Overflows

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

Local Standard H – Freeboard Levels

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

Flood Risk Within the Development

Local Standard I – Exceedance Flows

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

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

- The position of walls, bunds and other obstructions that may direct water but must not cause ponding.
- The location and form of buildings (e.g. terraces and linked detached properties) that must not impede flows or cause ponding.

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

Local Standard J – Watercourse Floodplains

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

Local Standard K – Retention of Natural Drainage Features

The LLFA will expect natural drainage features on a site should be maintained and enhanced. Culverting of open watercourses will not normally be permitted except where essential to allow highways and / or other infrastructure to cross. In such cases culverts should be designed in accordance with CIRIA's Culvert Screen and Outfall manual (C786).

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

Local Standard L – Impact of Downstream Water Levels

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

Designing for Maintenance Considerations

Local Standard M – Maintenance Requirements

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

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

Local Standard N – Minimising the Risk of Blockages

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

Local Standard O – Use of Pumped Systems

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

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

The Finished Floor Levels of the affected properties should be raised above this level and all flooding should be safely stored onsite.

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

9.4 Other Surface Water Considerations

9.4.1 Groundwater Vulnerability Zones

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

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

9.4.2 Groundwater Source Protection Zones (GSPZ)

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

Depending on the nature of the proposed development and the location of the development site with regards to SPZs, restrictions may be in place on the types of SuDS used within appropriate areas. For example, infiltration SuDS are generally accepted within Zone 3, whereas in Zones 1 (Inner Protection Zone) or 2 (Outer Protection Zone), the Environment

Agency will need to be consulted and infiltration SuDS may only be accepted if the correct treatments and permits are put in place. Any restrictions imposed on the discharge of the site generated runoff by the Environment Agency will be determined on a site by site basis using risk-based approach.

The majority of the east of the City of Wolverhampton is not within a Groundwater Source Protection Zone. The exception to this is a small area in Heath Town at and surrounding the Culwell Trading Estate that is covered by Zones 1, 2 and 3. The majority of the western half of the study area is covered by Zone 3. A section of Bath Road, the A41, the A454, Park West, Park Road East, Southgate, Summerfield Road, Meadow Street and the south of West Park to the north-west of the city centre ring road is covered by Zone 2. Bath Road, Meadow Street and Summerfield Road are also covered by Zone 1.

9.5 Nitrate Vulnerability 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 City of Wolverhampton study area is entirely within an NVZ. The NVZ coverage can be viewed on the Environment Agency's online maps.

10 Summary and Recommendations

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

10.1 Sources of Flood Risk

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

- *Fluvial flooding:* The primary fluvial flood risk is along the Smestow Brook and along a culverted tributary of the River Tame in the north of Bilston. Elsewhere, fluvial flooding occurs in close proximity to the Waterhead Brook (feeding into the River Penk) and across an area to the south and east of the Black Country Route (A463). There are several culverted watercourses within Wolverhampton which pose a residual flood risk to the City in the event of blockage, becoming overwhelmed or failure.
- *Surface water:* Surface water flooding is caused by intense rainfall. There are many areas at high risk of surface water flooding in Wolverhampton, due to the heavily urbanised nature of the area that impedes natural infiltration and drainage. Areas at particularly high risk include Pendeford, Perry Hall, Ettingshall and land between Dunstall Hill and Low Hill. The areas least impacted by surface water flood risk include large open green spaces which are situated along the northern, western and southern boundaries of Wolverhampton.
- *Sewer:* The sewers in Wolverhampton are managed by Severn Trent Water. Severn Trent Water provided their Hydraulic Flood Risk Register which details recorded incidents of sewer flooding in Wolverhampton between 11th June 1997 and 24th October 2023. According to this dataset, there are spatial clusters of sewer flooding in Aldersley, Claregate, Tettenhall, Castlecroft, Ettingshall Park and Fordhouses. The Severn Trent Drainage and Wastewater Management Plan (DWMP) was published in March 2023. The plan states planning objectives for internal sewer flooding risk is a high priority in the catchment served by the Barnhurst Wastewater Treatment Works to the west of Oxley. Storm overflow is considered a high priority for the catchment served by Trescott which is located in Perton to the west of Wolverhampton. The risk of internal flooding in a 1 in 50-year storm as well as storm overflow performance are classed as high priorities in the catchment served by Coven Heath which partly drains suburbs in the north of Wolverhampton including Fordhouses and Moseley Green.
- *Groundwater:* The JBA Groundwater Emergence Map indicates that there are areas in the City with groundwater levels that are either at or very near (within 0.025m of) the ground surface. These are situated predominantly in the north of

the City in Pendeford, Oxley and Fordhouses as well as some areas across the western half of Wolverhampton in Tettenhall and Compton. The 2020 SFRA recognises that as pumping and abstraction regimes have ceased or been changed, that local groundwater flooding incidences have occurred in the north-east and south-east of Wolverhampton. It is therefore anticipated that groundwater flooding issues are likely to be localised in their nature, affecting limited areas and a small number of properties.

- *Canals:* There are six canals in Wolverhampton which are the Birmingham Canal Navigations, Bradley Arm of the Birmingham Canal Navigations, Shropshire Union Canal, Staffordshire and Worcestershire Canal, Walsall Canal, and the Wryrley and Essington Canal. These have the potential to interact with other watercourses and pose a risk of flooding during breach or overtopping incidents. Records provided by the Canal and River Trust show that there have been three recorded breaches and four recorded instances of overtopping, all of which have occurred along the Staffordshire and Worcestershire Canal. There are several locations along the Birmingham Canal Navigations between Cannock Road and Wolverhampton Racecourse where the canal is perched. This means the canal is raised above the ground level of the surrounding land, which increases the risk of flooding from the canal in this area.
- *Reservoirs:* There are no reservoirs situated within Wolverhampton. However, there is a potential risk of reservoir flooding within Wolverhampton, and this risk is posed by the Sedgely Beacon Reservoir which is located to the south of the City. The level and standard of inspection and maintenance required under the Reservoirs Act means that the risk of flooding from reservoirs is relatively low. However, there is a residual risk of a reservoir breach/uncontrolled release and this should be considered in any site-specific FRAs (where relevant).

10.2 Recommendations

Reduction of flood risk through site allocations and appropriate site design

To locate new development in areas of lowest risk, in line with the Sequential Test, by steering sites to Flood Zone 1. If a Sequential Test is undertaken and a site at flood risk is identified as the only appropriate site for the development, the Exception Test shall be undertaken.

- After application of Exception Test, a Sequential Approach to site design will be used to reduce risk. Any re-development within areas of flood risk which provide other wider sustainability benefits will provide flood risk betterment and made resilient to flooding.
- Identification of long-term opportunities to remove development from the floodplain and to make space for water.
- Ensure development is ‘safe’. Dry pedestrian egress from the floodplain and emergency vehicular access should be possible for all residential development. If at risk, then an assessment should be made to detail the flood duration, depth,

velocity and flood hazard rating in the 1% AEP plus climate change flood event, in line with FD2320 guidance here.

- Raise residential and commercial finished floor levels 600mm above the 1% AEP plus climate change flood level. Protect and promote areas for future flood alleviation schemes.
- Safeguard functional floodplain from future development.
- Identify opportunities to help fund future flood risk management through developer contributions to reduce risk for surrounding areas.
- Seek opportunities to make space for water to accommodate climate change.

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

SuDS are designed to demonstrate how constraints have been considered and how the design provides multiple benefits e.g. landscape enhancement, biodiversity, recreation, amenity, leisure and the enhancement of historical features.

- Planning applications for phased developments should be accompanied by a drainage strategy which takes a strategic approach to drainage provision across the entire site and incorporates adequate provision for SuDS within each phase;
- Use of the SuDS management train to prevent and control pollutants to prevent the 'first flush' polluting the receiving waterbody
- SuDS are to be designed so that they are easy to maintain, and it should be set out who will maintain the system, how the maintenance will be funded and should be supported by an appropriately detailed maintenance and operation manual.

Reduce surface water runoff from new developments and agricultural land

- SuDS should be considered and implemented as part of all new development, in line with the Staffordshire SuDS Handbook, published in 2017.
- Space should be provided for the inclusion of SuDS on all allocated sites and outline proposals.
- Promote biodiversity, habitat improvements and Countryside Stewardship schemes to help prevent soil loss and to reduce runoff from agricultural land.

Enhance and restore river corridors and habitats

- Assess condition of existing assets and upgrade, if required, to ensure that the infrastructure can accommodate pressures / flows for the lifetime of the development.
- Opportunities should be sought to open up culverted watercourses wherever possible and reduce the residual risk from their blockage or failure.
- Natural drainage features should be maintained and enhanced.
- Identify opportunities for river restoration / enhancement to make space for water.
- A presumption against culverting of open watercourses except where essential to allow highways and / or other infrastructure to cross, in line with CIRIA's Culvert Screen and Outfall manual (C786) and the Black Country LFRM Strategy to restrict development over culverts and to daylight, where feasible.

- There should be no built development within 8m from the top of a watercourse or Main River, including culverted watercourses, for the preservation of the watercourse corridor, wildlife habitat, flood flow conveyance and future watercourse maintenance or improvement.

Mitigate against risk, improved emergency planning and flood awareness

- Work with emergency planning colleagues and stakeholders to identify areas at highest risk and locate most vulnerable receptors.
- Exceedance flows, both within and outside of the site, should be appropriately designed to minimise risks to both people and property.
- For a partial or completely pumped drainage system, an assessment should be undertaken to assess the risk of flooding due to any failure of the pumps to be assessed. The design flood level should be determined if the pumps were to fail; if the attenuation storage was full, and if a design storm occurred.
- An emergency overflow should be provided for piped and storage features above the predicted water level arising from a 100-year rainfall event, inclusive of climate change and urban creep.
- Consideration and incorporation of flood resilience measures up to the 0.1% AEP event.
- Ensure robust emergency (evacuation) plans are produced and implemented for major developments.
- Increase awareness and promote sign-up to the EA Flood Warnings Direct (FWD) within Wolverhampton.

10.3 Recommendations for Further Work

10.3.1 Level 2 SFRA

CWC have provided site allocations which have been screened against flood risk datasets. Based on the screening results, it has been deemed necessary to undertake a Level 2 SFRA in order to:

- Review flood risk issues further for all site allocations significantly impacted by flooding which is indicative or where there is uncertainty around its accuracy,
- Determine whether the requirements of the flood risk elements of the Exception Test could be met where this is required in high flood risk areas,
- Review the possibilities for surface water mitigation measures on sites at high risk of surface water flooding,
- Consider the actual and residual flood risk in greater detail on a site-specific basis,
- Explore flood hazard in greater detail should sites be allocated in high flood risk areas and the Exception Test required,
- Explore in greater detail the impact of climate change in relation to the Flood Zones if required for specific sites, and

A Static Mapping

B Data Sources used within the L1 SFRA

C SFRA User Guide

D Flood Alert and Flood Warning

E Summary of Flood Risk Across Wolverhampton

F Cumulative Impact Assessment (CIA)

References (JBA Subheading)

Linked documents

https://www.gov.uk/guidance/publishing-accessible-documents#writing-accessible-documents

https://www.rgsjpa.org/what-is-an-accessible-document-and-why-is-accessibility-so-important/

https://support.microsoft.com/en-us/office/improve-accessibility-with-the-accessibility-checker-a16f6de0-2f39-4a2b-8bd8-5ad801426c7f

https://library.leeds.ac.uk/referencing-examples/9/leeds-harvard

References following the Harvard system, e.g.

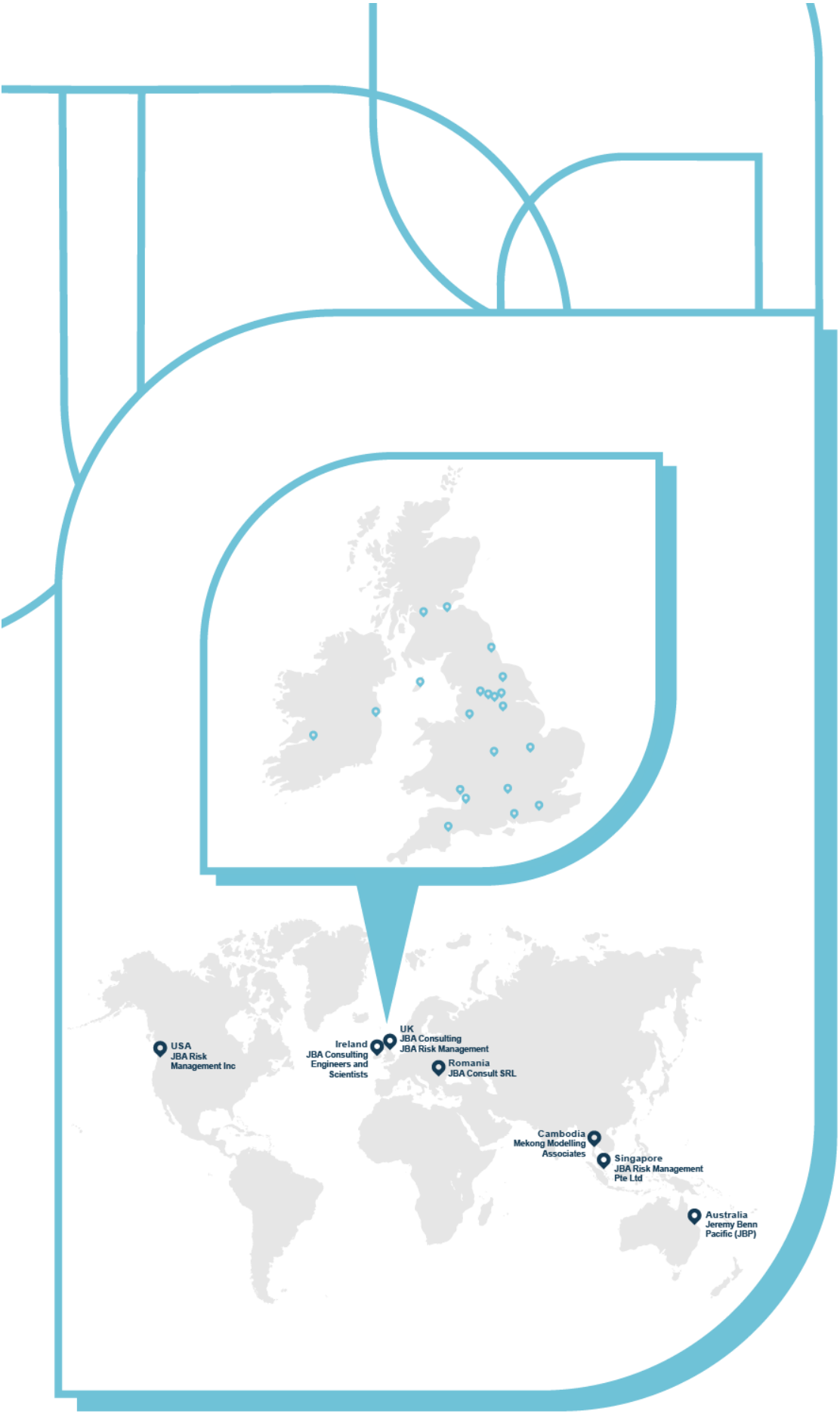
Surname, INITIAL(S). Year. Title of article. Journal Title. Volume(issue number), page numbers.

Examples:

Barnsley, I., Spake, R., Sheffield, J., Leyland, J., Sykes, T., & Sear, D. 2021 Exploring the capability of natural flood management approaches in groundwater-dominated chalk streams. Water (Switzerland), 13(16), 1– 21. https://doi.org/10.3390/w13162212.

Faulkner, D., Luxford, F., & Sharkey, P. 2020. Rapid Evidence Assessment of Non-stationarity in Sources of UK Flooding, Environment Agency Technical Report FRS18087/REA/R1. Available from: https://www.gov.uk/flood-and-coastal-erosion-risk-management-research-reports/development-of-interim-national-guidance-on-non-stationary-fluvial-flood-frequency-estimation (accessed 1 Nov 2022).

Hankin, B., Metcalfe, P., Johnson, D., Chappell, N., Page, T., Craigen, I., Lamb, R., & Beven, K. 2017. Strategies for testing the impact of natural flood risk management measures. Flood Risk Management, 1, 1– 40. https://doi.org/10.5772/intechopen.68677



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